REVIEW OF THE SPACE PROGRAM

HEARINGS

BEFORE THE

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

EIGHTY-SIXTH CONGRESS

SECOND SESSION

JANUARY 20, 22, 25, 26, 27, 28, 29,
FEBRUARY 1, 2, 3, 4, AND 5, 1960

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[1] Deceased.

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REVIEW OF THE SPACE PROGRAM

WEDNESDAY, JANUARY 20, 1960

House of Representatives,
Committee on Science and Astronautics,
Washington, D.C.

The committee met at 10:05 a.m., Hon. Overton Brooks, chairman, presiding.

The Chairman. The committee will come to order.

This morning we formally open the hearings for the current year.

More than half a year has gone by since the full committee has considered, in substance, the progress of our national space program. In today's swift world, this is a long time. Much has happened in that time. Equally important, much has failed to happen.

Those of us on this committee would be indulging in fanciful thinking if we did not admit to ourselves that the U.S. space effort has reached neither the pace nor the proportions which we had hoped for when we passed the National Aeronautics and Space Act in July 1958. Perhaps we expected too much. But there are definite indications—these have existed for some time—that a true sense of urgency has not constantly attended the American space program.

Those of us on this committee would also be blind to existing facts if we failed to recognize the groundswell of public discontent, uncertainty and—in some cases—dismay which is presently surrounding the space program.

Recognizing that our space scientists, engineers, and technicians have accomplished a great deal and that theirs is a very difficult job, nonetheless, I do not believe we can afford to ignore these danger signals. Nor can we ignore the obvious fact that the U.S.S.R. which was already operating from a superior position, has made relative advances as great as ours, perhaps greater, during this same period.

It also seems clear that the administration is not satisfied with the progress of our space program to date, as evidenced by the President's recent message asking for extensive changes in the Space Act of 1958. Just 2 days ago I introduced a bill embodying these changes at the request of the White House.

For all the foregoing reasons, the hearings we are beginning today would seem to be essential.

It is our intention here to make a thorough and careful review of the U.S. space program, to study the problems it presents with expert assistance, and to recommend to the Congress ways and means of shunting that program onto the fastest possible track.

We are beginning these hearings in a way in which we believe will place them in their proper context. We will be hearing from crucial witnesses whom we have asked to give an appraisal of the importance of the American space effort from the point of view of their particular departments. It is our hope that in this way we will be able to measure the true significance of that effort as a force—both domestic and international—in the scheme of our affairs as it exists today.

After establishing this broad view, we intend to investigate the details and specifics of the space program with subsequent witnesses and thus endeavor to locate its soft spots and find out what can be done about them.

In this connection, I want to say that we intend to push these hearings forward as rapidly as we can. It may be necessary for the committee to meet in the afternoon. It may be necessary at times to meet late in the afternoon because we have a heavy schedule of witnesses. But if the members of the committee will bear with me, we can get the job done. I know of no more important job this year to be done by our Congress than digging into the space program to see how this committee can constructively help the U.S. effort.

It is a pleasure this morning to open these hearings, gentlemen of the committee, members of the press and spectators, with the testimony of Hon. Livingston T. Merchant, Under Secretary of State for Political Affairs.

Mr. Secretary Merchant, you have a prepared statement. We will be happy to have you read it and then we would like to ask you a few questions.

STATEMENT OF LIVINGSTON T. MERCHANT, UNDER SECRETARY OF STATE FOR POLITICAL AFFAIRS; ACCOMPANIED BY PHILIP J. FARLEY, SPECIAL ASSISTANT TO THE SECRETARY FOR ATOMIC ENERGY AND DISARMAMENT; RAYMOND F. COURTNEY, OFFICER IN CHARGE, DEFENSE AND SPECIAL PROJECTS, OFFICE OF ATOMIC ENERGY AND DISARMAMENT; JOSEPH SISCO, DEPUTY DIRECTOR, OFFICE OF UNITED NATIONS POLITICAL AND SECURITY AFFAIRS; LEONARD MEEKER, ASSISTANT LEGAL ADVISER FOR UNITED NATIONS AFFAIRS; AND ALEXANDER SCHNEE, LEGISLATIVE MANAGEMENT OFFICER

Mr. MERCHANT. Mr. Chairman and gentlemen, I am appearing before your committee this morning in place of the Secretary of State who regrets as much as I do that it was impossible for him to be with the committee today. I will be followed by a distinguished group of witnesses including Mr. Allen Dulles, Mr. George Allen, Dr. Keith Glennan, and Secretary of Defense Gates.

The CHAIRMAN. Mr. Secretary, Mr. Herter sent us word that if we needed his testimony later on, he would be most happy to come before the committee at a later date and we thank him very much for that courtesy.

Mr. MERCHANT. Thank you, sir.

Most of the questions which I imagine this committee is most interested in will, I am sure, be answered by the testimony of those who follow me. I am equally sure that the committee understands that the Department of State, interested as it is in the exploration and use of outer space, has no technical competence or operational responsibility in this field. The Department's interest is substantially concerned with how our position in this field bears on our relations with other countries.

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

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

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

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

By being first to achieve success in space flight, the Soviet Union has reaped great prestige. Continuing achievements have made this gain an enduring one. It has become apparent to all that the Soviet Union is capable, where it chooses to concentrate its efforts, of pioneering work in advanced and difficult fields of science and technology. It has been demonstrated that the Soviet Union is not limited to following and imitating the achievements of Western science and technology.

Although this new and justified view of Soviet capabilities is greatly to the credit of the Soviet Union, Soviet spokesmen would like the world to draw even more far-reaching conclusions. The Soviet Union would clearly like the world to conclude from its successful satellites and lunar probes that the Soviet Union has drawn abreast and even ahead of the United States in all of the broadly related fields which contribute to or derive advantage from such accomplishments. Further, the Soviet argument runs that these successes portray overall capabilities, including military strength, and, therefore, that the Soviets ride the wave of the future.

The spectacular character of Soviet achievements has undeniably overshadowed the accomplishments of the United States, and it would be dangerous to regard as insignificant the effects of Soviet claims based on its achievements.

It is not within the competence of the State Department to attempt to compare the United States and the Soviet space programs. I believe, however, that later witnesses appearing before your committee will show that while the United States is behind the Soviet Union in total outer space achievements, a balanced appraisal indicates substantial and significant achievements on our own part. I also believe that these witnesses will testify that our program of space science and its practical applications appears to be sounder and broader than that of the Soviet Union.

Furthermore, what we have done and are continually doing in the many fields of modern science and technology, in addition to outer space, makes absurd any contention that scientific and technological leadership on any broad front has passed to the Soviet Union.

Finally, insofar as military aspects are concerned, I think I should properly leave this aspect to be dealt with by later witnesses.

My purpose is to place in perspective the fact that in response both to Soviet outer space achievements and to relentless Soviet propaganda exploitation of them, the world image of the general standing of the Soviet Union has been enhanced. This is not to say that we have lost the confidence of our friends in our strength or our scientific and technological capability. There is no doubt, however, that our friends are watching our own future progress and achievements in this field.

I have dealt extensively with the symbolic significance of outer space achievements because I believe we must all recognize these facts of life in the early space age. It is equally important, however, to examine the actual opportunities and problems arising from outer space activities, and I wish now to turn to certain objectives and characteristics of the U.S. outer space program which I believe have been recognized abroad and which we, ourselves, should fully appreciate. These matters relate in particular to the manner in which the United States as a free society and a willing member of the international community has gone about its outer space effort, and to the relationship between our approach and the substance of our program.

In contrast with the Soviet Union, the United States has taken an active lead in seeking international cooperation and consultation regarding the new opportunities and problems which are arising. Our approach has recognized two aspects of these matters. The first is that of consulting and cooperating in an effort to find means of assuring the use of outer space for peaceful purposes only. The second is that of consulting and cooperating in the conduct of outer space activities and in the establishment internationally of an orderly basis for their accomplishment.

With respect to the first of these matters, our approach has been consistent. Even before the launching of the first earth satellite, the President of the United States invited the Soviet Government to join in an effort to find ways to assure that outer space be used for peaceful purposes only. Ambassador Lodge has reiterated this proposal on appropriate occasions in the United Nations. The United States has thus made clear its desire, either as a part of or separately from the more inclusive efforts to establish control of armaments, to study and explore together with the Soviet Union and other nations what might be done to accomplish this objective.

Meanwhile we have sought to proceed with more immediately attainable consultative and cooperative activities related to peaceful uses themselves. In doing so, we have recognized that outer space, by its very nature, is not the concern of one nation or of only a few. It is of interest to all.

Accordingly, as one indispensable measure to foster international consultation and cooperation, we have taken the lead in United Nations activities related to outer space. In the 13th General Assembly, with the support of a number of other countries, we succeeded in having established a United Nations Ad Hoc Committee on the Peaceful Uses of Outer Space. This Committee was requested by the General Assembly to study and report on appropriate areas of cooperation, the nature of emerging legal problems, and future organizational arrangements to facilitate cooperation.

The Soviet Union and certain other countries refused to participate in the pioneering work of this Committee. Nevertheless, a constructive study was carried out and reported to the 14th General Assembly in the fall of 1959. This study has provided an informed basis on which the General Assembly can better approach the new matters with which it will have to deal. The Department wishes to express its thanks to the Members of the Congress who served as advisers to the United States delegation to the Ad Hoc Committee of the United Nations.

They played a helpful and constructive role and we regard the Ad Hoc Committee's meetings as highly productive.

Following submission of this initial study to the General Assembly, we again actively sought the continuance of United Nations efforts and succeeded in reaching unanimous agreement among members of the General Assembly on establishment of a committee to examine practical measures to follow up the initial study and, in particular, to work out proposals for convening an international scientific conference for the exchange of experience in and peaceful uses of outer space. The Soviet Union agreed to take part in the work of this new Committee, and, indeed, proposed the international conference to which the Committee will first turn its attention. I believe the ability of the United States and the Soviet Union to reach agreement on these matters is of the utmost importance.

We are now engaged in working out specific proposals and plans for the international conference and for other promising activities of the new Committee. We believe strongly that the proposed conference will serve as a valuable meeting ground for people engaged in outer space activities or interested in the results of these activities. It would usefully supplement exchanges thus far carried out in the international scientific community and should, we believe, be broader in its scope than the normal exchanges through purely scientific channels. We have welcomed as a hopeful sign, the Soviet Union's willingness now to share its experience and to participate in future activities.

In addition to these efforts to insure that the United Nations is appropriately organized to consider the problems and opportunities of the space age and is fully informed about them, one other aspect of our work within the framework of the United Nations is particularly significant. The allocation of radio frequencies represents the first practical problem of a regulatory character which confronts us in the outer space field and constitutes an important component in providing internationally a basis for the orderly accomplishment of outer space activities. In a meeting held during the fall of 1959 with over 80 other countries in the International Administrative Radio

Conference of the International Telecommunication Union, the United States called attention to the need for reserving radio frequencies for space communications and radio astronomical research. Although the Conference accorded some recognition to this problem and made minimal provision for frequencies for these services, the results of the Conference can be regarded as only a first step toward resolution of a problem which will become increasingly pressing in the future and toward the general goal of adopting useful regulatory measures.

In the conduct of our own space program, morever, we have also carried out in practice the principles of consultation and cooperation which we have supported in the United Nations. In doing so, we have been assisted by three "operational" characteristics of the U.S. program.

First, the U.S. program, by its nature and by virtue of our geographic position, requires a worldwide system of ground support facilities. A worldwide tracking and communications network plainly depends upon the participation of other nations and opens the way to direct cooperation. The number of countries involved in such cooperation in various degrees, is now approaching the figure of 20.

Second, our national tradition of "openness" has provided the basis for free and prompt dissemination of the results of our scientific activities, a matter in which we have been more consistent and conscientious than the Soviet Union, and also for bringing scientists of other countries actively into the planning and conduct of scientific experiments. We have, for example, explored possible cooperative programs with the British and look forward to completing an agreement to this end. We are undertaking similar discussions with Japan and with certain other countries. In recognition of the fact that the interests of NATO go beyond defense matters, we have offered through the NATO Science Committee to incorporate in future satellites scientific experiments which may be proposed by scientists of NATO countries.

Of particular importance is the support which we have given to nongovernmental scientific organizations which are active in the field of outer space and which, indeed, represent the traditional channel for scientific cooperation. The Committee on Space Research of the International Council of Scientific Unions is prominent in this regard. We have offered to place in orbit individual experiments or a complete scientific payload recommended by COSPAR.

The openness of our outer space program thus enables us to make possible mutually beneficial participation in outer space activities and to benefit from results achieved by scientists of countries which are not, themselves, actively launching earth satellites and space probes. It has the further advantage of widely informing the international scientific community of our own progress and achievements in the field of outer space. Although security considerations may affect some aspects of outer space programs, I believe that "openness" should continue to be a keynote of the U.S. effort.

A third characteristic of our effort has been our natural interest in the development of what may be called service or utilitarian applications of space vehicles. I refer to such information gathering and transmitting satellites as those for communications, meteorology, and navigation. The benefits of such satellites, when they become practical, will be widespread and should be widely shared. Such activities may, of course, add to the strength of our military position as well as contribute usefully to civilian activities. Furthermore, we should not overlook the possible usefulness of service satellites in contributing to the stability of international relationships and to maintaining the peace by providing information which will, for example, serve to discourage attempts at surprise attack. Closely related is the potential use of service satellites in enforcing international arms control agreements.

I mention these characteristics of our outer space effort because they promise to be of growing significance in facilitating the role of the United States in those international consultative and cooperative activities which give substance and meaning to outer space insofar as other countries are concerned and which, in turn, form a valuable support of our own effort. I have mentioned them also because they represent fundamental differences in the approach of the United States and the Soviet Union. These differences have not gone unrecognized by other countries, and our cooperative and consultative efforts have gained increasing recognition abroad. We feel that these efforts have strengthened our own position in an area where, by virtue of our free society, we enjoy greater flexibility than the Soviet Union.

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

The international power position of the United States by no means rests on activities in the field of outer space alone. These have, however, because of their dramatic impact, assumed a special significance. We are responding in the traditions of a free society. I am sure that by maintaining a broadly based, imaginative scientific and technological effort in the exploration and use of outer space, we shall find proof of the capabilities and effectiveness of our free society.

If I may at this point summarize my testimony, I would first note that all nations on this globe have an interest in the opportunities and problems with which outer space and its ultimate exploration so dramatically confront us. The Soviet Union, first to achieve a spectacular success in space flight, has gained thereby great prestige. The prospect is that this lead will not be easily overcome. As one would expect, Soviet propaganda has with some success capitalized on the technological achievements of the Soviet Union in space by attempting to present an image of preeminent achievement, not merely in science and technology, but across the board, including military power.

It would be wrong and dangerous to discount either the achievement or the impact of that achievement on the minds of peoples all over this world.

What I have also said, however, is that testimony will be given to show the strength and breadth of our own space program. Our own achievements negate any contention that scientific and technical leadership on any broad front has passed to the Soviet Union. The military aspect of all this I will leave to the witnesses who follow me.

I have also noted—and I think this of great importance—that the basic approach of our country differs from that of the Soviet Union. We have emphasized from the outset consultation and cooperation with others. Even more important, we have taken the lead in the effort to establish a firm foundation for the devotion of outer space to peaceful purposes. Our leadership in the United Nations and elsewhere in this effort is undeniable, and we will continue to follow this policy.

We will continue to work with other nations on the basis of our national tradition of "openness" and we will pursue our efforts to develop space vehicles for purposes of genuine service and utility to ourselves and those who are cooperating with us.

The Department of State throws its full support to a vigorous and continuing national effort in the challenging field of outer space. Soviet accomplishments in this field testify to the capacities of the Soviet Union. As responsible members of a free society, we recognize this fact. We have, however, full confidence that through our national efforts, the United States on the broad scientific front can and will demonstrate in the field of outer space the leadership which is historically associated with free men.

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

We have adopted a rule in this committee that the members of the committee would be limited to 5 minutes questioning for each witness. If we have time left over, we will go around a second time and give a further opportunity for questioning.

We were going to have a clock here. The clock hasn't shown up. We do have access to the clock on the wall and that ought to be enough for the average member and I will just ask members to remember that and if they do go far beyond that in a forgetful mood, the Chair may have to call that to the attention of the member.

Mr. MILLER. The Chair has now consumed 2 minutes, but I move that not be taken out of his time.

The CHAIRMAN. Without objection, it is so ordered.

Look at the clock there, George, and assure yourself that the chairman will not extend himself beyond 5 minutes.

Mr. Secretary, have we experienced any difficulties as a result of the Soviet progress in outer space with our allies or with uncommitted or neutral countries as a result of the Soviet prowess in the space effort?

Mr. MERCHANT. As I indicated in my statement, Mr. Chairman, there is no question but that by its achievements and exploits in the field of outer space, the Soviet Union has enhanced its prestige. I think that is on a worldwide basis. It may vary from country to country or from area to area, but it is a fact that it has gained prestige significantly from its achievements.

The CHAIRMAN. Have any of these uncommitted countries, our allies or neutrals, given this as a reason why they would not cooperate with us in any particular portion of our foreign program?

Mr. MERCHANT. No, sir; not to my knowledge in any case.

The CHAIRMAN. Do you have any suspicion that that is a reason why they are reluctant at times to participate with us in our program?

Mr. MERCHANT. I would have no evidence of that, sir. Of course, the image and attitudes of the Soviet Union, just as the image we present to the world, affects the degree to which we can obtain cooperation. In the United Nations where cooperation is not automatic, we have a situation. There has been a distinct gain by the Soviet Union in this field. I couldn't single it out, however, as an isolatable, single fact.

The CHAIRMAN. If they continue to gain in accomplishments and prestige, do you have any doubt in your mind but what that will affect the view of some of these neutrals or some of our allies with reference to future cooperation with our program?

Mr. MERCHANT. I think if the Soviet Union were to continue to gain significantly in prestige in this field, this would be an element, yes, sir.

The CHAIRMAN. And likewise in the reverse, if we continue to lag in our space program, the same would result, wouldn't it?

Mr. MERCHANT. This is one of the factors I think that create or influence national and popular attitudes abroad.

The CHAIRMAN. So that the space program is bound up in a bundle, you might say, altogether with our foreign policy. And the foreign policy will move forward better, more efficiently and faster, easier, as we produce results in the space program, isn't that true?

Mr. MERCHANT. It is one element, of course, in many, Mr. Chairman, but I wouldn't deny for a minute that our progress and position in this field is of real importance in our foreign policy and its execution.

The CHAIRMAN. Have you any way you can indicate where the State Department has not done all that it should have done in pushing agreements and understandings and cooperative efforts with other countries in reference to the space program?

Mr. MERCHANT. The only one I can think of, sir, at the moment, is the fact that I think the Soviet Union, against the background of its achievements in the early days, showed a great reluctance to cooperate with certain of our activities in the United Nations on outer space.

The Soviet Union may well have thought that by standing alone, you might say, it had more to gain than by a markedly cooperative attitude.

Fortunately, as I indicated, in the last general assembly in the fall of 1959 there was an increased spirit of cooperation or the appearance of a spirit of cooperation on the part of the Soviet Union in setting up the United Nations Committee on Outer Space.

The CHAIRMAN. Mr. McCormack.

Mr. McCORMACK. Mr. Secretary, can you give us any idea what the Department expects the Soviets to do in the near future in the Pacific?

Mr. MERCHANT. No, sir, I wouldn't want to try to interpret their statement. I think very possibly Mr. Allen Dulles would be certainly in a better position to give an intelligence estimate or appraisal of that.

Mr. McCormack. Of course, you don't mean by that that you haven't got some information, yourself, as to what the opinion of Central Intelligence is, and other intelligence, do you?

Mr. Merchant. No, sir.

Mr. McCormack. Can't you take us into your confidence, the American people, and let us know what the Department thinks?

Mr. Merchant. Well, the Soviet announcement described this as I think a large space object. Whereas the launching they have forecast would be consistent with other types of experiments, I don't think we have any sound basis for doubting that it is an experiment of the character described in the announcement. It is a very considerably extended range into the central Pacific as you know, sir, and I believe technically, the stated objective would be consistent with the definition of the impact area as given by the Soviets.

Mr. McCormack. It has a lot of serious military implications, does it not?

Mr. Merchant. Clearly there could or may well be military implications.

Mr. McCormack. Now, you say at page 12 the prospect is that this lead will not be easily overcome. That is an admission that we are behind in the field of outer space, isn't it?

Mr. Merchant. The prestige which has accrued from the successes, Mr. McCormack, of the Soviet Union, which have been spectacular in nature—that prestige has been considerable.

Mr. McCormack. The prestige wouldn't come unless they had the successes, would it?

Mr. Merchant. That is right, sir.

Mr. McCormack. That means you are admitting that they are substantially ahead of us in what might be called the field of outer space?

Mr. Merchant. No, sir——

Mr. McCormack. I am not talking about intercontinental ballistic missiles, now.

Mr. Merchant. The point I was trying to make there, sir—and I think it may not have emerged clearly from the language, is that they have taken a lead in prestige by reason of the spectacular character of their achievements.

Now, we have had achievements of a very significant character in this field. They haven't partaken, however, of the same spectacular quality that has been true of the Soviets.

If you consider such things as the discovery of the Van Allen Belt—this, in the field of science, and in the field of space technology, is a discovery, I am told, of the highest importance. I don't think the average layman, though, equates this, you might say, with a lunik, or the first satellite.

Mr. McCormack. I believe in being objective. Do you admit that the substance of your testimony is—as a legislator, I would like to get facts to legislate upon and I am sure all my colleagues would—that the Soviet Union is ahead of us in the field of outer space?

Mr. Merchant. I hadn't intended to be evasive, Mr. Chairman. I was trying to put it a little in perspective. I think we clearly concede Soviet superiority. This has been concentrated, I think, in the large power boosters, allowing them to put heavy objects into orbit or space exploration and this lead will take time clearly to overcome.

Mr. McCormack. How long will it take us to overcome it?

Mr. Merchant. I couldn't estimate that, sir. I wouldn't feel competent.

Mr. McCormack. No further questions.

The Chairman. Mr. Fulton.

Mr. Fulton. Mr. Secretary, I am glad to see your career has led to these heights. I welcome you here, too.

Mr. Merchant. Are you placing me in orbit, Mr. Fulton?

Mr. Fulton. It indicates "I knew you when." The question is this: When there is obviously competition between Russia and the United States, doesn't the administration accept that as a competition or a race? We are in it, aren't we?

Mr. Merchant. Certainly.

Mr. Fulton. So that we really know there is a race on in science with respect to outer space and as well on the missile developments on a shorter range.

So then we concede that there are larger payloads and larger boosters, that Russia is ahead on getting larger payloads into orbit or into space. Also, with regard to controls and energizers she probably is, too. However, we don't concede Russia is ahead overall.

Mr. Merchant. That is correct, sir.

Mr. Fulton. We might find the United States ahead in some fields while Russia is ahead in others, and that can be reasonably said from the point of view of both policy and on a scientific basis of your science advisers in the Department, can it not?

Mr. Merchant. Yes, sir.

Mr. Fulton. The question comes then on the program the administration is entering into. Are they simply trying to catch up to Russia in some fields or are they trying to keep ahead in others, or are we really going to have a program that I am for, of leapfrogging Russia? Would it be possible for us to have a space program that leapfrogged Russia and moved ahead our targets more or less independently of her propaganda? Why don't we do that? Why don't we set targets ahead 3 to 5 years, far-reaching and far-seeing constructive targets and then go ahead and reach them instead of looking to see how Russia is running and then run down that street?

Why shouldn't we arrange it so we would be running clear ahead of her in every field? What do you think of that program?

Mr. Merchant. I think it is a very constructive approach, sir. I am not familiar, obviously, in detail with the scientific plans. I wouldn't understand them if I were, I am afraid.

This is a very broad scientific and technological field, as I understand it. I think it might be comparable to a track and field meet where there are an awful lot of events going on inside and outside the stadium. I would be greatly surprised if it would not in the months and years ahead be the case that there were areas spectacular even in character where, as you describe it, a leapfrog result might be obtained. We are in competition, if it is perfectly clear, and this is a deadly and serious one.

Mr. Fulton. When you read off Russia's motives here it seems to be pretty wholesome selfishness to me. They want to be ahead for many purposes. And I would say that we pretty much want to be equal or ahead, too, in the United States.

My next question is in the field of cooperation, and I would like to ask Mr. Meeker this, since he has been an adviser to our U.S. delegation to the 14th General Assembly, just concluded, where I have been a U.S. delegate serving with him: Don't you think the United Nations new permanent committee on space for peaceful uses and for advancing these peaceful uses by cooperation is a tremendous step forward? Here it is unanimous. We all gave in, on each side, and came up with a solution that on space, on the Antarctic, and on about three other areas we are in agreement on major problems with the countries behind the Iron Curtain.

Now, isn't that a tremendous new turn? Shouldn't we be giving some attention to that, as well as to a good many of our fears as to what the future may hold? What do you think of that?

Mr. MEEKER. It seems to me that is a very correct conclusion and analysis of the situation and what is necessary now in the coming weeks and months is to prepare for and carry out a program in the United Nations Committee which will make the most of these opportunities of cooperation which have been opened up by the very agreements that you refer to.

Mr. FULTON. I agree and I think it would be a constructive approach. May I finish by saying I want to compliment Cabot Lodge, the head of our U.S. delegation: Jim Barco, the special representative to the United Nations Security Council on behalf of the United States, as well as Leonard Meeker here, and also Mr. George Feldman, who was an adviser to our U.S. delegation on space, for the excellent work they did. It was a pleasure to work with them. I was pleased to have the comment that some of us who have worked as Congressmen, as advisers, could share the credit on page 7 of your statement. It is a fascinating field, and I think it would be a constructive one with fine results to the world if we handle it right. To me, the 14th General Assembly just closed, of the United Nations, was a tremendous step forward, on a constructive basis, and we in the United States ought to be prepared to follow through.

That is all, thank you.

The CHAIRMAN. Thank you very much.

Mr. Miller.

Mr. MILLER. Mr. Secretary, I am going to try to get you into orbit in your own field and away from some of these other things.

In answer to a question the chairman asked you with respect to relations to Russia, you said it is one element in many. What are some of the other elements besides space?

Mr. MERCHANT. I think I was talking about the image of the Soviet Union.

It ranges beyond the scientific field—more widely than just outer space. The positions and attitudes taken in the United Nations on various matters. The extent to which they enter into aid agreements has a great influence in certain areas in the world. Actions such as the brutal repression in Hungary, this is the sort of thing that contributes to the image of the Soviet Union. The behavior of their allies, such as Communist China at the Indian border in Tibet. Their military posture and strength. Their willingness or lack of willingness to cooperate in joint ventures over the whole range of human relations. The public impact of the personalities of their leaders.

I would say it is the total image of the Soviet Union and it is equally true of the United States or any country; it is composed of the physical, of the military, of the political, of psychological, and of personal elements.

Mr. MILLER. That is what I wanted. That is what I thought you meant.

Now, in this race for outer space, how do you weigh it against these other elements? Is it the all-important one or are there others that contribute to other nations' attitudes toward Russia that are more important?

Mr. MERCHANT. It is such a complex of attributes and forces, sir, that I would find difficulty putting down a percentage for each one.

This is important because it is spectacular. It is indicative of, as I said, a great capability in an area which is a new frontier to man's imagination, almost, so it is important. But I would not say that it was the most important as a single element.

Mr. MILLER. Has it the substance that certain of these other elements have? Will the fact that they are creating the practice of genocide in Tibet, today, last longer in the minds of the people of India and the Orient than this spectacular thing?

The first nation to have radio was Italy—Marconi and the wireless—but this is forgotten now, for example.

Mr. MERCHANT. I think the lasting image on any country by other people is that country's attitude toward and treatment of other human beings. So in answer to your question I would say, sir, that the more lasting imprint in the human mind would be things like Hungary or Tibet, rather than a single scientific achievement.

The CHAIRMAN. Mr. Osmers.

Mr. OSMERS. Mr. Chairman, I thought I would make the observation that, as many view the military posture with relation to Russia, we are not in bad shape at all. I am referring now to the weapons field. There is apparently a lag on the part of the United States in the field of the million-pound thrust rockets which are used to orbit vehicles in space.

Now, how important would you say it was from the standpoint of the Department of State and the prestige of the United States, how important is the time element in overtaking the Soviet Union in purely peaceful exploration of outer space? We know the time element in the military is all-important. How would you rate the time element in connection with the satellite and space program?

Mr. MERCHANT. I think, sir, others could answer that more precisely but the brief answer, I understand, is that there is no present military requirement for the very large booster engine. So to that extent, important as I believe it is to overtake ultimately the Soviet present preeminent position in this field, as I understand it, that lag in that area from a military point of view is not greatly significant, but I would rather have that answer confirmed by those who will follow me.

Mr. OSMERS. Mr. Chairman, I would like to ask just one other question:

Without making a detailed study of the various positions at the international conferences, I have gained an impression that the Russians have up to now always steadfastly resisted any meaningful inspection within the Soviet Union of sites and missile bases and things of that character in which this Nation has been willing to participate.

What has the effect been on other nations of the world of the Russian refusal to permit honest, meaningful outside inspection of their preparations within the Soviet Union?

Mr. MERCHANT. Well, you are entirely correct, sir, of course, in saying in effect that where progress in this area to date, where progress has been halted, it has been due to the Soviets failing to submit to what we consider to be adequate and necessary inspection and control measures. I think this point is reasonably well established in world public opinion.

Certainly safeguarded disarmament has to be the crux of our position and to the extent it isn't understood I think we have to just keep hammering on the simple logic of it.

Mr. OSMERS. Now, Mr. Chairman, the Soviet has done two things—Mr. Khrushchev has made two announcements which have been designed obviously to influence the world as to the peaceful intentions of the Soviet Union. Just prior to his departure from the United States when he spoke to the United Nations in New York, he was very forthright in urging complete and absolute disarmament. Here recently, in speaking in Russian to the governing body there, he made a very great propaganda announcement about a reduction in the armed forces of the Soviet Union.

Now, in this country I think it was largely viewed by the general public in both of these instances as being straight propaganda of the most blatant variety.

How was that viewed throughout the world?

Mr. MERCHANT. It is hard to generalize, sir. I think that Mr. Khrushchev's General Assembly speech on total disarmament had a considerable impact around the world. I would say the greater impact was in the less developed and less sophisticated parts of the world.

We feel as everyone does that disarmament is too serious a matter for all of us, to fail to look carefully at any proposal from any quarter.

The proposal of Mr. Khrushchev for total disarmament raises a lot of questions that have to be asked and answered.

On the reduction of troops, I don't think I've got the basis for any generalized estimates as to what the effect of that has been around the world. It is really too recent. It has probably had some propaganda appeal. On the other hand, as you read his full speech it comes through pretty clearly that this is really a reorganizing, streamlining, improving of the combat effectiveness of his forces—at least to a very significant degree.

Mr. OSMERS. In other words, they are doing something we did at the end of World War II. They have waited until now to do it and are now bringing their forces in line with a more modern concept of ground defense?

Mr. MERCHANT. That is right. They are making reductions comparable to the ones we made earlier.

Mr. OSMERS. That is all I have.

The CHAIRMAN. Mr. Teague.

Mr. TEAGUE. No questions, Mr. Chairman.

The CHAIRMAN. Mr. Van Pelt.

Mr. VAN PELT. No questions.

The CHAIRMAN. Mr. Anfuso.

Mr. ANFUSO. Mr. Merchant, in your statement you concede the Soviet Union has reaped great prestige by being first to achieve success in space flight and that the world image of the general standing of the Soviet Union has been enhanced.

Have you then given serious consideration to the fact that space exploration is not only important for the advancement of mankind and the security of our country, but that it offers us a serious challenge in waging psychological warfare? If so, how are you prepared to meet this challenge?

Before you answer that question I might add that it is my prediction that the Russians are going to achieve another great first in its test in the central Pacific—such as demonstrating the ability to put man into space and that they will use this for political propaganda during the summit conference.

Now, the indication for that is the fact that they have blocked out 45,000 square miles for this test, which is more than we have ever blocked out.

How are you prepared to meet this challenge? Supposing this event does take place? You will go to the summit rather shorthanded unless you can meet it psychologically in some way.

Mr. MERCHANT. I think it is an interesting speculation, sir, that you have offered. Certainly the Soviets do attempt to gear some of their activities to specific events in order to get a propaganda impact from it. We all recall that just before, or practically coinciding with Khrushchev's arrival in this county, there was the Lunik II.

Perhaps we are not as flashy in the propaganda field as we should be. My own philosophy is that propaganda is no substitute for policy and for constructive action. If you do the sound thing and if you construct and pursue the right policies, good propaganda naturally is thereby created.

Answering your question specifically, I know of no specific countermeasure, you might say, for what may, as you suggest, prove to be a psychological exploit, or a scientific exploit subject to psychological exploitation.

I make one other comment, sir, and that is that the summit conference, as with all international conferences dealing with serious matters, is not, it doesn't seem to me, affected in its conduct or its outcome by propaganda. You can capitalize and gain propaganda advantage but the issues are going to be discussed and dealt with and if possible solved, you might say, removed from the propaganda atmosphere, or aura, that attaches to it.

Mr. ANFUSO. Would you say other nations today regard Russia as being first in this effort and as being a greater power than the United States?

Mr. MERCHANT. As I think I testified, the achievements of the Soviet Union in this area have notably enhanced its prestige and contributed—not created, but contributed—to an image. They have done their best to build on this, to exaggerate it, to drive it home, to multiply the actual, practical fact.

Mr. ANFUSO. If they continue to achieve success in that regard with other nations will it not make it more difficult for us to keep our friends and to win new friends?

Mr. MERCHANT. Yes. As I replied to the chairman, this is a real factor in foreign policy.

Mr. ANFUSO. Which should be considered. We certainly should have a policy of our own.

Mr. MERCHANT. Absolutely.

Mr. ANFUSO. Mr. Merchant, you know that I have written you several letters in connection with international cooperation and I wonder whether you are prepared to submit to the permanent United Nations committee certain suggestions on peaceful cooperation with regard to space medicine and biology protection and reentry of man in space vehicles and other experiments of that kind?

Mr. MERCHANT. As I understand it, sir, we are giving most careful consideration, now, to the subjects which might properly be put before that committee and we have welcomed your specific suggestions in this connection. We have not, to the best of my knowledge, reached any final decision as to what our proposals will be before the committee. The committee has not yet met and organized itself.

Mr. ANFUSO. Don't you think that we have much to gain by international cooperation and we have much to offer—for instance, we have greater tracking facilities and we can certainly help the Russians in recovering a man, should they put a man into orbit before we do. But they also have much to offer us in this field of peaceful exploration, which may be the answer to avoiding another war.

Mr. MERCHANT. I agree, sir.

As I indicated, one of the fundamental elements in our policy has been to stress and to practice international cooperation and we welcome that from every other country.

Mr. ANFUSO. I thank you for the cooperation you have given me personally and I hope we can continue to work together.

Thank you, sir.

Mr. MERCHANT. Thank you, sir.

The CHAIRMAN. Mr. Bass.

Mr. BASS. Mr. Secretary, you stated earlier in your testimony, I believe, that we were very definitely engaged in a race with Russia in the exploration of outer space.

I noted with interest the suggestion of my collague, Mr. Fulton, that we fix our policy on a leapfrog basis, as he puts it, and accomplish that, evidently regardless of what the cost would be.

I would like to ask you, do you think we should set our own goals on space exploration and then stick to them, regardless of what Russia has done or does, or should we base our space program on a race-with-Russia basis?

Mr. MERCHANT. I don't really feel competent in this field, sir, but my own reaction is that whereas it is right and proper to recognize that in a sense, and in a very real sense, we are in competition and the world is watching, I never think you should base your policy, so to speak, on reactions to what other people do. I think you want to set your program as the soundest, the most farsighted, and most imaginative, and go ahead with it.

Now, just what the complications might be on putting a man in space or other aspects of this from a scientific point of view are, just what the detailed planning of those responsible for this in the scientific field are, I just don't know, sir.

Mr. BASS. That is all.

The CHAIRMAN. Mr. Sisk.

Mr. SISK. Mr. Secretary, you discuss in your statement the things that are being done with reference to international cooperation, and on page 7 you mention certain specific proposals concerning the international Conference.

Now, I am concerned with what your Department, which has the responsibility of our international affairs, what proposals the United States has come up with, or planned? Not necessarily conferences but a specific plan which will provide for peaceful space exploration.

I am thinking from this standpoint: Are you stressing the importance of doing this through a United Nations committee, through the United Nations, or is your Department putting more emphasis upon a bilateral agreement, or a multilateral agreement outside of the United Nations? Of those three things that you are pushing within your Department which do you emphasize as being No. 1?

Mr. MERCHANT. Well, in such matters as can be expected to come before the Committee, as, for example, the definition of the peaceful use of space, the first problem, obviously, is to—on the basis of adequate study—is to formulate our own policy, our own policy views, and this is what is in process.

On such a matter I would myself think—I may ask, with the chairman's permission, Mr. Meeker, to comment further on this—I would think that type of project or proposal would, to be really useful, then have to be considered on a multilateral basis rather than a bilateral basis. What one would be seeking would be a universally accepted definition, you might say.

Now, of course, there is a great deal that could be done also through the scientific community on an international basis, but I would rather expect the United Nations Committee on Outer Space to be the focal point for multilateral consideration of all these matters which extend far beyond just bilateral relationships between any two countries.

Would you agree on that, Mr. Meeker?

Mr. MEEKER. Yes.

Mr. MERCHANT. I don't know that that exactly answers your question, sir.

Mr. SISK. It indicates the attitude of your Department placing the emphasis on the work of the United Nations, or at least a multilateral operation rather than an idea of just Russia versus the United States because we happen to be the leading nation at the moment in this field.

Looking ahead, let's say 5 or 10 years to the time when we may, let's say, land a task force on Mars, and that some other country might possibly do the same thing. Because of your responsibility in international affairs, I am interested in the extent your Department is planning on being able to make certain that that will be a peaceful operation. Either bilaterally or multilaterally.

This becomes all important if we look into the future, based on the proposals of our scientific people.

Mr. MERCHANT. I would say that philosophy, sir, is central to all our policy thinking.

As I think I noted in my testimony, the President made a proposal before the first sputnik that this was a matter of the greatest importance for international multilateral consideration.

It seems to me that we have got a chance which may not be available to us very long, to establish and gain universal acceptance of policies to insure that this new frontier, this new dimension, will only be used for peaceful purposes.

Mr. Sisk. I agree with that statement and that is what I am happy to hear you make. I don't know how long it is going to be, but certainly if the scientists know what they are talking about—and I have a great deal of confidence in them—there is going to be a time, when we will have some people on the moon and Russia will have them and perhaps the United Kingdom.

Now, what is going to happen? I think you have indicated it is later than we think, and I am interested in how broadly your planning may be going on within the State Department because of your responsibility in this field, to make certain that this thing which we talk about every day—peaceful exploration of outer space—is going to be carried forward.

Mr. Merchant. I think Congressman Fulton mentioned earlier Antarctica. Driving up here, this had occurred to me in a small and terrestrial sense. It is roughly analogous to our approach and our purpose with respect to the ultimate regime or environment of outer space.

There in Antarctica is the last uninhabited land mass of the world, and with the leaps and bounds ahead of science in all fields, no one can foresee what in 10 years might be the utility or the value or the usefulness to mankind of that area. And I think we were fortunate and I think we can properly congratulate ourselves as the U.S. Government in taking the leadership in establishing, before conflicts or competition arose to a really serious degree, in negotiating a multilateral treaty whose central thought was that Antarctica henceforward should be devoted only to peaceful purposes.

Mr. Sisk. I am concerned, and I am sure many people are, with the fact that we can now lay down ground rules that maybe in 10 years we cannot—due to the things that will develop and happen. So it seems to be urgent that your Department take leadership in this and that we come forward with specific proposals for doing this.

This was very vividly brought out just recently—and this may be a little farfetched—but in a rather widely televised program on birth control, this hassle that is going on over birth control, well, someone who was opposed to birth control indicated that, after all, the progress in outer space is going to make room for additional people, and that is what we are going to do with the surplus population.

I think we have to solve this problem first or we are going to be in trouble, if you get the point, Mr. Secretary. Thank you, Mr. Chairman.

The Chairman. Mr. Riehlman.

Mr. Riehlman. Mr. Secretary, you have covered in great detail the propaganda effects accrued to Russia because of their being able to move into this field of exploration in space ahead of the United States, and secondly, the capabilities of putting into orbit much larger satellites than we are capable of doing today.

Now certainly the United States has made great strides in the exploration of outer space, and in many fields other than just the capabilities of putting large objects into orbit under thrust.

In scientific publications we have read a great deal about these accomplishments.

How effective are we, through our State Department and other communications services, in being able to handle this type of propaganda in order to affect the thinking of other nations that we are in this to accomplish great things for peaceful purposes?

Mr. MERCHANT. My impression, sir, is that certainly insofar as the international scientific community goes, there is a very widespread understanding of our unique achievements in this general field. I mentioned the discovery of the Van Allen Belt which, from a scientific point of view, I gather it was totally unexpected as to its existence, and I understand that it has the most serious implications involving space travel and so forth.

There have been a number of others. The Argus experiment. The discovery of the fact the earth was pear shaped. These are things maybe not as spectacular as an impact shot to the moon, to the man on the street, but to the scientific community, these are very notable achievements and I think in the long run, popular understanding develops a more balanced view under the guidance and gradual dissemination of knowledge from the scientific community.

I wouldn't want to try to assess how successful with the man in the street we have been in publicizing, propagandizing or informing as to our achievements.

Certainly this has been our purpose, to honestly exploit our honest achievements and this will continue to be our purpose.

It is a fairly esoteric field and it is a field of tremendous breadth.

Mr. RIEHLMAN. That, I think, is one of our great problems that affects our Nation. We haven't been able to build in this Nation the engine—we are in the process of it now—to put into space the big object, which apparently appeals to the mass of people in their thinking. Because they have been able to do that, they are considered far, far ahead of us in this whole field of exploration of space.

And I cannot agree with that philosophy. I think that as far as that portion of it is concerned, they are. But in the broader aspects, I feel our Nation is abreast and ahead. Could you comment on that at all?

Mr. MERCHANT. I go back to my analogy of the track and field meet. There are an awful lot of events going on and it may be the hammer throw outside the stadium that will win the meet, I don't know. I believe that may be a fair analogy.

Mr. RIEHLMAN. I realize, Mr. Secretary, that you are not in a position to answer a lot of the questions that this committee would like to ask you with respect to the outer space program, or exploration of space. I certainly don't want to ask any questions that are not proper as far as the State Department's interests go in this field and I am sure the committee wouldn't want to. We are vitally interested in knowing whether or not our activities in this field are properly dispensed to the peoples of the world and that through the State Department we are doing everything we can to keep them abreast of our activities. Even though they may not be quite as spectacular on the surface as those of Russia.

Mr. MERCHANT. That certainly, sir, is our effort and purpose and I think perhaps on this particular aspect of it, Mr. George Allen will be a helpful witness.

Mr. RIEHLMAN. Thank you very much.

That is all, Mr. Chairman.

The CHAIRMAN. Mr. Mitchell.

Mr. MITCHELL. Mr. Secretary, following the questions of Mr. Riehlman concerning the psychological impact of the spectacular achievements of the Soviet Union and the effect that they would have upon your particular department and its role in worldwide diplomacy, that is the general subject of my questions also.

In your statement you acknowledge, if I correctly interpret it, that insofar as the spectacular achievement concept is concerned, we have been outdone by the Soviet Union. But you state that our program of space science and its practical applications appears to be sounder and broader than that of the Soviet Union and, therefore, you conclude that the scientific and technological leadership on any broad front has not passed to the Soviet Union, but, in effect, that on the broad front, we are ahead.

Is that correct? But that on the spectacular achievement front, the Soviet Union is ahead?

Mr. MERCHANT. I think on the broad front of scientific and technological development, not confined to space exploration and space science, I think we are ahead, sir.

It is hard—as I think I indicated in earlier questions—I think it is hard to balance and to define overall leadership. They are clearly ahead, obviously, as we all know, on the big booster launchers. But I understand, and other witnesses are far more competent than myself, I understand that if you balance achievements in the broadest area, that from a scientific point of view, many of our "firsts," so to speak, are of the greatest importance and I think we conclude that, on balance, there is not a clear case for Soviet leadership across the board.

Mr. MITCHELL. Here is what concerns me. I think that you, representing the State Department, would have liked very much to appear before the committee this morning and point out spectacular achievements on our part and to have said what effect it had on our ability to negotiate, for example, in the field of international cooperation, or the field of outer space, as well as the general field of cooperation, in disarmament and other things. Is that correct?

Mr. MERCHANT. That is correct, yes, sir.

Mr. MITCHELL. Therefore, do I conclude that you feel, that although we have this broad program, this sound program in science and technology not only in space, but generally, that we also have a great need for the spectacular achievement as well?

Mr. MERCHANT. Yes, sir. It would make me very happy; surely.

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

The CHAIRMAN. Mr. Quigley.

Mr. QUIGLEY. Mr. Merchant, would it be a fair statement to say that the several Soviet spectacular firsts in space have not made the State Department's job any easier?

Mr. MERCHANT. Yes, sir.

Mr. QUIGLEY. Is it conceivable that if these spectacular firsts were to continue unabated, unmatched, that your job could become almost impossible?

Mr. MERCHANT. I don't think so, sir, because I don't think you could conclude that a succession of spectacular achievements and exploits in one area of a nation's activity would be controlling. I mean, what we would be doing in the whole area of our policies and our actions, not just in science, or one field of science alone, would enter into the equation, so to speak. Do you see what I mean, sir?

Mr. QUIGLEY. I see what you mean, but let me illustrate what I have in mind by this question: I presume that like every good Washingtonian you have read a certain bestseller, "Advise and Consent."

Mr. MERCHANT. Yes, sir.

Mr. QUIGLEY. Now, I don't want to give the plot away if you haven't read it, but if I do, it is your own fault. If you have been in Washington 6 months and haven't read this book, it is your own fault.

Let me direct your attention to the final scene in that book. It ended on a note of optimism which, in my opinion, was slightly contrived, perhaps a little forced, but it was optimistic.

You knew as a reader and the people in that plane heading for Geneva—and, incidentally, you would have been in that plane if you were occupying your current position—you knew and I knew and the reader knew that in 3 days' time we were going to be on the moon, and so we went into Geneva, or our President and our Secretary of State headed for Geneva, with a certain note of optimism.

Can you conceive what the atmosphere would have been in that plane if we knew that instead of getting to the moon in 3 days, after the Soviets, it was going to be 3 years?

Mr. MERCHANT. I don't think the atmosphere would have been one of jubilation. On the other hand, sir, the power relations between countries depend on many things. As I tried in my statement to put in perspective, without discounting or deprecating the problem which the Soviet spectacular achievements have created, the equation is one made up of many, many elements.

I don't have to name them: Military power, geography, allies—of course, here you are affected in the long run by psychological factors. Geography, productivity, the will and capability of the people, the quality of their leadership, all these things go into the creation of the totality of the power position of a country.

I think we must keep a sense of proportion.

Mr. QUIGLEY. I agree with you, but the thing that worries me is that we have managed to survive the first sputnik, we have managed to survive a Soviet bull's-eye on the moon, we have managed to survive the photographs in Life magazine of the back side of the moon as seen from a Soviet camera. These things have hurt us and I think they have made your job much more difficult. We have suffered propaganda setbacks. But what I am afraid of is that if they continue, we will continue to suffer propaganda setbacks—if they put the first man in orbit, if they land the first man on the moon. I still think we are not at the point of no return, but I do worry and wonder, if this thing continues and they not only get the first man on the moon, but they get the first troops to the moon and get them there with hydrogen bombs and with rockets that can send them back, this may cease to be something more than a situation where we are embarrassed, propagandawise. We may actually be in a position where none of us dare think about this country ever being.

Mr. FULTON. Would the gentleman yield?

Mr. QUIGLEY. If I have any more time, I will yield—may I yield under the rules?

The CHAIRMAN. You may yield your time as long as you have it.

Mr. FULTON. Did it ever strike you that it might do the United States good, abroad, to be second for once? It is always the brightest one in the class who does everything first and suddenly finds himself popular when he finds somebody else competing with him.

Mr. QUIGLEY. This may be true, psychologically, but it is like my trying to tell myself that the fact that the Soviets need 45,000 square miles in the Pacific indicates how inaccurate their guidance systems are. I would like to believe that, but I don't.

Mr. FULTON. Mr. Teague of Texas says—look how Alaska helped Texas.

Mr. QUIGLEY. That is all, Mr. Chairman.

The CHAIRMAN. Mr. Karth.

Mr. KARTH. There has been a great deal of conjecture today about the value of propaganda. I may be in error, but it seems I understood you to minimize its effect to some degree at least. I think we must all agree that propaganda does have the effect of capturing the imagination and the minds of man and, therefore, formulating opinions. In elections in this country, for example, where we have the best educated people in the world on an overall basis, propaganda has even won elections or lost them. Now look at the propaganda the Soviets have put out insofar as Khrushchev's bold proposals for world peace are concerned—that is, disarmament, reduction of the manpower forces in the Soviet military posture and his so-called disarmament proposals, and so on and so forth.

My question is this, sir: What is the general opinion in the minds of the people of the world—as you refer to them on page 13—as to the militaristic attitude of the United States, as opposed to the militaristic attitude of the Soviet Union?

In light of all these propaganda proposals that have been played by Mr. Khrushchev, are we considered the militaristic nation? Are we considered the nation who is most often propounding solid proposals for peace, or is Russia being considered that nation?

Could you answer that, sir? I think this is important because people are generally interested in peace rather than in war. What is your posture? What is the perspective that we are held in, in the eyes of the world, insofar as this militaristic attitude is concerned?

Mr. MERCHANT. I suppose it varies considerably from country to country. Certainly behind the Iron Curtain we are painted as a militaristic nation, a potential aggressor.

In generalizing though, sir, it is my belief that we are not regarded generally in the world—the general impression of the United States is not that of a militaristic power with aggressive intent.

I think it is pretty well understood and accepted, the things we have stood for—as was described earlier, the extent to which we unilaterally disarmed after the Second World War when the Soviets didn't; the aggression in Korea; the attack on the offshore islands; the Communist-supported, the Chinese Communist-supported activities with many of its neighbors; Hungary.

I would think probably as good a test as you could get as to what the world concept of the United States is, as good a test probably would be over a period of years in the General Assembly of the United Nations where more than 80 countries are represented. To the extent you can generalize, I would say that apart from the area behind the Iron Curtain, we are regarded as a nation essentially devoted to peace and that would be my answer, sir.

If I may make one point, sir, I have not intended in anything I have said, to deprecate the importance of an imaginative, forceful, intelligent information service to present the facts about ourselves and present our policies truthfully, forcefully, and effectively.

The point I tried to make earlier, I think, was that propaganda, as propaganda, cannot be the substitute for a policy and in the long run, it won't stand up, I think. And propaganda, or an information program, is much more effective and it is easier to conduct if it is faithfully and truthfully reflecting and explaining a sound policy.

I wouldn't want my friend, George Allen, to think that I had undermined him before this committee.

Mr. KARTH. Mr. Secretary, it is my opinion that we have had quite a difference of opinion, or quite a reversal in foreign relations, at least in foreign policy thinking, in the last 8 or 9 months or so. Instead of the hard, ironfisted foreign policy of the late Mr. Dulles, to the more conciliatory, willing to talk and negotiate, exchange visits type program of the present. What, in your opinion, is the effect of this change in attitude on foreign policy relations in the minds of the people of the world? Has this been good, has it been bad, has it been indifferent? Has it had any effect at all?

Mr. MERCHANT. I would not concede, sir, that there has been any change in our foreign policy, in the essentials of our attitudes and actions outside our country's borders.

We hold strongly to the essential elements in what has consistently been our foreign policy and we have consistently said that we were prepared to negotiate at any time on any controversial issue.

Mr. KARTH. The effect, Mr. Secretary, has been a little different. To meet you halfway.

Mr. MERCHANT. Yes, I was coming to that, to make a point on this, sir: I think a part of the appearance of an increase in negotiating activity and visits and so forth, is, in fact, a reflection of a change in attitude, if not policy, on the part of the Soviet Union. And I think the policy of Mr. Khrushchev as enunciated, to attempt to relax tensions, has resulted in a greater willingness on the part of the Soviet Union to engage in negotiations.

The Antarctica treaty for one thing; coming in this year as opposed to refusing to come in the year before in the General Assembly on the Outer Space Committee; the Geneva Foreign Ministers Conference last summer—which was the first foreign ministers conference since the fall of 1955, as I recall it.

I think this activity in a very real sense has been a reflection of a change in attitude, on the Soviet part.

Mr. KARTH. But you would agree there has been some change on the part of the United States, insofar as their foreign policy is concerned?

Mr. MERCHANT. A change on the part of the President of the United States?

Mr. KARTH. More conciliatory. I think the treaty of Antarctica indicates that.

Mr. MERCHANT. No, I think the President has consistently been conciliatory. No, sir, I would not concede that.

Mr. KARTH. Mr. Chairman, in the interests of time, I will forgo any further questions.

The CHAIRMAN. Gentlemen of the committee, I would like to put forth this thought right now. It is 11:45 and we have four members remaining to question. Is it the desire of the committee to try to finish up this morning or go over to 2:30?

Mr. MILLER. I think this morning.

Mr. ANFUSO. This morning.

The CHAIRMAN. Everyone seems to wish to conclude this morning.

Mr. FULTON. Would you hear from the minority?

The CHAIRMAN. Surely.

Mr. FULTON. The minority side unanimously agrees with the chairman.

The CHAIRMAN. I privately consulted with the minority before I brought the matter up.

Mr. HECHLER. Mr. Secretary, I believe, and I am sure you believe, from your testimony, that we have to achieve a peaceful and not a military solution. Yet the question is so frequently raised by the man on the street and although it has been answered frequently, I don't think it can be answered too frequently. I want to give you an opportunity to give again a simple and clear answer to this question which is frequently raised: how can we continue with our missile and space program in a way which will catch up and leapfrog Russia and at the same time talk about, believe in, and work toward disarmament?

It seems to the ordinary person to be a conflict. I want to give you an opportunity to clarify this simply so that the people can understand it.

Mr. MERCHANT. Well, I think I would answer this way, sir: Disarmament without adequate inspection and controls is the most dangerous of all frauds and illusions. Anxious as one is to negotiate on disarmament, it seems to me as a practical matter that a failure to maintain a position of military strength in the face of great military power removes from the negotiation the incentive to agree to a properly inspected and safeguarded disarmament.

So from a practical point of view, to my mind, the maintenance of one's defensive power practically contributes to the ultimate securing of sound, effective agreements on controlled and reduced armaments.

This, to my mind, is the essential point.

Mr. HECHLER. That is a very good answer.

I would also like to ask you: Would it have an adverse effect on our foreign policy if foreign nations felt that our space program was not centrally directed, did not have central leadership, or if they felt that there was an excessive amount of competition among the military services in such a way as to slow down that program?

Would this have an adverse effect if these facts were true?

Mr. MERCHANT. I have had enough difficulty, sir, explaining to well-educated, well-informed foreigners in many countries the simple fact of separation of powers under our Constitution, to believe that foreigners, generally speaking, would be particularly interested in the details of how we conduct a program.

Mr. HECHLER. I suppose I have run across different foreigners than you have, perhaps, but I find many of them who seem to feel a certain frustration about the way that our program is being run administratively. They constantly raise the question: Would it not be much simpler if you had a single space agency with central leadership and direction?

I find it difficult to answer a question like that. That is why I raised the question, that if this were true, would this have an adverse effect on our foreign policy?

Mr. MERCHANT. I think, sir, they are interested in results, essentially. I haven't had the same experience that you have, possibly because I imagine I am a more recent newcomer to the world of outer space than you.

I wouldn't think this would be a major factor in their attitudes, myself.

Mr. HECHLER. If it were true, do you feel it would affect our foreign policy adversely?

Mr. MERCHANT. I think if other people felt we were not making a coherent, well-organized, administratively sound, effort and were dispersing or duplicating unnecessarily our resources, I think this would reflect on our ability to operate successfully in a very important field.

I would agree completely on that.

Mr. HECHLER. That is all, Mr. Chairman.

The CHAIRMAN. Mr. Daddario.

Mr. DADDARIO. Mr. Secretary, you have stated that the Department is interested in how our activities in this space field bear on other countries. In answering questions, you come to the conclusion that it has not made it any easier for you. Is that correct?

Mr. MERCHANT. Yes, sir.

Mr. DADDARIO. You have also stated that you believe our solid achievements in the area of peaceful uses of outer space—the possibilities of communications, meteorology, and that type of thing, sets well with the scientific community throughout the world, that we are making broad achievements in this area and that this is, in the long run, the way in which we will off-balance the sensational achievements of the Soviets. Is that correct?

Mr. MERCHANT. Yes, sir. With the footnote—I think I noted that in the area where the Soviet lead is clear on high power boosters that we, as I understand it, are making a very significant effort to develop a booster which would enable us to project into space, or orbit, far heavier loads than we have to date. So I would not say that you might say that we were accepting defeat in one area and concentrating on other areas—maybe that wasn't the intended implication of what you said.

Mr. DADDARIO. Well, the reason I am concerned with that approach to it is that it assumes that the scientific community through the world, which is an opinionmaking, leadership type of community, does have this opinion of our effort.

On page 12 you referred to the fact that we are maintaining a broadened base program. I have talked to scientists throughout the world and to people whom I have known over the course of time, and I find a criticism about our efforts in the peaceful uses of outer space—that it is too broadly based, that it has no direction, that it is not going anywhere, that we are doing many things that we should but we are doing many things that we should not be doing. That we are wasting time, effort, manpower, and that this leaves them with a sense of frustration as to our inability to direct our full forces to a sensational achievement in the area of peaceful uses. Therefore, I have come to a different conclusion than you have.

Haven't you, in your seeking out information, found that this is a criticism—the scientific community has to our effort?

Mr. MERCHANT. I can't honestly say I have encountered it, sir; but here again I really don't feel that I am a competent witness on this phase of the subject, for this committee. I accept what you say that there is criticism that we are maybe too broadly dispersed. But I think the record of some of the less spectacular, but nevertheless, as I said, scientifically extremely significant achievements on our part would confirm that, even though more broadly spread possibly, our national effort has shown great progress in this new field.

Mr. DADDARIO. I think perhaps it has shown great progress, but the thing that bothers me is that we have come to an assumption as to the State Department's approach to this. The basis of it appears that we are making solid achievements in one area. If this is an assumption and if it is affecting the leading minds in the scientific community throughout the world, it would seem to me that your job is going to become more difficult as the years approach to carry out your relations with these other countries when you admit that they are making spectacular achievements in certain areas. And if, in fact, we are not getting into their minds that we are properly accomplishing our end objectives in the peaceful area, this would seem to be a doublebarreled problem you would then have to overcome.

Mr. MERCHANT. My understanding, as I said, sir, is that within the international scientific community there is a very real respect for our achievements and for our capabilities and that this knowledge of what we have done and are doing has been more widely spread by reason that one of our more basic policies is to place very great emphasis on international cooperation.

Mr. DADDARIO. I am afraid I am in disagreement with you on this because the people I know who are eminent scientists don't come to this same conclusion.

Mr. Anfuso has asked me to ask you a question and that is, has any answer been received to Dr. Glennan's proposal of last fall to make a United States worldwide tracking facility available for use in any Soviet man-in-space program?

Mr. MERCHANT. I am informed no, sir.

Mr. DADDARIO. That is all.

The CHAIRMAN. Mr. King.

Mr. KING. Mr. Secretary, there have been eminent scientists recently, Dr. Teller being one who comes to my mind, but not the only one—who have stated categorically that the progress of Russia in the scientific field is so rapid, and their momentum is so great, that inside of 10 years they will have overtaken us in practically every significant department of scientific activity. Moreover, that they are going so fast, relative to our speed, that as of now there is nothing we can do to prevent that from happening. It is much like two trains, the one being ahead traveling 30 miles an hour; the one behind traveling 60 miles an hour, and there is no known means whereby the train traveling 30 miles an hour can build up its speed to 60 miles an hour fast enough to prevent the other one from overtaking it.

Now, if that be true, then isn't it a little deceptive and dangerous to continuously make the flat statement that we are ahead of the Russians in the total broad scientific picture—which may be technically true, but is still a deceptive statement, if it also be true that the Russians will have overtaken us in 10 years and there is nothing we can do to prevent them?

Would you care to comment on that?

Mr. MERCHANT. Well, if the statement you made is true, I think what you say obviously follows—and this is a matter of judgment, but this assessment which you attributed to Dr. Teller is not what I have been given to understand by the people working with this program in the Government.

In other words, if we are behind and going so much slower we never can catch up, obviously then you can't make any claim for anything except total loss in all areas. However, that assessment differs from what I have been given to understand.

Mr. KING. Dr. Teller's statement was not that we could never make up for lost ground, but his point was that if we were to accelerate our program as much as would be conceivably possible right now, we still couldn't do it fast enough to prevent the Russians from overtaking us. That we would have to look to some time in the more distant future, shall we say, 15 or 20 years from now, before we could again catch up with them. That they were leapfrogging us and that they were in the process of jumping over us and we couldn't stop them now even if we were to double our educational output because of the inevitable lag that is always present in this type effort.

I appreciate your answer on that.

That is all I have.

The CHAIRMAN. Mr. Roush.

Mr. ROUSH. Mr. Secretary, do I assume correctly when I assume there is a very close liaison between the State Department and NASA?

Mr. MERCHANT. Yes, sir.

Mr. ROUSH. May I assume you are aware of our future program and what we are planning to do in the next year and the next 2 years?

Mr. MERCHANT. Mr. Farley has just given me the answer, that we are so informed within the limits of our ability to understand.

Mr. ROUSH. You do have the schedule for our firings which are planned and things of that sort?

Mr. MERCHANT. Could I ask Mr. Farley to answer that question, Mr. Chairman? I think he is more familiar, obviously.

Mr. FARLEY. We are informed of these things. On the other hand, we do tend to concentrate more on the activities they are undertaking which will require preparatory work with other countries since we do not attempt to duplicate and follow all their efforts.

Mr. ROUSH. What I am attempting to get is this: Is there any attempt to coordinate our proposed achievements with State Department policy and activities? I am thinking of what the Russians have done. For example, Mr. Khrushchev came to America and they hit the moon.

Mr. Anfuso spoke of what probably they will be doing in connection with the summit conference.

Is there any attempt to coordinate our activities so that we might get the maximum propaganda value out of our achievements?

Mr. FARLEY. I would say this is a factor taken into account. In general our effort is to anticipate when we will have such an achievement so that we can make maximum exploitation of it rather than to try to tailor the program to some particular foreign event, since we can usually find an international conference, an important meeting, in which we are able to take advantage of what we do.

We do not attempt to distort their program for propaganda purposes but rather to take political and psychological advantage of what they do achieve.

Mr. ROUSH. Thank you.

That is all, Mr. Chairman.

The CHAIRMAN. Mr. Secretary, that completes the schedule of the committee. What I want to ask is this, and I am not going to interrogate you especially regarding these two matters but I am going to ask you, if you would, to cause the answers to be placed in the record with reference to what I want.

I would like to have just a little bit more on the progress which has been made in international cooperation. Now, you have mentioned that two or three times, but not specifically. I would like to have details: "We have done this. We had an ad hoc committee. We attended this conference." Tell us what the results are, and set it out specifically, step by step, so that we will know in this committee what has been done.

Mr. MERCHANT. I will be happy to supply that.

The CHAIRMAN. Two. I would like to know what you have done in setting up scientific attachés in your embassies and consulates throughout the world. We had some testimony on that last year. It is not exactly in line with the space hearings but it is close enough to where I think it would be proper to place that in this record. If you will give us both of those we will appreciate it.

Mr. MERCHANT. I would be very happy to supply that for the record, sir.

(The information requested is as follows:)

MAJOR ELEMENTS OF UNITED STATES INTERNATIONAL CONSULTATIVE AND COOPERATIVE ACTIVITIES IN THE FIELD OF OUTER SPACE

From the inception of its present outer space program as part of the International Geophysical Year, 1957–58, the United States has recognized the interest of all nations in the purposes for which outer space is explored and used, has actively sought to promote the establishment internationally of an orderly basis for the conduct of outer space activities, and has encouraged international participation in the conduct of such activities and the sharing of their results. The United States has played a leading role in encouraging international consultation and cooperation with respect to two basic aspects of the international opportunities and problems arising from the exploration and use of outer space.

First, the United States has expressed its willingness to participate in a study of the possibility of assuring that outer space be used for peaceful purposes only. In this regard, the United States has consistently expressed the view that if there is general agreement to proceed with such a study on a multilateral basis, this country would join in examining the matter without awaiting the conclusion of negotiations in other substantive areas relating to the reduction and control of armaments.

Second, as Secretary of State Christian A. Herter has stated before the United Nations General Assembly: "Recognizing that progress in disarmament might be slow, however, the United States has urged that peaceful uses of outer space be considered as a separate step toward constructive change." Significant advances in this area have been made through arrangements within the framework of the United Nations, through traditional international scientific channels, and through direct arrangement with other countries.

ACTIVITIES WITHIN THE UNITED NATIONS

In the United Nations, Ambassador Lodge has called attention to the fact that events in outer space during the past 2 years have challenged man's political as well as his technological inventiveness. Ambassador Lodge has stated: "It is a prime task of governments and of the United Nations to see to it that political progress keeps pace with scientific change. Unless this is done, the world runs the serious risk of relying on political institutions and arrangements that are outmoded and inadequate." A principal objective of the United States in the United Nations has been to assure the provision of an informed basis and suitable organizational arrangements better to enable the United Nations to deal with the new field.

First steps in the General Assembly

In addressing the 13th session of the United Nations General Assembly, September 18, 1958, the late Secretary of State John Foster Dulles expressed the belief of the United States that the United Nations "should take immediate steps to prepare for a fruitful program of international cooperation in the peaceful uses of outer space." To this end, the late Secretary proposed the establishment of a committee to make the necessary preparatory studies and recommendations. Subsequently, the United States, together with other interested nations, introduced a resolution calling for the establishment of such a committee, and on December 13, 1958, the General Assembly adopted this resolution, thereby bringing into being an 18 member Ad Hoc Committee on the Peaceful Uses of Outer Space.

Under the terms of General Assembly's resolution, the Ad Hoc Committee was requested to study and report to the 14th General Assembly on four basic matters bearing on future action within the framework of the United Nations: the existing activities and resources of the United Nations: the existing activities and resources of the United Nations, its specialized agencies, and other international bodies, relating to the peaceful uses of outer space; the area of international cooperation that could appropriately be undertaken under United Nations auspices; the nature of emerging legal problems; and future United Nations organizational arrangements in this field.

The Ad Hoc Committee met at United Nations Headquarters between May 6 and June 25, 1959. The Soviet Union, Poland, and Czechoslovakia refused to participate in the work of the Committee because of dissatisfaction with respect to the number of Soviet bloc representatives named to the Committee by the General Assembly. India and the United Arab Republic also declined to participate. The Committee's work, therefore, fell to 13 nations: Argentina, Australia, Belgium, Brazil, Canada, France, Iran, Italy, Japan, Mexico, Sweden, the United Kingdom, and the United States. The representative of Japan was elected chairman of the Committee.

In a series of constructive discussions conducted primarily through committees of scientific and legal experts, the Ad Hoc Committee considered the matters assigned to it and prepared a report which serves as a useful introduction to the international opportunities and problems of the space age.

The Ad Hoc Committee's findings in the scientific area emphasized that the principle of open and orderly conduct lies at the root of international cooperation directed toward the peaceful uses of outer space and the adherence to this principle would further the progress of space science and technology, both in the narrow sense as activities in themselves, and in their relation to human progress. The Ad Hoc Committee noted the evident need for efforts of coordination and encouragement by the United Nations in support of international cooperation in the scientific field.

In the legal area, the Ad Hoc Committee considered that, as a result of practices followed in outer space exploration, there may have been initiated the recognition or establishment of a generally accepted rule to the effect that, in principle, outer space is, on conditions of equality, freely available for exploration, and use by all in accordance with international law or agreement. The Committee emphasized the need for resolving practical legal problems as they arise.

With respect to future organizational arrangements within the United Nations, the Ad Hoc Committee found no need at present to establish an autonomous intergovernmental organization for international cooperation in the field of outer space. It suggested, however, that the General Assembly might wish to consider establishment of a committee to study practical and feasible measures for facilitating international cooperation, to consider means for studying and resolving legal problems, and to review the matters initially examined in the Ad Hoc Committee's own report.

Continuing interest of the General Assembly

In his address of September 17, 1959, in connection with the opening of the 14th Session of the General Assembly, Secretary of State Herter urged the Soviet Union to join in the cooperative efforts of the United Nations in the field of outer space. Secretary Herter said: "There could be no more dramatic illustration of a spirit of cooperation in the world today as we stand at the threshold of the space age than for this Assembly to act unanimously in this field." On December 12, 1959, the General Assembly did act unanimously to establish a new Committee on the Peaceful Uses of Outer Space both to carry forward the work of the Ad Hoc Committee and, as an immediately practical step toward cooperation, to organize an international conference for the exchange of experience in the peaceful uses of outer space. The initial Soviet proposal for such a conference was welcomed by the United States as evidence of a spirit of cooperation on the part of the Soviet Union.

Elected to membership on the new Committee were Albania, Argentina, Australia, Austria, Belgium, Brazil, Bulgaria, Canada, Czechoslovakia, France, Hungary, India, Iran, Italy, Japan, Lebanon, Mexico, Poland, Romania, Sweden, the Soviet Union, United Arab Republic, United Kingdom, and United States.

The pioneering efforts of the Ad Hoc Committee and the subsequent action of the General Assembly have prepared the groundwork for the United Nations to consider the opportunities and problems of the space age, thereby helping to assure, in the words of Ambassador Lodge, that political progress keeps pace with the scientific change.

Initial activities of the specialized agencies

The United Nations Ad Hoc Committee placed special emphasis on the need for international coordination of radio frequencies for space tracking, communications, and research purposes as the first technical area in which immediate international action was required. The Ad Hoc Committee noted that there already existed in the International Telecommunication Union (ITU), a specialized agency of the United Nations, a means for handling this problem.

The United States recognized this matter as the first practical problem of a regulatory character which has arisen in the outer space field and as an important element in the provision internationally of a basis for the orderly conduct of outer space activities. Meeting with over 80 other countries in the International Administrative Radio Conference of the ITU, which was held in Geneva, August through December 1959, the United States called attention to the need for reserving radio frequencies for space communications and radio astronomical research. The Conference accorded some recognition to this problem and made minimal provision for frequencies for these services. However, the results of the Conference can be regarded as only a first step toward resolution of an already pressing problem which will become increasingly urgent in the future.

In another specialized agency of the United Nations, the World Meteorological Organization (WMO), the United States has taken the lead in focussing attention on a field where satellites may be of widespread service. Looking to the future, the United States has encouraged the WMO to study the application of satellites in the field of meteorology, where their use promises significant improvements in weather forecasting. Following presentation by the United States of the current assessment of the potentialities of satellites in this field, the WMO established in 1959 a special panel, of which the United States is a member, to perform a continuing review of progress toward realization of these potentialities.

As a result of a recommendation of the United States in 1958, UNESCO is also prepared to undertake such activities in this new field as may prove useful with the fuller determination of the specific role to be played by the United Nations and its specialized agencies.

OTHER INTERNATIONAL ACTIVITIES

Opening the consideration of scientific matters by the United Nations Ad Hoc Committee on the Peaceful Uses of Outer Space in May 1959, Dr. Hugh L. Dryden, Alternate Representative of the United States and Deputy Administrator of the National Aeronautics and Space Administration, observed: "Creative ability is not confined to any race or nationality. The records of past achievement repeatedly demonstrate this potential of men everywhere, given the opportunity to contribute. I am sure that the exploration of space will prove no exception. It is a task vast enough to enlist the talents of scientists of all nations."

In keeping with this view, the United States has given practical effect in the conduct of its own outer space programs to the principles of consultation and cooperation it has supported in the United Nations. The range of activities underway or envisaged includes exchanges of scientific and technical data, exchanges of visits among scientists, coordinated programs of observation and experimentation, and cooperative programs in the tracking of space vehicles and in the conduct of space exploration.

Traditional channels of international scientific cooperation

Reflecting the origin of the space age in the International Geophysical Year, 1957–58, traditional nongovernmental channels of scientific cooperation have played a continuing role in facilitating international consultation and cooperation and in providing a means for exchange of information regarding scientific research activities in outer space. Increasingly significant in this regard has been the Committee on Space Research (COSPAR) of the International Council of Scientific Unions. During 1959, successful efforts to obtain the cooperation of the Soviet Union in United Nations activities were paralleled by the success of the international scientific community in arriving at agreed organizational arrangements for COSPAR.

The United States has strongly supported this nongovernmental channel of scientific interchange and activity. At the second meeting of COSPAR held at The Hague in March 1959, Dr. Richard W. Porter, the delegate of the U.S. National Academy of Sciences, expressed the full support by this country's scientific community of COSPAR's objective of bringing together the capabilities of satellite launching nations and the scientific potential of other nations. Dr. Porter made known the willingness of the United States to undertake the launching of experiments proposed by scientists of other countries. It was pointed out that this could be accomplished by sending into space either single experiments as part of larger payloads or groups of experiments comprising complete payloads.

The strong support by the United States of free and full scientific communication through traditional channels was further evidenced by the active participation of scientists of this country in the First International Space Science Symposium held under the auspices of COSPAR at Nice during January 1960. U.S. scientists presented over 45 papers at this meeting and played a prominent role in discussions looking toward further exchange of data respecting the conduct of scientific research activities in outer space and their results.

Arrangements with other countries

In addition to participating in the activities of international governmental and nongovernmental bodies, the United States has embarked on a program of cooperative arrangements directly with other countries. These arrangements are being effected in the areas of space research and ground support.

Cooperation in space research is in a relatively early stage of development. An initial pattern which is emerging reflects the U.S. offer in COSPAR and is based on the cooperative planning and conduct of specific experiments, with the scientific instrumentation being designed and provided by scientists of other countries and the launching operations conducted by the United States. In keeping with the offer made through COSPAR and in recognition of the fact that the interests of NATO go beyond the military, the United States offered in April 1959 through the NATO Science Committee to place in orbit experiments proposed by scientists of NATO countries.

Since the general offer made in the spring of 1959, technical discussions looking toward arrangements of this character have been and are being undertaken with scientists of a number of countries in Europe, Asia, and the Americas. These discussions are already beginning to come to fruition with the formulation of firm plans for joint programs with Canada and the United Kingdom. Others are expected to follow in the near future.

International cooperation has also been facilitated by the fact that the United Nations space program, by its varied nature and as a reflection of this country's geographic position and global relationships, requires a worldwide network of ground support facilities for the tracking of and communications with space vehicles. Governmental and technical discussions have been completed or are underway to place on a firm basis the radio and optical tracking facilities established during the International Geophysical Year, 1957–58; to extend the capabilities of this basic network in support of new programs such as the deep-space probe programs; and to meet the special needs of programs such as Project Mercury. In some instances facilities established by other countries form a valuable supplement to the U.S. network.

These tracking arrangements have been regarded by the United States as essentially a cooperative effort of this country and the other countries involved. Where practical, provision is made for active participation of others in the operation of the network, and in a number of cases facilities are operated entirely by personnel of the host country. In cases where full operation in this manner is not feasible, a degree of participation and training may prove possible. The number of countries with which tracking arrangements have been made or are being discussed is approaching 20.

A special aspect of the usefulness of the tracking network in facilitating international cooperation is its capability of acquiring scientific data from space programs of the Soviet Union. The United States has already transmitted to the Soviet Union a number of tape recordings of the data transmitted by Sputniks I, II, and III. In furtherance of this unique form of cooperation, Dr. T. Keith Glennan, Administrator of the National Aeronautics and Space Administration, offered on December 7, 1959, to utilize the services of the network in support of scientists of the Soviet Union in connection with any manned space flight program that may be undertaken by that country. This offer was subsequently affirmed in correspondence from the U.S. National Academy of Science to the Soviet Academy. No reply has as yet been received.

The cooperative arrangements in space research and tracking which the United States has initiated with other countries have provided an opportunity for those countries to play an active and essential role in the space age and have served to demonstrate the genuine interest of the United States in effective and meaningful international arrangements.

PROGRESS OF DEPARTMENT OF STATE SCIENTIFIC ATTACHÉ PROGRAM [1]

At the present time (January 1960) there are 14 distinguished scientists assigned as scientific attachés or deputy attachés in 9 posts abroad: 2 men each in London, Paris, Stockholm, Tokyo, and New Dehli, and 1 man in Rome, Bonn, Buenos Aires, and Rio de Janeiro. A special consultant served in Moscow for 3 months during 1959 and he will return for a similar period this summer. With selection of men for the deputy attaché posts in Rome, Bonn, and Moscow all of the presently authorized positions will be filled. A modest increase in geographic coverage is contemplated for 1961.

The persons selected for these positions are mature scientists, with established reputations in the American scientific community and in their countries of assignment. Each has facility in the language of the country of his assignment. Before departing for his post, each man has been assigned to Washington for intensive briefing in various offices of the Department and for consultation at other Government agencies and appropriate nongovernmental

[1] Background of the science attaché program is presented in hearings before the House Committee on Science and Astronautics in "Dissemination of Scientific Information," May–June 1959, pp. 122–137.

groups. Of the 14 men, 7 may be classed as physical scientists, 4 as life scientists, and 3 as engineers. Ten have been recruited from academic life, three are on leave from other Government agencies, and one is from a private research institute. They are appointed as Foreign Service Reserve officers for a 2-year period.

The scientific attachés are an integral part of the Embassy structure, and in collaboration with other specialists in the Embassy they assist and advise the Ambassador on the problems arising from the interaction of science and foreign relations. It is their responsibility to keep the Department informed of developments in science significant to foreign relations and to advise of the impact of U.S. policies on the scientific activities of the host countries and the influence that foreign policies may have on U.S. scientific activities.

An increasing responsibility of the scientific attachés is to assist their Ambassadors in coordinating the many foreign science programs supported by various U.S. Government agencies in the countries of assignment.

A possibly unique aspect of their job is its representational character. With their recognized stature among foreign scientists they are in excellent positions to explain U.S. science and policy to an important and influential segment of the foreign public. They are becoming a focal point for U.S. and foreign scientists seeking closer contact with each other and are able to initiate and foster means for the exchange of information and for collaborative research.

The CHAIRMAN. Now, Mr. Fulton has some questions to ask you.

Mr. FULTON. I have two things to clear up. One is on this specific test of the Russians. It isn't so unusual because in the orbits of the Soviet space vehicles that they have been using previously, it is within a 4-percent correlation of their previous orbits and it would seem to be an extension of their range otherwise, which is a land range going eastward—northeast.

To me it sounds like a logical development of the Soviet policy of a man in space, or control of orbits, or more lunar shots. It is entirely within the context of the scientific base they have already developed. Everybody seems to talk around the United States and in these newspapers as if it is a completely acute angle off in another direction and off in another region. It isn't.

Wouldn't you agree with that?

Mr. MERCHANT. I would.

Mr. FULTON. And your scientific adviser?

Mr. FARLEY. We do agree that this is the most likely explanation.

Mr. FULTON. So it isn't any terrifically unusual occurrence. We would be doing the same thing if we were in the same position, from the United States, coming up east instead of being at Vandenberg and going west.

My question is, on this man-in-space program where there has been more the feeling of cooperating for peaceful purposes, could we indicate a show of help, as we helped the Russians, on one of their trawlers' officers with ulcers, we certainly went out of our road to help them there; couldn't we try to make it a joint program. Because at some point in the Pacific I can see where it is going to overlap and there will be real trouble. On our range going west and theirs moving east, in just about the same satellite pattern, why couldn't we work something out to avoid the future trouble which everybody thinks there now arises? Because there will be a gray area where it will intrude on our proposals and they will say, "We have the right to go ahead," and we say, "We are on the same track," and we meet head on.

Are we doing anything to try to head it off?

Mr. FARLEY. The particular area you identify either in tracking or in other aspects of a man-in-space program is one which we think could be potentially a very attractive one for this United Nations committee on which for the first time we will have the Soviets this coming year.

Even before that, as I think it was Mr. Anfuso's question which indicated this, Dr. Glennan has made it known to the Soviet through, I believe, our National Academy of Sciences that if they would be willing to let us know of any launchings of this kind we would be willing to put the services of our worldwide tracking network at the disposal of their effort there. This is simply a preliminary step.

Mr. FULTON. I would like that put in the record. That is very important to me.

Mr. FARLEY. We will obtain this for you.

(The information requested will be found on p. 28.)

Mr. FULTON. There is the impact of what this committee sees in its work. For example, when we in the Antarctic have changed from the troubled era of competition on the discovery of new lands on the earth, and have taken an entirely new policy there, it ought to apply as well in space and it looks to me as if there has been a significant and basic change in international relations.

It was Dr. Selden's book, "Dominion Over the Seas," that led to the Spanish Armada.

It was Dr. Grotius of the Netherlands, that led to the Mare Dominorum—freedom of the seas.

It appears to me we have made a tremendous step forward in the United Nations through these negotiations, in 1959, and on the Antarctic treaty negotiations where everyone in the United Nations accepted the freedom-of-the-seas basis for land and space and to me that is a mature advance in the history of the world. Don't you think that is possible?

Mr. MERCHANT. I agree, sir. I think this is a significant advance. I think the Antarctic treaty is a very important development, and I think the approach which has been taken by the United Nations, if I may say so, under our leadership, in the dedication of outer space to purely peaceful purposes, is a very hopeful augury for man's future at a time when there are many depressing elements in the picture.

Mr. FULTON. And we should strongly move ahead in these constructive steps both in the U.S. Department of State, as well as under Cabot Lodge and in cooperation with the others at the United Nations.

Mr. MERCHANT. Yes.

Mr. FULTON. Thank you.

The CHAIRMAN. Thank you very much, Mr. Secretary.

At this point, the committee will adjourn until tomorrow. Tomorrow we have the CIA here, but Mr. Dulles has a security council meeting in the morning at 10 and we will not be able to open up until 11 o'clock. However, I want all the members of the committee to know that we will be prepared to come back tomorrow afternoon if we don't finish with him by noon tomorrow. We will ask him to come back at 2 o'clock tomorrow afternoon.

If there is nothing further, the committee stands adjourned.

(Whereupon, at 12:10 p.m., the committee adjourned to reconvene at 11 a.m., Thursday, January 21, 1960, in executive session.)

(The executive session of January 21, 1960, concerned another matter and is not included here.)

REVIEW OF THE SPACE PROGRAM

FRIDAY, JANUARY 22, 1960

House of Representatives,
Committee on Science and Astronautics,
Washington, D.C.

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

The Chairman. The committee will come to order.

We have been having some interesting testimony in this committee, which is causing us considerable thought. In fact, some of it is causing real concern on the part of members of the committee as to the security and safety of our Nation and what we should do in reference to speeding up the space program.

This morning, therefore, we asked Mr. George V. Allen, Director of the U.S. Information Agency to appear before us and give us the benefit of the information which his agency has accumulated from many parts of the world to show the impact of the Soviet progress in space on the minds of the peoples of the world.

We have in mind the thought that the spectacular character of the Soviet developments is such that it may be having a tremendous impact upon peoples generally and may be affecting our diplomacy and status as a nation in world affairs.

Accompanying Mr. Allen, we have Mr. Harry Carter, General Counsel; Mr. James Halsema, Director of Plans for the Agency; Mr. Oren Stephens, Director of the Office of Research.

We are happy to welcome you gentlemen to this committee. I think this is the first time, Mr. Allen, that we have had the pleasure of having you here before the committee. You have a prepared statement and we will ask you, if you will, to proceed with the statement.

STATEMENT OF GEORGE V. ALLEN, DIRECTOR, U.S. INFORMATION AGENCY; ACCOMPANIED BY HARRY CARTER, GENERAL COUNSEL, JAMES HALSEMA, DIRECTOR OF PLANS; AND OREN STEPHENS, DIRECTOR OF THE OFFICE OF RESEARCH

Mr. Allen. Thank you, Mr. Chairman. I appreciate the invitation of the committee to appear this morning, particularly since the committee members have shown themselves to be aware of the importance of space programs on world opinion, which is the aspect of the question which most directly concerns the Information Agency.

The Chairman. I can tell you this, that we on the committee don't feel there is anything going on that is more important than what is going on with regard to space at this hour.

Mr. ALLEN. As an introduction to the subject, you may be interested in a brief history of world reaction to space developments as our Agency has seen it.

Our sources of information include reports from our own offices overseas and from other agencies of this Government. In addition, public opinion polls and analyses are conducted by survey organizations overseas and we frequently have access to the results, just as other countries utilize the various polls taken in the United States. You may be certain, for example, that the Soviet Embassy in Washington keeps Moscow closely informed of the results of Gallup polls taken in the United States. I may add, incidentally, that the Soviet Embassy will also follow with great interest the hearings of this committee.

The successful launching of Sputnik I, created an intensity of reaction throughout the world which has rarely been paralleled by any other single discovery or invention. The public awareness of the first sputnik was almost universal. People in remote areas of even the most remote countries knew of this sensational event within a few days.

The element of drama was, of course, pronounced. The achievement was generally regarded as opening a new era—the era of space. Most people around the world saw it as such.

Added to this drama was the element of shock. The United States had announced, as early as July 25, 1955, our own earth-satellite program, now known as Vanguard. The developments in our program had been reported from time to time in meticulous detail. On the other hand, a low-keyed Soviet announcement implied that the U.S.S.R. would probably launch an earth satellite, with no statement as to when but with some details of proposed weight and orbit. The announcement received little attention in the general or even scientific press of the world.

Consequently, those who were interested in impending satellite launchings generally expected the United States to achieve the first, and perhaps the only, results.

The achievement of placing in orbit the first earth satellite, without great advance fanfare, increased the prestige of the Soviet Union tremendously and produced a corresponding loss of U.S. prestige, due primarily to the contrast. The Soviets were greatly exceeding world expectation of their scientific and technological capacities; we, on the other hand, were falling short of world expectation of us. An important element in underlining this contrast to the rest of the world was the reaction in the United States itself. We, ourselves, seemed confused, dismayed, and shaken by the development. Our own domestic debate helped make the Soviet achievement seem even more significant, and tended to put the whole matter into a framework of U.S.-U.S.S.R. rivalry.

As time passed, highly colored press and radio treatment of space matters gave way to more sophisticated judgments and more balanced reactions. This welcome change was helped greatly by our successes in launching a series of satellites and obtaining information from them, though our payloads were of a lesser magnitude than those of the Soviet Union.

We also began to see editorials abroad which pointed out the difference between American openness in letting the world in on our failures as well as our successes, and Soviet failure to announce attempts as well as achievements.

During the 18-month period following the first sputnik, our reports showed that the United States steadily regained prestige. At the same time, the prestige that accompanied Soviet achievements also continued to increase, so our regaining of stature did not approach the commanding position that we had enjoyed before Sputnik I. Furthermore, our failure to equal Soviet accomplishment in the terms the world sees as important—success in placing very large payloads in orbit—made the Soviet program even more impressive.

For a period of many months, the prevailing world opinion seemed to anticipate a kind of seesaw, with first the United States and then the Soviet Union accomplishing some noteworthy activity. This was accompanied by some hopeful notes that the United States would overtake the Soviets in payload weight, guidance accuracy, and so on.

Then came the two dramatic and successful Soviet moon shots, followed by the failure of our own. As a consequence of these events, the seesaw seems to have tipped solidly in the Soviet direction, in world opinion. Today, although we continue to see the hope expressed abroad that the United States will catch up, we also see growing doubt that this is likely during the next 5 or even 10 years.

Except for the most dramatic of space events, the world press now is less inclined to give startling headlines to every development. At the same time, general world interest in space has grown steadily, in both seriousness and depth of coverage—and along with this has been a surge in interest in all aspects of science and technology. Here the United States has an advantage: the vastly greater accessibility of our research, and our general willingness to share our findings with others. These two factors help to sustain our position.

However, we now see increasing speculative stories on what the Soviet Union will do next. There seems to be a prevailing view that the first spacemen will be from the Soviet Union. We have seen wry comments, some made in America, that Americans, landing on the moon, will find Russians there. In other words, the great expectations of American achievements in space are no longer in evidence. Soviet space leadership has been widely accepted.

The implications of this acceptance are important. The world looks at both America and the Soviet Union with new eyes today.

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

Before Sputnik I, few people of the free world believed the Soviet Union was currently in a position to challenge America in the broad fields of science, technology, and production. Now, the sputniks and luniks are taken as evidence that the Soviet Union is able to challenge America successfully in all these fields, including even production.

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

Some science and engineering students are being attracted to the Soviet Union for this reason. Soviet technological and cultural exports are getting a better reception around the world. Soviet scientists and technicians are being accorded greater prestige, are speaking with increased authority, and are being listened to more attentively.

One interesting—and perhaps dangerous—effect of Soviet success in space has been the new credibility it has lent to Soviet claims in these other fields. Before sputnik, most Soviet pronouncements of spectacular achievements were usually dismissed as propaganda. Since sputnik, their claims have been much more often believed.

Premier Khrushchev, in a speech at Krasnoyarsk on October 9, 1959, following his return from the United States, made this statement:

> The Americans now frankly admit their lag behind the Soviet Union in several most important fields. Today, for instance, I read a statement by American General Medaris, head of the chief technical and rocket administration of the United States. He says that, should the Soviet Union suspend its space program, the United States would need 3 to 5 years to catch up with us or to overtake us. This is a valuable and sensible admission.

The principal danger in the situation seems to me to be the cockiness which these successes have engendered in Soviet officials themselves. If it were a question merely of competition in scientific achievement, no one could properly begrudge the Soviets their magnificent successes, any more than we should begrudge their economic progress. Now should one begrudge their new-found feeling of self-confidence. Most foreigners who visited America during the first half of the 19th century found our self-confidence showing on every side. However, if this new-found Soviet cockiness (arrogance is not too strong a word) translates itself into adventuresomeness in foreign affairs, the world is in for a good deal of trouble.

Even though Soviet officials, themselves, have generally sought to present their space program as peaceful and scientific, the world public's reaction has been to read into space activities a military implication. Premier Khrushchev's statement that the U.S.S.R. has now shown that it can hit any spot on the earth's surface, found an echo in an editorial in the Danish newspaper, Information, on September 14, 1959. Commenting on the Soviet success in hitting the moon, this editorial declared, "* * * now we know * * * that an H-bomb-carrying rocket can, with precision, hit New York."

Attached to this statement are representative excerpts from other editorial opinion. Worth particular note is the comment by Berliner Morgenpost, also of September 14:

> If we had to choose between freedom and moon rocket, we would choose freedom. However, we need not make such a choice because the United States will accomplish a moon shot tomorrow or the day after.

Obviously, to maintain this confidence in us, we must push forward vigorously with space exploration.

Many people of the world are showing growing concern over the potential military dangers of an unchecked space race, and there is widespread concern over the need for international agreements to assure that space will be explored for peaceful purposes only.

All space activities are now seen within the framework of Soviet-American competition. Regardless of how Americans may feel about it, the world sees the United States in a space race with the U.S.S.R. Recent British interest in instrumenting an earth satellite is a helpful development. More international activity in space will tend to interest more people in international control.

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

(The attachment to Mr. Allen's statement is as follows:)

Press Quotations on U.S.–U.S.S.R. Space Activities

BRITAIN

"Indeed, it may be doubted whether Mr. Khrushchev, accorded full honors as a head of State, would now be leaving for Washington had not the first sputnik 2 years ago shocked the United States into a dire, if grudging, admission that Russia, in some respects held a commanding lead in the conquest of space" (Times, Sept. 14, 1959).

"[The Soviets] have proved themselves the Columbuses of the space age * * * they deserve to be congratulated * * * but * * * the rocket has political as well as scientific implications. The timing * * * was designed to make it clear that Mr. Khrushchev is talking from strength, not weakness * * *. The Russians have gained such a tremendous prestige advantage they can afford to be generous" (Guardian, Sept. 15 1959).

"In putting a space vehicle on the moon the Russians have provided the most complete, as well as the most dramatic, proof of the length of the lead that they now hold in accuracy of launching and control. The rocket, in Soviet hands, has become a precision instrument" (Times, Sept. 15, 1959).

DENMARK

"One may say that one should not be surprised, either because the moon was reached or because the Russians came first * * *. But * * * it makes a difference that it has, in fact, taken place * * * every little human being, in the very instant when the Soviet ruler sets his feet on American soil, must have told himself that now we know * * * that an H-bomb carrying rockets can, with precision hit New York * * *" (Copenhagen's information Sept. 14, 1959).

FRANCE

"It is with the purpose of putting all the trump cards on his side in his secret ambitions that Khrushchev sent the new rocket to the moon over the weekend. It is to make it quite clear to the Americans that he is not the representative of a backward country but of a power at least equal to the United States and Khrushchev staged the successful lunar shot" (Paris-Journal, Sept. 14, 1959).

GERMANY

"If we had to choose between freedom and moon rocket, we would choose freedom. However, we need not make such a choice because the United States will accomplish a moon shot tomorrow or the day after. As far as the military balance of power is concerned, lunik is not decisive in the close race between two world powers" (Berliner Morgenpost, Sept. 14, 1959).

ITALY

"It is clear that the country that can hit the moon with a rocket may more easily drop an H-bomb on New York or San Francisco. Now the Russians as well as the Americans possess the weapon of terror. Nuclear war would mean the end of everyone and everything" (Milan's La Stampa, Nov. 3, 1959,).

"The latest moonshot * * * frightens no one and * * * does not alter the political balance between the two coalitions" (Rome's Il Tempo, Sept. 13, 1959).

TURKEY

"In order to eliminate the impatience and disappointment of the public, the responsible statesmen announce that America is superior to Russia from the military viewpoint. But the fact remains that America has been left behind in the space race, and the commencing of the President's trip in this atmosphere of failure casts a shadow on the American public * * *" (Yeni Sabah, Dec. 2, 1959).

"* * * The Soviets, which advanced speedily in the fields of atomic and hydrogen weapons and guided missiles, have left America behind by launching the first rocket to the moon. It is probable that after these last events, a coordination will be undertaken between the American military research branches."

"* * * By letting the Russians get ahead in the space race, America has created a situation which could weaken her on the political front also" (Cumhuriyet, Sept. 15, 1959).

GREECE

"In spite of the Soviet effort to attribute political importance to the moon rocket, Lunik II is a step toward the conquest of space and an historic scientific accomplishment. However, there still remains much to be done before man reaches the moon. Launching of the U.S. moon satellite is expected by scientists as a far more important accomplishment than the moon rocket" (Ethnikes Kyrix, Sept. 15, 1959).

"The entire world rejoices over the scientific achievements and would be even happier if world antagonism were confined to creating conditions for the further development of man's knowledge. This joy, however, is reduced by the fact that the Soviet achievement was aimed at underlining Soviet supremacy and strength * * * Soviet boastings may serve to awaken the Western peoples and demonstrate once more Soviet political methods" (Kathimerai, Sept. 15, 1959).

INDIA

"The feat no doubt has its political and strategic advantages for the Soviet Union. * * * As far as the layman is concerned, the best hope the Russian conquest of the moon holds out is that the nuclear powers of the world will now realize the virtual limitlessness of man's power and the utter futility of a war in such circumstances" (Free Press Journal, September 1959).

"It is no mere coincidence that the Russians should have launched such a rocket on the eve of Mr. Khrushchev's visit to the United States for doubtless they wish to demonstrate to the world and to America in particular their scientific superiority" (Express).

GHANA

"This is a scientific achievement of the greatest magnitude. Russian scientists * * * have given positive proof of their scientific and technological superiority" (Ghana Times, Sept. 15, 1959).

URUGUAY

"That Soviet science and Soviet effort should have achieved this triumph is, in the opinion of those with a limited vision, a threat to humanity * * *. We will not apply such a limited criteria. Science is universal, developed by men for men * * *" (Accion, Oct. 29, 1959).

COLOMBIA

"Over and above the confusion being created by Russian propaganda on satellites and rockets, one should try to distinguish the issues in order to avoid overlooking the moral and political misery which are hidden behind such undeniable achievements" (El Colombiano, Nov. 4, 1959).

"As far as rockets are concerned, it is unquestionable that the Russians are much ahead of the North Americans, for they have at their disposal all the resources of the Red Government * * *" (El Colombiano, Nov. 30, 1959).

URUGUAY

"It is unquestionable that, for the time being, the Soviets have achieved an advantage over all other countries through successful attempts with space rockets, although these successes were achieved after failures, such as those the United States has recently experienced, without the world knowing about them" (La Manana, Nov. 28, 1959).

BURMA

"It must now be definitely conceded, that the U.S.S.R. has now, even if it is for the time being, positively outstripped the United States in the development of rocket missiles with the last Saturday's successful launching of the Soviet cosmic missile, Lunik II, to the moon. Congratulations had poured into Russia from all quarters and, indeed, she must be deemed well deserved for the outstanding achievement of the age" (The Guardian, Sept. 14, 1959).

THAILAND

"A few days before Khrushchev left for the United States Moscow announced the successful shooting of a rocket to the moon. Though this is a great scientific achievement Khrushchev must be fully aware that he can no longer use such achievements to intimidate the opposite side because it has been seen that the race is rather even and neither side can be said to really have surpassed the other" (Prachatipatai, Sept. 23, 1959).

THE PHILIPPINES

"The comparative pattern of the United States and Russian space probes is beginning to be clear. While the Russians place accent on a further reach—that is, the further the better—the United States appears more intent on exploring and conquering the problems of one stage before proceeding to the next. It should not be hard to predict how the race will wind up" (Herald, Oct. 15, 1959).

CAMBODIA

"The United States is the only country beside the U.S.S.R. that can put up satellites, but undeniably, the United States is now behind. The United States may one day duplicate this Soviet feat, if she is willing to cooperate or compete with the Russian" (Mien Hon, Oct. 6, 1959).

INDONESIA

"The Soviet Union scientists' success in launching the moon rocket represents a great victory in the scientific race in the field of outer space. This brilliant success will strengthen the Eastern bloc's position on the present chessboard of international politics" (Suluh Indonesia, Sept. 17, 1959).

MALAYA

"Lunik is a wonderful scientific achievement. The successful shooting of lunik at the moon has established Russia as the most advanced country in the world of science" (Utusan Melayu, Sept. 15, 1959).

JAPAN

"It is now clear that Moscow is one lesson ahead of America at least in the field of long-range rockets, though of course it may be that America still is in the lead as far as overall military strength is concerned" (Yomiuri, Sept. 14, 1959).

The CHAIRMAN. Thank you very much, Mr. Allen, for your statement. It is certainly a most reasonable, and most interesting statement. It doesn't mince words, but gives us your viewpoint based on information which you no doubt have obtained throughout the world.

How many offices of information, by the way, do you have?

Mr. ALLEN. Throughout the world we have about 160 U.S.I.S. posts, in capitals and in principal cities. Also, in addition, we are very closely associated with other activities, mostly in Latin America, called binational centers. There are a hundred of those—fifty, I believe, in Brazil, alone.

NOTE.—As of January 15, 1960, Brazil has 54 binational centers of which 16 have American grantees, the rest are run by locals.

Those are institutions which we support by supplying usually an English teacher or a director, but they are maintained primarily by the local community of Americans and the people of Rio, or Buenos Aires, Tegucigalpa or wherever it may be.

The CHAIRMAN. You state, on page 7 of your report, this:

However, if this new-found Soviet cockiness—arrogance is not too strong a word—translates itself into adventuresomeness in foreign affairs, the world is in for a good deal of trouble.

Now, isn't that a rather conservative statement of yours?

Mr. ALLEN. It is an understatement, sir, but I think it carries the full implication of the mischief which would result if the Soviet authorities began to feel that their preeminence in space entitled them to throw their weight around in international relations.

The CHAIRMAN. Of course, what you really mean there is that if they throw their weight around as a result of these achievements, it will probably lead to war?

Mr. ALLEN. If it translated itself into actual physical aggression, I can see no other result.

The CHAIRMAN. Then there is a serious danger aside from actually the physical strength vis-a-vis the United States and Russia, there is a serious danger of provoking a war by the feeling internationally held of weakness on our part?

Mr. ALLEN. Yes, but I should make it clear in the record that I do not expect the Soviet authorities to engage in military aggression because of their feeling of superiority in the space field. I don't see any reason to think that that is likely to be the result.

The CHAIRMAN. Well, it has already provoked certain cockiness on the part of Mr. Khrushchev because of his pronouncements already made as to the Russian achievements. That is true, isn't it?

Mr. ALLEN. That is true, sir, although I point to the statement which I have already made, and which I think is perhaps proper for us Americans to keep in mind. I have been reading recently reports on foreign travelers who came to the United States between 1800 and 1850. Almost a universal refrain goes through their comments about the United States.

We seemed to think we were destined for the greatest possible future. "Horizons unlimited" was our point of view. We were cockey.

The Soviet people are still in a revolutionary frame of mind. It is lessening somewhat, but with their achievements in space, they naturally feel very pleased with themselves.

I don't think we should reach the conclusion that they are going to undertake military aggression to achieve domination in the world, although we would be foolish if we didn't do everything we could to prevent any such actions from succeeding, if by any chance it became their policy.

The CHAIRMAN. I may differ with you just a little bit in feeling that the Soviets ought to be pleased with themselves. I think the reverse. Perhaps in the accomplishments in the space age, they should be pleased, but not completely. I don't think they should be pleased a bit.

Mr. ALLEN. I agree, overall.

The CHAIRMAN. Where is the Soviet achievement greatest throughout the world, generally? Is it greatest among the educated people or is it greatest among the illiterate people?

Mr. ALLEN. I don't have any figures on that, except as you might judge by countries. I don't believe you can find a very consistent pattern insofar as educational standards or economic development are concerned.

However, here is a question asked by various polling organizations, some of them Gallup affiliates between June 1958 and March 1959. The question is this:

All things considered, do you think the United States or Russia is ahead in total military strength at the present time? Considerably ahead, or only a little?

These have been totaled to show the net favorable attitude that the United States is ahead and the net favorable attitude that the Soviet Union is ahead.

In March 1959, a survey conducted among college students in Vietnam was very favorable to the United States. Thirty-two percent more were favorable toward the United States than toward the Soviet Union, as regards their opinion as to who was ahead in military strength.

In Greece, a survey among the general population gave the United States a 20-percent advantage.

In Italy, the general population gave the United States a net advantage of 15 percent.

That means counting the ones who thought the United States was far ahead or who thought we were slightly ahead, as against the total of those who thought Russia was slightly ahead or way ahead. We do not count those who had no opinion.

In Okinawa, 14 percent. In Uruguay, 4 percent. In West Germany, 1 percent. In Japan, we were minus 1 percent. In Turkey, minus 2 percent. In France, minus 10 percent. And in Great Britain, minus 15 percent.

Of those countries I mentioned, the net favorable impression about the U.S. superiority in total overall military strength was 5.8 percent.

The CHAIRMAN. That is on the plus side?

Mr. ALLEN. Yes, sir.

The CHAIRMAN. Now, does the interest in space extend to areas, we would say, that are remote from civilization? For instance, the areas in the darkest parts of Africa?

Mr. ALLEN. That was something which rather surprised us. We found that knowledge of the fact that the Russians had put up the first sputnik spread with amazing rapidity to most remote areas. It was such a spectacular piece of news that it spread very rapidly.

I don't believe interest in Nepal or Laos or places of that kind is nearly as intense as in countries which are more advanced in scientific matters, but the news of space developments is astonishingly widespread.

The CHAIRMAN. I know you quote Ghana here, and I would assume, therefore, that even in Africa and the jungles of Brazil, there is knowledge of what is being done. Is that correct?

Mr. ALLEN. That is correct.

The CHAIRMAN. Mr. Chenoweth.

Mr. CHENOWETH. Mr. Allen, what sort of story are we putting out in our Information Service? Are we doing anything that might in any way imply that we are a second rate nation or that we are behind Russia in any sense? Just what type of approach are we making to this problem?

Mr. ALLEN. We are highlighting, of course, every success the United States has in space or in general scientific developments, and we have had some rather remarkable ones. We seek to remind the world, for example, every time we get a chance that seven out of the eight earth satellites at the present moment spinning around the earth, are American.

People tend to overlook that when they hear about the Soviets' photographing or hitting the moon.

Mr. CHENOWETH. How much time do you spend impressing that point upon them?

Mr. ALLEN. Every time the occasion arises, we repeat it. One of the most spectacular recent advances in science was the trip of the submarine *Nautilus* under the icecap of the North Pole.

Fortunately, we had excellent pictures of that. The commander of the ship brought them out under his arm. You may recall that he flew back here and was decorated by the President. We developed those pictures and made a film within 2 days. Within 4 days we shipped 150 copies of the film around the world. It showed the submarine going down under the icecap, off Alaska.

Shots were taken through the periscope of the bottom of the ice, looking back as the sub came out, and so forth. It made a spectacular picture. We put it in newsreels in theaters all over the world.

Whenever we have something to talk about, you can be sure we play it to the utmost.

Mr. CHENOWETH. Is it a fact that the Russians are better at propaganda than we are?

Mr. ALLEN. Well, they have certain advantages in propaganda which we have to admit and have to face up to. Any totalitarian regime can control not only the news output of the country in its press and radio, but also the statements of its public figures.

I have some interesting excerpts from Soviet propaganda on space here in my hand, selected from Soviet radio programs. The Russians don't even have to write their script to show the world how far they are ahead in space. They just copy editorials from American newspapers, or articles by American columnists, or statements in the Congress of the United States. The Russians say, "This isn't what we are telling you people around the world. This is what the Americans, themselves, are saying."

Mr. CHENOWETH. You don't put anything like that out over our service?

Mr. ALLEN. No; not like that.

Mr. CHENOWETH. We hope you are not.

Mr. ALLEN. At the same time, we report the fact, for example, that this committee is looking into the space situation. It is legitimate news which we have to publish, and I think we should. We have got to develop credibility if we want people to listen to the Voice of America or to look at what we are putting out. If they think that we are putting out a one-sided story and not giving a balanced picture of the situation in the United States, they are going to pay no attention to our material.

Mr. CHENOWETH. Your statement, Mr. Allen, seems to carry the implication with it that it is generally recognized in these countries that we are far behind the Russians in this space race and that it will take several years to catch up and, therefore, we have suffered a tremendous loss of prestige. Is that the actual situation in these countries as you find it?

Mr. ALLEN. That is as honest a statement as I can make, sir.

Mr. CHENOWETH. We had Mr. Merchant, the Under Secretary of State, before us a few days ago and he said:

> Our own achievements negate any contention that scientific and technical leadership on any broad front is passed in the Soviet Union.

There is apparently some difference of opinion.

Mr. ALLEN. I want to emphasize, Mr. Chenoweth, that I am describing public opinion in foreign countries to the best of the information of my Agency. That doesn't mean that foreign countries may not be mistaken. They may be. But the impression in foreign countries is that the Soviets have taken a very great lead. And I must say that they have gained that impression largely from statements made in the United States.

Mr. CHENOWETH. Which I think are most unfortunate. I think the time is here when we are going to have to think pretty realistically on this whole situation. I personally am getting sort of fed up with hearing prominent men going up and down the country saying that we are a second-rate nation and are now subject to the will of the Russians, that we are at their mercy.

I just don't subscribe to that theory and I haven't heard or seen anything before our committee which would lend any credence to any such proposition, at all, from the military standpoint or any other standpoint.

In certain phases of the space program perhaps the Russians are a little ahead of us. I don't think that is of any great significance. They probably have a little greater thrust and they can shoot an intercontinental ballistic missile a few miles further than we can—I am not even sure they can do that.

I am just wondering whether we are putting our best foot forward, Mr. Allen, in your proposal of telling the world just what we are doing.

Mr. ALLEN. I think, Mr. Chenoweth, we are making a very good presentation of American scientific development.

I was asked by this committee to report as honestly as I could what the foreign attitude is and I have done it. I myself think foreign people have generally exaggerated the Soviet lead. That is why the USIA continues to remind people overseas of the very significant successes we have had. I repeat that seven out of the eight earth satellites at the present moment are American, but this is recalled by a lot of people abroad.

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Mr. CHENOWETH. Then you must confess to this committee, that up to this time your efforts have failed to make this impression abroad?

Mr. ALLEN. Yes; they have failed.

Mr. CHENOWETH. What can you do to correct that situation?

Mr. ALLEN. This is another instance in which a government information agency is expected to do things that it cannot do.

Foreign people get their major impression about the United States, not from what the USIA says, but from what they read in their own newspapers, from their own correspondents in the United States who are reporting the U.S. scene as they see fit, or from statements by their own spokesmen or by their own people who have visited the United States, or from quotations from American public figures.

The U.S. Information Agency is trying to do everything it possibly can to supply information to foreign news agencies and newspapers and radio stations and television stations of what is going on in the United States.

But the major impression foreigners get about the United States is not going to be from what the U.S. Information Agency hands out. That doesn't mean to say that we are not worthwhile. Far from it. The need for our activity increases, in my honest opinion, constantly. But we ought not to delude ourselves into thinking that we can change the attitude of the world by our handouts.

Mr. CHENOWETH. Let me ask you another question: Who prepares these programs that deal with our space effort and our entire missile and satellite program?

Mr. ALLEN. We use various media of information—all the mass media we can lay hands on. Perhaps the best known is the radio, the Voice of America.

Mr. CHENOWETH. Don't you have any technical people or scientists down there who could prepare some of these programs and give you the specific details?

Mr. ALLEN. I have my science adviser for radio, press, motion pictures, exhibits, television, and so forth, Mr. Harold Goodwin, here with me. We put out information in all of these fields.

I have brought with me a packet of books we have put out in cooperation with the National Science Foundation. It contains American scientific books that we send abroad. This little shelf of books contains two on the specific subject of space, "The World in Space," and "Satellite Rockets in Outer Space." Those are types of books we have in our reading rooms and libraries dealing with the subject of science.

Mr. CHENOWETH. May I inquire if you have any staff who are peculiarly trained and equipped to prepare programs dealing with space?

Mr. ALLEN. We work with the National Science Foundation and the National Aeronautics and Space Administration and other people who have scientific staffs, but Mr. Goodwin will tell you about the specific experts we have to prepare this material.

STATEMENT OF HAROLD L. GOODWIN, SCIENCE ADVISER, U.S. INFORMATION AGENCY

Mr. GOODWIN. Mr. Chenoweth, in each of our media we have people who are competent in the field of science. They are roughly the same kind of people that the news services and wire services have in reporting science. However, our principal source is outside of the agency. We have a contract with the National Academy of Science, for example, whereby we can call on the Academy for any expertise the American citizen can ask on a given question.

We have very close relationships with all the scientific agencies of Government. In the field of space, our primary resources are the space agency, the Department of Defense—as the Department of Defense military space activities become newsworthy—and in addition, the Space Science Board of the National Academy of Sciences.

So instead of attempting to originate all of this material with our limited staff, we go to the experts who know most about it.

Mr. CHENOWETH. Wouldn't it pay you to employ someone on your own staff to devote more time and attention to this program?

Mr. GOODWIN. Well, sir, if we did not have all of the sources we have outside of the Agency, this would be properly indicated, but we have had no difficulty at all in getting a good volume——

Mr. CHENOWETH. Who coordinates all this information that you get?

Mr. GOODWIN. It is coordinated by science officers in the various media services.

Mr. CHENOWETH. You have no one assigned exclusively to space, then?

Mr. GOODWIN. Yes, sir; we have. We have one man who is full time at the space agency, whose function is to channel into the Agency all materials that come from the space agency and from the scientific community.

Mr. CHENOWETH. Then he actually prepares the program?

Mr. GOODWIN. No; the programs are prepared by the various media. For example, the Voice of America program might be prepared by Mr. Joseph Lubin who is an extremely competent science editor in the Voice.

Mr. CHENOWETH. Some years ago I was chairman of a subcommittee that investigated some of the programs, and we were amazed at the type of material going out over the Voice of America at that time. I hope it has improved since then.

Mr. ALLEN. Let me recall, Mr. Chenoweth, that I sat before you at that time. I was in charge of it 10 years ago, when this investigation came up.

Mr. CHENOWETH. I think you have improved it, Mr. Allen, honestly. I haven't heard any complaint lately, but you will remember what we were really up against.

The CHAIRMAN. Mr. Sisk.

Mr. SISK. Mr. Allen, I would like to inquire as to some specifics, if you wish to make any comment on them. We have right on our doorsteps some rather peculiar reactions. I am curious as to whether you have any comment on this impact of the so-called feeling of cockiness, and that it is now good sport to pull Uncle Sam's whiskers, so to speak.

I am referring to certain things occurring down in Cuba, and also I think within the past few days, a reported incident where Mr. Trujillo has apparently done an about-face and now thinks Mr. Fidel Castro is possibly a great world hero.

Would you comment on whether or not you feel that this cockiness and, to some extent, this loss of world prestige by the United States may have caused some of this. Or to what extent it has a bearing?

Mr. ALLEN. That is a very natural question, Mr. Sisk.

However, my answer is no, and I will tell you why. For a hundred years, Britannia ruled the waves. During those hundred years, local politicians in various countries got the greatest pleasure in twisting the British lion's tail. The more outstanding a nation like the United States, or the Soviet Union, or Great Britain is, the more kudos a local politician will get by saying, "See what a brave man I am. I have shaken my fist at the great United States." Perhaps the Soviet Union will begin to come in for it soon. I don't think the fact that people in Panama, or Cuba, or various places are "plucking the eagle's feathers" means a lack of prestige for the United States.

I think it would tend to indicate the contrary.

Mr. SISK. You mentioned in the poll which you discussed a little while ago about the results, I believe, from Uruguay, which led me to feel possibly that the old idea that a man is not without honor, say in his own country, or in his own neighborhood, might have some bearing.

Uruguay, I believe, had a minus. It had some 4 percent minus, in spite of the fact that in some of the southern Asian countries they indicated we were substantially ahead, or substantially more powerful than Russia.

I was curious to know as to what extent in Latin America and in these areas, specifically within our own ball park, so to speak, there is a feeling of concern about our position.

Mr. ALLEN. As it happens, Uruguay was 4 percent plus, but you are still correct in that Uruguay was much lower than Vietnam, or Greece.

Mr. SISK. I am sorry. I thought you said 4 percent minus, but it was still some 4 percent plus in Uruguay.

Mr. ALLEN. Yes.

There doesn't seem to be any particular pattern. Uruguay is the only country in Latin America in this tabulation, but I don't see how you can make a great deal out of it because in countries like Italy, for example, they are 15 percent plus, and Great Britain is 15 percent minus.

France is 10 percent minus. Those are countries right next to each other. I think it has a lot to do perhaps with political relations at the moment, or the evidence of American military strength they happen to see.

Now, my guess would be that the reason Vietnam is so high is that there is a good deal of evidence of American military activity in the Far East, and there is a military advisory group in Vietnam, itself.

Mr. SISK. You have more or less answered the next question I have in mind: Do you see any particular significance with reference to areas of the world, then, in this matter?

Do you find that in, let's say, southeastern Asia, our prestige may be somewhat higher, than it is in Western Europe, or than it is in Africa, or that Africa is higher than it is in South America?

You apparently do not find this in areas.

Mr. ALLEN. No, because two countries in the Far East, for example—Vietnam and Cambodia, right next door to each other—might supply a very different result. It depends somewhat on the political orientation of the country. Wishful thinking always goes into these matters.

Mr. SISK. I believe you did read the specific questions that were asked.

Now, did these questions have to do with the standing of the United States, vis-a-vis Russia in space or in overall strength?

Mr. ALLEN. This was total military strength.

Mr. SISK. That is what would be of some concern to me because I think certainly we have never made any admission—at least that I know of—and I think it would be most unfortunate if anyone had to admit that Russia was stronger than we are in overall military strength.

That is the thing that troubles me a bit. I don't think there is any question our people will admit that in the specific field of thrust, in the space program, Russia is somewhat ahead of us. I think we all have to admit that. But in the overall military, I am somewhat curious as to whose propaganda they are buying because I do not think that out of the United States is coming propaganda that would indicate we admit inferiority in overall military strength.

Mr. ALLEN. Not at all.

Mr. SISK. Are the Russians quoting statements of the United States that would indicate that fact?

Mr. ALLEN. No. The unfortunate part is that Soviet achievements in space get translated in people's minds into an overall superiority in other scientific and technological fields—and in the military field.

I personally think they are wrong—that is, the opinion of peoples around the world as regards relative military strength, but my responsibility is to try to report as accurately as I can, what the people do think.

Mr. SISK. I appreciate that, Mr. Allen, and I think you have done a very fine job. I am sorry I wasn't here to hear your statement, but I have briefly read it here, and none of these questions are inclined to be critical. I am just concerned that in some way we have not been able to differentiate in the minds of the people—and maybe it is impossible to do—the progress in so-called peaceful exploration of outer space. That is all we have ever talked about, peaceful exploration of outer space, and, generally, I think even the Russian, so far as outer space is concerned, refers to it as being peaceful. But, then, because they seem to be somewhat more advanced—and I think because they started earlier in this particular field—then they are ahead in everything.

I am not blaming you for not being able to unsell them on that idea, Mr. Allen, but to me that is of some concern and that is why I was glad to have your statement.

Mr. ALLEN. I would like to say, Mr. Sisk, at this point that while I think the opinions of people in other countries are important and that we ought to try as best we can to keep our finger on the pulse of public opinion in other countries, nevertheless we have seen through experience that public opinion changes rather rapidly. Therefore, I would not exaggerate the importance of opinion at any particular moment.

Moreover even if an overwhelming majority of people say they think the Soviet Union has more overall military strength than the United States, that doesn't necessarily mean that they think the Soviet Union would come out on top in a war. If you had taken a poll in 1939 of opinion in the United States as between the military strength of Germany and Great Britain, the vast majority of people would have said that the Germans had much more military strength than Great Britain, but if you had asked another question, who do you think would win in a war, there might have been quite a different answer.

I think all these figures ought to be considered in their proper perspective.

Mr. SISK. I think your statement has been very good, Mr. Allen, and, of course, I would hope that we in this committee and in the Congress might be able to do everything possible to strengthen our hand in attempting to present the true picture to the world.

I think no one in this country concedes that Russia is ahead of us in overall strength. I think it is unfortunate that they have taken these few rather extraordinary accomplishments of Russia and have thus been able to calculate that Russia is way ahead. To me, this is an unfortunate thing. I would hope that your agency would proceed to do everything that you can, of course, to do away with this type of feeling. I assume that that is your prime objective, is it not?

Mr. ALLEN. That is correct, sir.

Mr. SISK. That is all, Mr. Chairman.

The CHAIRMAN. Mr. Van Pelt.

Mr. VAN PELT. Mr. Allen, would you explain this plus and minus in public opinion polls, please?

Mr. ALLEN. Yes, sir.

The questions asked are usually of this type:

All things considered, do you think the United States or Russia is ahead in total military strength at the present time. Considerably ahead, or only a little?

Now here is a statistic from Great Britain, for example: In November 1957, 4 percent thought that the United States was considerably ahead of Russia. Fifteen percent thought that the United States was a little bit ahead. Thirty-one percent thought that Russia was a little bit ahead, and 19 percent thought that Russia was considerably ahead. Six percent thought they were equal and 25 percent had no opinion.

In order to strike a balance, we take the figures of 4 percent who thought the United States was way ahead and 15 percent who thought we were slightly ahead to make a total of 19 percent who gave us the edge. But then 31 percent thought Russia was slightly ahead and 19 percent way ahead. So that made a total of 50 percent who gave Russia the edge.

You strike off the ones who thought we were equal and who had no opinion, and subtract the ones who gave us the edge from the ones who gave the Russians the edge and we get a balance of minus 31 against the United States and in favor of Russia.

Now, that was November 1957, or 1 month after they launched their first sputnik. This is a dramatic illustration of the impact of their getting up the first earth satellite. The next month, the British gave the Russians a 31 percent overall military advantage.

Exactly 11 months later, after we had put up several, the Russian advantage had dropped to minus 15 percent in Great Britain.

In West Germany, however, the Americans were ahead of Russia by a net of 15 in November 1957, just after sputnik. Maybe it took the Germans a little bit longer to form an opinion. Eleven months later, we had dropped to practically even. How to explain that is difficult.

Mr. Van Pelt. That is all, Mr. Chairman.

The Chairman. Mr. Karth.

Mr. Karth. On page 5 you speak of revised public opinion toward Russia. I think you have explained some of my questions but generally that might not be true. Is this revised public opinion toward Russia's overall capabilities becoming greater by the day, less, or is it remaining about the same since Sputnik I?

Mr. Allen. It has waxed and waned, but at the present moment my impression is that it is waxing, as a result of the moonshots.

When they first put up an earth satellite, we began to talk very excitedly about it, and pressures built up for us to get up one ourselves. Finally, when we tried and didn't succeed, Russian prestige, went way up. It was a sort of shock effect. Then gradually, as we began to put them up, people began to recover and say, "Well, the United States, of course, is going to catch up once it puts its mind to it." There was a much more balanced attitude, and people would say, "This thing is going to seesaw one way or another."

At the present moment the Russians have had the last word. They are the ones who hit the moon and photographed its back side, and the pendulum is swinging in their direction. My guess is that the only way we can recover is to make a spectacular success.

Mr. Karth. Have any foreign countries changed their attitude in the sense that they are less chummy today, as a result of some of these spectacular Soviet achievements than they were prior to them?

Mr. Allen. Less chummy with us?

Mr. Karth. Yes, sir.

Mr. Allen. I don't think so.

Mr. Karth. You say you don't think so. There is some evidence of it, though?

Mr. Allen. Well, their attitude toward the United States in general—whether they would like to be friendly or allied with us—depends on a lot more things than just space technology. It depends on whether the United States follows a policy that they feel is in their national interests, in the United Nations, or in helping less-developed countries develop themselves, and so forth. Those things determine whether a country feels close to the United States and supports the American position internationally.

Mr. Karth. These spectacular space achievements of the Russians have had no significant effect that you can see at all?

Mr. Allen. I don't think so.

I used the illustration of 1939. If you had taken a poll in the United States, I think a large majority of people would have said that Germany had the superior military might over Great Britain, but that wouldn't mean that the Americans were going to side with Germany.

Mr. Karth. I understand, sir.

You say that Russia gets a great deal of their propaganda—and I am one of those who feel that propaganda is just as devastating as a missile on various occasions—they get a great deal of their propaganda from newspaper stories here at home and speeches, et cetera.

Would you advocate more secrecy, less secrecy, or about the same kind of public dissemination of opinion as we now have?

Mr. ALLEN. I would not advocate more legislation or regulations concerning secrecy. I would plead for a more adult attitude on the part of both executive and legislative officials in pronouncements regarding space and in statements about what we are going to achieve. If we could take a somewhat more calm attitude on the subject, we would present a better image abroad. For a time, we bordered almost on hysteria on the subject of space and rockets.

Mr. KARTH. As long as the truth is known and is available to the public, you have no objection to its dissemination?

Mr. ALLEN. That is correct.

Mr. KARTH. What do you think the Congress can do to give you greater assistance in the job that you are attempting to do, sir—and I think it is might fine. What do you think Congress can do at this session to help you do a better job, even, than the job you have done?

Mr. ALLEN. I have mentioned that one of the most interested observers of what goes on before this very committee will be the Soviet Union. If I were called before this committee again next month, I would probably bring another group of statements from Radio Moscow quoting what has been said here today, as well as statements on the floor of Congress or in political meetings that will take place.

The CHAIRMAN. Will the gentleman yield?

Mr. KARTH. Yes, sir.

The CHAIRMAN. Do you have any statements there now, regarding this committee?

Mr. ALLEN. Well, yes; I have a statement from Tass, the Soviet news agency, of yesterday. Tass is, of course the press agency of the Soviet Government. This was in their file to all the papers that they can service in Europe, in English, from their Washington correspondent, Mr. G. Shishkin. This report is as follows:

> The House of Representatives Outer Space Committee began hearings yesterday on America's lag behind the Soviet Union in space exploration. First to address this committee was the Deputy Under Secretary of State for Political Affairs, L. Merchant. He said that the Soviet Union had acquired terrific prestige by reaching out into space first. The remarkable nature of the Soviet achievements, he said, has undoubtedly relegated everything done by the United States to the background. The Deputy Under Secretary pointed out at the same time that despite the Soviet achievements, the United States could take the lead in space explorations.
>
> Committee Chairman Brooks did not share Merchant's optimism. He stressed that the scale and pace of American space explorations do not justify the hopes. Showered with embarrassing questions by the chairman of the committee—

[Laughter.]

Mr. KARTH. I am sorry I started this, Mr. Chairman. I apologize.

Mr. ALLEN (reading):

> Merchant was compelled to say that the U.S. Government recognizes Soviet superiority in space exploration and particularly in creating powerful rockets needed for space flight. Merchant made it clear that it is not easy to overcome this superiority, although success in this field is of great importance to U.S. foreign policy.

In the course of hearings which are expected to continue for about 6 weeks, the committee will hear testimony by military and civilian representatives of the U.S. Government, as well as scientists and industrialists.

The CHAIRMAN. Of course, he won't send anything over there in favor of the United States, to show our strength and our position, will he?

Mr. ALLEN. No, no. We can't expect that.

The CHAIRMAN. Thank you for yielding. I think it does give us a lesson in caution.

Mr. KARTH. Mr. Allen, do you think they will use any of your statement tomorrow in their Tass news release?

Mr. ALLEN. I expect they will. And you may be sure that I had that very much in mind when I drew it up.

Mr. KARTH. Yes, sir; I am sure you did.

Mr. ALLEN. At the same time, under our system, I think a representative of the executive branch of the Government when testifying before a committee of Congress must give as honest and straightforward a reply as he possibly can and let the chips fall where they may.

But when you say what can we do——

Mr. KARTH. I meant legislatively, sir. Would more money make your job more effective?

Mr. ALLEN. I am not of the type who thinks all you have to do is to spread a lot more propaganda on these situations to take care of them.

I think, under the democratic process, in open session of this kind, that intelligent human beings and men of good will, by throwing all the cards out on the table, can reach reasonable and sound decisions. That is why I think hearings of this kind are useful, in spite of the fact that I know my Soviet opposite number is going to take advantage of everything said here.

I certainly wouldn't propose that we clam up, or change our democratic system. I do think, though, as the chairman has just said, that we should feel a heavy sense of responsibility for what is said in public meetings.

Mr. KARTH. That is all, Mr. Chairman.

The CHAIRMAN. Mr. Bass.

Mr. BASS. Well, then, Mr. Allen, pursuing this particular line further, I gather you feel that any statement by congressional leaders to the effect that the United States is behind Russia in the military field or in the space field can be used as a very effective propaganda weapon against us, with the rest of the world.

Mr. ALLEN. Not only can be but will be. That doesn't mean to say, Congressman, that we ought not to have full debate on all matters pertaining to the Government's business, but I think Tass reports of this kind, if brought prominently to the attention of members of Government, will make us all feel a heavier responsibility than what we have felt up to the present.

Mr. KARTH. Would the gentleman yield at that point?

Mr. BASS. Yes.

Mr. KARTH. Mr. Allen, some time ago one political party was calling the other political party a warmonger party, if I may use those words, and I use them advisedly.

Would you say this was quite detrimental to our foreign relations?

Mr. ALLEN. I would say that statements of that kind will certainly be used by the Soviet propaganda apparatus for every possible propaganda advantage they think they can get out of it.

Mr. BASS. No further questions.

The CHAIRMAN. Mr. Hechler.

Mr. HECHLER. Mr. Allen, I think you are on the right track. I like the way that you described the American openness in letting the world in on our failures as well as our successes.

Even though both of us deplore some of the fanfare which preceded Vanguard in 1957, I wonder if in the long run this strategy of truth won't really pay great dividends for our country.

Mr. ALLEN. I think it will but I want to be careful, Congressman—trying again to be as honest as I possibly can—to differentiate between straight factual reporting and a dramatic buildup of expectations through the manner in which it is presented, either by Government officials or by radio commentators, or by press columnists. I would plead for a truthful but dignified presentation.

Mr. HECHLER. I am in wholehearted agreement with that. I have always felt that the best public information program is one that involves some mild humility, perhaps tinged with a little pessimism now and then, coupled with concrete results. I guess you are sort of like a river. You can't rise above your source, and you have to have results in order to talk about them.

Shifting to another question, what information have you secured about the image of this country abroad in our emphasis on the production of consumer goods, luxury and our emphasis upon the frills, such as larger tail fins, rather than our desire to build the foundation of national strength, through a stronger space program, national defense, and the use of our national strength in the protection of the ideals we believe in?

Have you observed any foreign reaction to this?

Mr. ALLEN. Yes, and you have opened up a very interesting question that we have to wrestle with, constantly.

For example, perhaps the most spectacular single thing my agency was concerned with during the past year was the national exhibition that we held in Moscow last summer. Upward of 3 million Russians came to see their first glimpse of the American way of life. We had to decide what kind of Amercian way of life to present. Should we emphasize the high standard of living in the United States, the number of automobiles, bathtubs, washing machines and so forth? One of the most significant debates throughout the world, in India, in South America, and everywhere else today is how to elevate the standard of living of the masses of the people. There is great argument as to whether the Communist system is the best and quickest way to do it—whether Karl Marx is right when he says that under the capitalist system, the monopolists get more and more control of the production of wealth into their hands and the rich get richer and the poor get poorer until finally the whole thing collapses.

Now, we know that is nonsense. The capitalist system as developed in the United States has produced a very high standard of living for all of the people.

Now, are we just going to hide that under a bushel and not talk about it?

So we concluded that we had to show that the American economic system was not what Karl Marx predicted.

However, when you do too much of that, people say you are bragging about your bathtubs, washing machines, and so forth.

Mr. HECHLER. I am wondering what really attracts and inspires foreign nations. I wonder whether it is materialism. Isn't it true more people have been attracted to this Nation by its ideals? Is it not true that the best foreign information program is the Declaration of Independence and the demonstration that we are willing to produce the kind of hardware that will defend it?

Mr. ALLEN. Yes. I think that our Declaration of Independence, and our concepts of human freedom and human liberty, are the best things we have to talk about in our propaganda. I often say to my staff that the best propaganda document ever turned out in the United States was our first document: The Declaration of Independence.

However, a part of our philosophy is our belief in spreading the attributes of modern economy widely among the people.

So, in addition to allowing a man to go to the church he wants to and to say what he wants to and write what he wants to, a part of the American way of life is to let a man get his fair share of the products of the industry to which he contributes. We would only be presenting one side of it if we only told about the democratic freedoms of speech and——

Mr. HECHLER. I would just like to suggest that many of the struggling masses of the world are more interested in how well we live up to the ideals of the Declaration of Independence in this country. They are more interested in that than they are in the materialistic side of our economy and how well our goods are distributed. I think you have touched on something there that is very important.

Mr. ALLEN. I have to agree, from my experience in a good many parts of the world, that say the peoples of the colored races of the world are perhaps more interested in the racial situation in the United States than they are in the economic.

Mr. HECHLER. I want to relate this to the hearing before this committee. This is the Science and Astronautics Committee. What we accomplished in the space program indicates the depth of our belief in these ideals, and the success of the American system.

The CHAIRMAN. Mr. Riehlman.

Mr. RIEHLMAN. Mr. Allen, I am sorry I wasn't here to hear some of the questions that were asked you but I am vitally interested in knowing what your agency is doing to counteract some of this propaganda today in relation to our own position in this space age.

Mr. ALLEN. We have a very active program, Mr. Riehlman, in the whole field of science. Not only space, but in other fields of science as well. Our principal emphasis is on what the United States is doing in the scientific and technological field which is of benefit to humanity, including, of course, the great field of medicine. The United States has made far more contribution than all other countries combined in history to the eradication of malaria, for example. We have done so much more than everybody else combined; that is a story we can continue to tell, and we do, although we have to be careful not to give the impression, by emphasizing other aspects of science and space, that we are trying to get people's attention off of the space question. We also are emphasizing, as I said here earlier, that in the very field of space itself, while the Soviet Government has achieved some very spectacular things, nevertheless we are by no means out of the picture and that seven of the present eight earth satellites spinning around the earth are American. Only one Russian sputnik is now spinning around the earth.

Mr. RIEHLMAN. What is your observation of the effect of this type of information on the minds of people around the world?

Mr. ALLEN. I have one illustration here. Recently, we put out a series of four 15-minute television programs on space activities. One of them was built around the X-15 airplane that is being prepared to shoot to the edges of outer space.

I have a report here from newspapers in Stockholm, in Brussels, in Seoul, in Manila, in Buenos Aires, Rome, Oslo, Lisbon, Tripoli, and London, where the BBC had a very long program, using primarily our films. All the reviews were very favorable to our space effort. That is just one example.

We are doing things in all our information media. We have packets of this type [indicating] that we send out to all of our posts abroad, with items on all sorts of scientific development. This is a bookshelf of scientific books that we send to all of our own overseas libraries and present to school libraries in various countries. Two of those books are on the subject of space.

I might take a second to tell the committee about our libraries. We have about 150 U.S. information libraries abroad. Nobody has developed the public library the way the United States has. We do everything we possibly can to bring people and books together. The European concept of a library grows out of the Middle Ages. It is some place way back in the back of a monastery, or a university, that is musty, and the librarian is standing there almost with a bayonet to keep people from getting at his books. He still thinks of them as rare manuscripts that somebody might steal, get dirty or tear.

We put our libraries in as conspicuous a place as we can find, in the heart of town or near the university, where as many people as possible go by. We make it as easy as possible for them to step in off the sidewalk. And we advertise, which is shocking to some of our European scholastic brethren. We have a show window. And if some subject at the moment is particularly interesting to the public, like space, we will put the latest attractive book jackets in the window, so that the people can see. We try our best to bring people and books together. That is an American concept that no other country has developed nearly as much as we have.

We have a little reading room for children, with low desks and tables and books on shelves. We have all our books right out in the open.

People go and take them off the shelf and look at them there, or sign a card and take them home.

In the field of science, we are being particularly active now because of the great interest in it.

Mr. RIEHLMAN. On page 6 of your statement, Mr. Allen, you say—

It is hardly an overstatement to say that space has become for many people a primary symbol of world leadership in all areas of science and technology. Some scientists and engineering students are being attracted to the Soviet Union for this reason.

Now, what information do you have as to the number of students that are being attracted to the Soviet Union?

Mr. ALLEN. I have no specific figures. We merely have had two or three reports. I think one of them was from Calcutta, saying that a few students who had been trying to decide where to go to study scientific developments had gone to the Soviet Union rather than to the United States.

I wouldn't want to give the impression from what I have said that this has become a sudden trend, but there is enough indication to show that Soviet successes in space have attracted some students.

Mr. RIEHLMAN. And you are referring entirely to foreign students? You don't know of any American students who have been attracted to Russia?

Mr. ALLEN. No, no, not at all.

Mr. RIEHLMAN. That is all, Mr. Chairman.

The CHAIRMAN. Mr. Daddario.

Mr. DADDARIO. You have a most difficult responsibility, Mr. Allen, and I wonder if you could tell us how more complicated it becomes as other countries in Europe and throughout the world become more preoccupied with their own endeavors, with their own economic problems. And as these economic problems become settled, as they preoccupy themselves with the European Common Market and with the so-called outer seven, from an economic standpoint and they have market responsibility, they see their way clear to accomplish some of their end objectives. Isn't there a tendency there for them to isolate themselves away from us and to focus this whole world problem into a race between the Russians and ourselves?

Mr. ALLEN. There is some tendency of that type, Congressman. The first thought that ran through my mind, when you began to speak, was to comment that I hadn't seen any particular change because everybody is always more interested in his own situation than he is in any other. Consequently, it is nothing new if the people of the Common Market area are primarily interested in their own problems. But, as you explained your point of view, I think I understand what you have in mind. I concur that if the European countries, through the Common Market, are able to stand on their own feet and become more independent, economically, and therefore less dependent on the United States, there might be some little tendency for them to withdraw and say, "This space race is between the United States and the Soviet Union, and doesn't concern us very closely."

I don't believe that that is a great likelihood, but there is some possibility in that direction.

Mr. DADDARIO. Well, when you quoted figures of minus 15 for England, minus 10 for France, minus 1 for Germany, and then you later on clarified that by saying that it had certain political overtones, isn't there in this somewhere a relationship, showing the direction toward which the leadership in these countries wish to head themselves? And that is away from any strong conflict which might occur between ourselves and the Russians?

Mr. ALLEN. I don't know. There might be, but I remind you again that the question asked was, "Who do you think has the overall military superiority, the Soviet Union or the United States?" I don't think you can judge that if a great majority of the people in Great

Britain say the Soviet Union has more divisions or more total overall military equipment, that that means the people of Great Britain are going to necessarily go over and side with the Soviet Union. I used the illustration that if you had taken a Gallup poll in the United States in 1939, a great many people would have said Germany had military superiority over Great Britain, but that didn't mean Americans would side with Hitler.

Mr. DADDARIO. I don't know that that is necessarily a proper analogy. We have airbases in England, we have military personnel in West Germany, and we have military personnel in connection with France. The thing that strikes me is, not where do we stand: West Germany, France, and England, together with the United States in overall potential military strength, as against the Russians, but where does the United States alone, separate and apart, stand with the Russians?

Mr. ALLEN. That is right. The question was: "Do you think the United States or Russia is ahead in total military strength at the present time?"

I have another question here that was asked which wasn't on total strength but: "Do you think the Western Powers are stronger in atomic weapons than the U.S.S.R., weaker, or about equal?"

The question includes all the Western Powers, but narrows it to atomic weapons.

On that question—atomic weapons—in June 1955, in Great Britain 34 percent more thought the Western Powers were ahead than thought that the Soviet Union was ahead.

In November 1957, the net advantage for the Western Powers had dropped from 34 to 5 percent.

In West Germany the figures are 33 percent more thought we were ahead in June of 1955 and that had dropped to 21 percent in November 1957.

In France, in June 1955, 14 percent more thought we were ahead than thought the Russians ahead in atomic weapons. In November 1957—that is just after sputnik—the percentage was minus 6 percent. A majority of Frenchmen thought the Soviets were ahead in atomic weapons.

In Italy, the percentage dropped from 23 percent in 1955 down to 16 after Sputnik I.

All these decreases took place just after Sputnik I. It shows that although sputnik had nothing to do with atomic weapons at all, yet there was a sharp change of public opinion on this subject as well.

Mr. DADDARIO. It strikes me, Mr. Allen, and I would like your opinion on this, one of the main objects of the Russians certainly is to isolate this conflict so that it is a conflict between the United States and Russia, with the other countries left off by themselves. Everything I hear here today seems to focus the conflict in that direction and it then gets us to the point. Isn't there a possibility that if we keep going along on this road and if the feeling about Russian superiority as reflected in these figures in England, France, and West Germany, keeps manifesting itself, that we can look toward the day when Europe would desire to be isolated from the conflict? If they could then be convinced by the Russians that they would not be subject to attack, this whole world conflict could be isolated into Asia, away from Europe, and could be consolidated in that manner between ourselves and the Russians?

Mr. ALLEN. I think that is a very good point, Congressman, and it reinforces the brief statement I had in my opening statement which I would be very happy to elaborate on. I said that there is some talk of Britain building the instrumentation for an earth satellite. We would supply the booster, but Britain would supply the satellite itself. I think that would be an excellent thing. And I would like to see the French and the Italians and the Germans and various other people—maybe smaller nations—get into the act. Nothing would interest them more, in this space picture, than to have one of their satellites beeping around the world, and it might lead away from the thing that you have so rightly pointed to as a possibility—that other people will wash their hands of it and say, "There is a contest between the United States and the U.S.S.R. which is no concern of ours. We are not interested."

Furthermore, one of the most important things in this whole space picture, in my opinion, is to get an international agreement on the peaceful uses of space. It is a very pressing thing, I think. If we can get more countries interested in it, they will tend to concern themselves with an international agreement on space.

Mr. DADDARIO. Well, in other words, you feel that there ought to be—and I quite agree with you—that all of these countries ought to feel as though they are still in this same ball game on our side.

Mr. ALLEN. Exactly.

Mr. DADDARIO. And that they are not to be put in a position of just becoming spectators?

Mr. ALLEN. That is right.

Mr. DADDARIO. That is all, Mr. Chairman.

The CHAIRMAN. Mr. King.

Mr. KING. Mr. Allen, first of all, I should like to congratulate you on what I think is a very excellent, illuminating statement, one of the outstanding statements I have heard during my year's membership on this committee. I started out by underlining the portions of your testimony that I thought were important and I ended up by underlining practically everything in your testimony.

I might say also I have had some experience with the Voice of America. I had the opportunity of participating in four broadcasts in the French language, working with Mr. Stefan Osusky, whom I found to be a man of great competence, of commendable comprehension of the processes of our Government. I think he is doing a very splendid job. He has shown me many of the broadcasts he has put together and I want to commend your department for that type of work.

Mr. ALLEN. Thank you very much, sir.

Mr. KING. Now, much has been said this morning about this matter of, shall we say, self-analysis. Some of it going perhaps too far, recklessness in our self-analysis, and the detrimental effect that that has had on our promotion efforts abroad. I agree with everything that has been said, to this point: I agree that it is very bad to indulge in reckless statements. Statements, for example, that the Russian military posture is more favorable than ours. I think such a statement made publicly by a responsible official is not only untrue, but I think very damaging. So all that has been said along that line I agree with.

But I would add this thought and I ask you to comment on it: It seems to me we should not infer from that, for 1 minute, that we can no longer indulge in a good healthy self-analysis and self-criticism. It seems to me that that has always been the strength of the American system. And I would be far more worried if we got to the point where we were afraid to examine and confess our own weaknesses, even though we did it publicly. I would be more worried over that fact than I would be worried over the fact that we made some unfavorable statements public from which the opposition could gather a publicity advantage.

That is also a danger but it seems to me the lesser of the two dangers. It seems to me that the strength and vitality of our form of government has always been rooted in the fact that we were free to discuss our own weaknesses as well as our own strength. And this being a democracy, it seems to me that it is most important that the American public be kept apprised at all times of just where we stand.

For example, if it be true, and I think it is, that the Russians are turning out twice as many scientists and three times as many engineers as we are—I have seen that statement in print several times—if that be true, I think the American people should know about it, even though that may do us a little damage propagandawise abroad.

I think the greater danger would be for the American people to fail to realize that fact. They should know it. That is particularly true in our form of government where everything we do has to be supported by the people and especially by the taxpayers. They have to pay the bill. They are entitled to know what they are paying for and what the great needs and urgencies are.

Now, specifically, I think you go along in general with what I have said and you made the statement that you feel we should not indulge in—I think you said we should have an adult attitude on this, and I agree with that.

I am wondering if you would care to expand just a little more as to what you would consider legitimate type of self-criticism and self-analysis, which is acceptable, in contrast to the uncalled for, juvenile or hysterical attitude that might cause us damage abroad.

Would you like to discuss that?

Mr. ALLEN. Yes. I want to say I concur heartily that the American people should know the facts. Either we have to have criticism in our system of government or else we must adopt some other system, and certainly I would not propose that.

The principal thought that I have on a more adult approach would be along this line: First and foremost, we should recognize that the United States is going to have a problem in the propaganda field, because of our system, and should try to minimize the difficulties and not get too worried because of public opinion overseas.

We Americans are inclined to feel badly hurt when we see figures going against us, such as I have read.

Now, I am certainly not proposing an ostrich attitude—that we pay no attention to public opinion overseas. On the other hand, I am asking for a commonsense middle ground. We should not get frustrated by it. Along the lines you have been bringing out, we should not shut off healthy inquiry or investigations such as this committee is carrying on, regarding what we are doing in space.

I don't think we ought to let world opinion be the be-all, and end-all, of what we do, but we should not ignore it. That is the more adult attitude I had in mind.

Mr. KING. That is all I have.

The CHAIRMAN. Mr. Allen, I want to tell you this, that I think you have made a very excellent, well-balanced feet-on-the-ground statement that should help the committee attain a sense of responsibility as Members of Congress in issuing statements. Likewise, it gives us a very good idea of world opinion and its importance to this country as well as the importance of the space program in fashioning world opinion. We do appreciate your statement.

I wan to ask you one final question, and I think it is a key question: Is it of importance, psychologically that we view space as a race, a race in which we must win at all cost?

Mr. ALLEN. I think that is an extreme statement that I would not subscribe to.

The CHAIRMAN. It is not a statement, it is a question.

Mr. ALLEN. If you put it in a positive way and ask whether we should regard space as a vital race which we must win at all costs, you would use extreme language that I couldn't subscribe to.

The CHAIRMAN. Would you agree if we left off "at all costs"?

Mr. ALLEN. If it were put a little more in perspective, I might go along. I will say this, Mr. Chairman, that I think no matter what we feel about it or how we may want it to be, we are in a space race with the Soviet Union. We can't deny it and we can't avoid it, I don't think.

The CHAIRMAN. We might as well accept it?

Mr. ALLEN. We might as well accept it. Public opinion in the United States as well as overseas is going to put up what the Russians have done against what we have done. Every time the Russians do something, it is going to be marked up on a sort of chart. We are in a contest. There is no doubt about that, and so no matter what we want to do about it, we are in this race.

The CHAIRMAN. And you don't want to run second in the race, do you?

Mr. ALLEN. I don't want to run second in the race. If you were to say, though, that we ought to put aside all military activities in regard to missiles and put everything we have got on space because it is absolutely vital that we win that one, I think we might win a battle but lose the war.

The CHAIRMAN. And we wouldn't want certainly to give up freedoms, for instance, to win space?

Mr. ALLEN. That is right.

The CHAIRMAN. We wouldn't want to give up the right of free speech to win space, but summing it up, you would say it was a very vital program for us to win?

Mr. ALLEN. That is right.

The CHAIRMAN. And that we as a nation, don't want to run second in a space race?

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Mr. ALLEN. And at the present moment, I think the contest is primarily on who is going to put the first man up there.

The CHAIRMAN. Now, Monday morning we will have the Secretary of the Defense Department as a witness and I would like very much to have a full attendance. We will adjourn.

(Whereupon, at 12 noon, the committee adjourned to reconvene Monday, January 25, 1960.)

REVIEW OF THE SPACE PROGRAM

MONDAY, JANUARY 25, 1960

House of Representatives,
Committee on Science and Astronautics,
Washington, D.C.

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

The Chairman. The committee will come to order.

Members of the committee, we are privileged to have before us today the Secretary of Defense, Hon. Thomas S. Gates, Jr., who has a prepared statement.

In addition to the Secretary today, we have Dr. Herbert F. York, Director of Defense Research and Engineering, and also we have Brig. Gen. George S. Brown, Military Assistant to the Secretary of Defense.

Mr. Secretary, do you have any others whose names you would like to have in the record at this point as backing up your testimony, and supporting your position?

Secretary Gates. No, sir.

The Chairman. We are pleased to have you with us, Mr. Secretary.

In the press there have been so many statements of so many characters, and so many statements at variance with other statements and at variance with testimony that this committee has received over a long period of time, that we are especially anxious for you this morning, if you will, to straighten things out. We are glad you have a written statement. After you read it, we would like to ask you some questions. I know you are a very busy man so the committee has adopted a 5-minute rule for questioning, each member being allowed 5 minutes for questioning. In that way, we can get the important questions to you, we can stick to the subject and at the same time, release you at the earliest possible moment.

With that prelude, sir, we are very happy to have you and if you will proceed with your statement, we will appreciate it very much.

STATEMENT OF HON. THOMAS S. GATES, JR., SECRETARY OF DEFENSE; ACCOMPANIED BY DR. HERBERT F. YORK, DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING; AND BRIG. GEN. GEORGE S. BROWN, MILITARY ASSISTANT TO THE SECRETARY OF DEFENSE

Secretary Gates. Thank you, Mr. Chairman.

Mr. Chairman and members of the committee, I am glad to have this opportunity to discuss the missile and space programs of the Department of Defense and their relation to national security.

Our ballistic missile and space programs are only about 10 years old. In that short span of time we have achieved impressive results.

In the years between 1945 and 1953, following the end of World War II, we were interested in the possibilities of developing rockets into weapons systems of longer range. Our experts examined the problem thoroughly and came to the conclusion that with the relatively low yield atomic weapons then available ICBM's could not compete with other approaches such as aircraft and air-breathing missiles.

Following the invention of the thermonuclear weapon, our experts restudied the problem and concluded that with a thermonuclear warhead, the ICBM could become a competitive strategic weapon. These first thermonuclear weapons were, however, very heavy.

In the face of this difficulty, there were two directions in which to go. We could go ahead and start the development work on a massive rocket, or we could direct our energies toward a reduction of the size and weight of the warhead and thus the entire weapon. We chose the latter. We also carried on extensive work on missiles of the air-breathing type and developed several excellent weapons systems as a result.

In 1953, our nuclear scientists made a genuine breakthrough. They told us they could make nuclear warheads a great deal smaller and lighter than earlier warheads. Our long-range ballistic missile program really started at that point. It has progressed since then with astonishing speed.

We have been successful in developing the Atlas, the first of our ICBM systems, from design to maturity in a far shorter period than was originally estimated. In 1954 the Von Neumann Committee, composed of some of our top scientific experts, estimated that with unlimited funds and top priorities, we could have ICBM's in 1962 or 1963. Actually, the Atlas was turned over to the operational forces of the Air Force nearly 3 years ahead of that schedule.

The Polaris system was first conceived about 3½ years ago, and the target date was optimistically set for 1963. We now fully expect to have this system operational in 1960—a full 3 years ahead of prediction.

There are other examples. We have made rapid progress in developing the IRBM. We are moving ahead with the second-generation ICBM, the Minuteman. Each year since 1953 we have spent increasing amounts on our ballistic missile programs and we have the weapons to show for these expenditures. Today, our ballistic missiles are reliable, accurate, and effective.

Our present ICBM and IRBM boosters are adequate for our immediate needs for military satellites. We anticipate a continual growth with our improved upper stage boosters for space vehicles, which will provide considerably more weight-carrying ability in a year or two.

The development of the very large thrust boosters has been assigned by the President to NASA. In accord with this decision, there is pending before Congress a proposal to transfer the Saturn project—the large clustered space booster—and the Development Operations Division of the Army Ballistic Missile Agency to the National Aeronautics and Space Administration.

This does not mean that the Department of Defense has no interest in large boosters. We are very much aware of the importance to the welfare of the United States of a vigorous program in space flight and exploration, and of the need for bigger boosters for the space exploration program. In view of the potential military need for much larger boosters than are now available, we strongly endorse a vigorous NASA program. We have, of course, made available military personnel to assist him, whenever requested by Dr. Glennan.

We intend to follow NASA progress in large boosters closely just as we follow other NASA projects—Tiros (meteorological satellite) and Mercury (man-in-space), for example—that have potential military applications. Let me assure you that we have very close working relationships with NASA and we are going to keep them that way.

There are now several DOD–NASA working groups which provide, on a day-to-day basis, essential liaison and cross-fertilization of requirements and technical knowledge on projects of mutual interest. The National Missile Ranges and tracking stations of both NASA and DOD have been used heavily in support of space launchings for both agencies. In order to make the most effective use of these facilities, a comprehensive study in the area of integrated range support for missiles and space vehicles currently is underway.

To assure effective DOD support for the NASA Mercury project, Maj. Gen. Donald N. Yates has been named as DOD coordinator for Project Mercury support. In this task, he reports to me through the Joint Chiefs of Staff. General Yates is also continuing his assignment as Commander of the Atlantic Missile Range located at Cape Canaveral, Fla.

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

We are pushing other programs that have direct military applications. These are communications and navigation satellites. In each of these areas, we have important research and developments projects well underway. All show promise. Some have progressed to the point where they are now in the stage of applied development where we can test their feasibility on a systems basis.

The present satellites show promise in initial tests. They must undergo feasibility demonstrations on a systems basis, before we start line production. Let me assure you that when one of our projects proves itself in such fashion, we will make sure there are funds available to support production.

We have steadily increased expenditures and efforts for defense space related programs. The funding for separately identified space-related programs in fiscal year 1959 was $381 million, for fiscal year 1960 the funding is $414 million, and for fiscal year 1961, $481 million.

These figures do not include funds for ballistic missiles or for programs transferred to NASA.

Remember these are test programs and there will be some failures. The reason why we test is to learn through experience where the bugs are, what has to be fixed or changed and how we should redirect our research efforts.

During the last 6 months we have made improvements in the organizational structure and assignment of space responsibilities within the Department of Defense. I am confident these improvements will accelerate our program by eliminating overlap and duplication.

On September 23, 1959, a plan for the progressive and orderly transfer of space projects from ARPA to the military departments was initiated. This plan assigns to the Air Force responsibility for the development, production, and launching of military space boosters; and for the separate assignment to the military departments on the basis of primary interest or special competence, of the development responsibilities for payloads and specialized ground support equipment for space and satellite systems.

Specific assignments for development of payloads have been made on Midas (early warning satellite), Samos (reconnaissance satellite) and Discoverer (engineering research satellite) to the Air Force. Transfer of the Transit (navigation satellite) and Notus (communication satellite) projects to designated military departments is anticipated sometime during the current fiscal year.

Another important organizational improvement has been the strengthening of the position of Director of Defense Research and Engineering. We have recently placed the Advanced Research Projects Agency directly under his supervision. ARPA continues to be responsible for certain basic research programs. In particular that in the field of solid propellant chemistry will contribute to our future rocket development programs for use in missiles and space flight.

I have spent considerable time in describing the progress of our military missile and satellite programs because I feel that many have failed to distinguish between military and nonmilitary achievements in space. Our satellite program has progressed. We have placed a number of satellites in orbit. I am confident we have gained much technical and scientific information which will enable us to demonstrate further progress in the next year.

The present day space programs of both NASA and the Department of Defense are, of course, largely outgrowths of missile programs. The technology, facilities, and components developed in the past for ballistic missiles are now used today for space projects. Similarly, today's missile development effort will no doubt find future application in both civil and military space activities. In this connection, the total direct obligations planned for research, development, test, and evaluation of missiles in fiscal year 1961 will be approximately \$2.4 billion. This figure includes separately identified funds in the procurement budget for development, test, and evaluation of large missiles. Of course, our total missile program including procurement is much larger.

This summary of the space efforts of the Department of Defense offers no grounds for complacency or self-satisfaction. Nevertheless, we have made great strides in missile and satellite development. In the area of the Department of Defense's responsibility space activities having direct military application—we have sound programs. We are moving swiftly toward their accomplishment.

Mr. Chairman, I appreciate the opportunity you and your committee have given to me to develop these thoughts. Dr. York is here with me to assist in answering any questions you might have.

The CHAIRMAN. Thank you very much, Mr. Secretary, for a very informative statement that you have made. I have listened to every word very carefully.

I must confess that I am one of those persons you refer to on page 7 of your statement, one who has failed to distinguish between military and nonmilitary achievements in space. It seems to me that any achievement in space is going to more or less have military significance. It is hard for me to distinguish between the two. Do you share that view?

Secretary GATES. We have an interest in doing in space what we can do better there than we can do elsewhere, so that we are very acutely aware of what goes on in the space effort, in the field of space exploration and scientific progress. We are very interested in maintaining a strong big-booster program for this purpose.

However, there are no firm military requirements from the Joint Chiefs of Staff for the use of space, other than the projects which I mentioned upon which we are working. The future will unfold, I am sure, more interest and probably will be related to man in space in some way over the longer future.

The CHAIRMAN. How are you going to have some of these programs which you refer to—for instance, the Mercury program, the Tiros program, the reconnaissance program and the Saturn project and many other programs, perhaps, that you haven't referred to, without the big booster?

Secretary GATES. The point of the big booster, Mr. Chairman, is to put increased weight in space, what we call payload. This is what the Russians have the capability of doing. We have no military requirement for our missile programs that requires that kind of booster, so that we have enough booster capacity, today, to handle our intercontinental missile programs and the satellite programs that we have specific military requirements for.

The CHAIRMAN. Well now, the other day I think you testified before the Senate and referred to the fact that our capabilities should be based, as I read it, on the intention of your possible adversary.

Secretary GATES. No, I didn't testify that way, Mr. Chairman.

The CHAIRMAN. I am not trying to quote you, but what is your position on that this morning?

Secretary GATES. Do you mean you want my comments on this discussion that is going on about intelligence, Mr. Chairman? This gets into the subject of intelligence.

The CHAIRMAN. Perhaps I misread your statement, but as I read it, I had understood that it was related to the intentions of your possible adversaries as to our defense system.

Secretary GATES. There are some who are interpreting it that way, Mr. Chairman.

The CHAIRMAN. How really should it be interpreted?

Secretary GATES. Well, the intelligence under discussion estimates missile capacity and missile production and the dates on which numbers of intercontinental missiles may become operational.

The intelligence information has improved so that it is now possible to have it more refined and better evaluated on what the Russian intercontinental missile programs may be. Originally it was only possible to estimate missile capability. There is now better information available from a variety of sources on a variety of subjects that are considered in reaching an intelligence estimate. There is obviously no intelligence whatsover, on U.S.S.R. intentions as to specific military or political policies or actions. Of course, it is impossible to have such intelligence. What we have is a refined and better set of facts pertaining to the probable, or what the Soviet ICBM program may be.

The CHAIRMAN. So you are not relying on their intentions at all, now, are you?

Secretary GATES. We have never been relying on their intentions, as to what they would do with regard to specific actions.

The CHAIRMAN. I will ask you one more question and I will stop because we are going to invoke the 5-minute rule this morning.

We have had witness after witness, Mr. Secretary, come before us last year and this year, too, referring to a missile gap of several years between the time that we will catch up with the Russian development in the big booster and the ICBM.

Now, what do you have to say about that this morning? Do you agree that there is a missile gap and for a period we will be in a difficult spot defensively?

Secretary GATES. I testified extensively, Mr. Chairman, in closed session on this. It gets a little difficult to go into detail in an open session. But again, we are mixing up the question of big booster capability for space exploration, where it is admitted we are behind the Russians with the relative positions we hold with them in connection with the development of intercontinental missiles.

Now, I testified that I believe our retaliatory capability is on a sound basis.

The CHAIRMAN. You don't testify about the missile gap?

Secretary GATES. We have been talking about whether there is a deterrent gap rather than missile gap. Missiles are only one way of doing this terrible business. We have a number of ways.

The CHAIRMAN. Of course, we have the manned aircraft there, but I am talking about the missile gap. Is there such a thing as that in your mind?

Secretary GATES. I have tried to look at the total retaliatory capability of the United States. Assuming a surprise attack on the United States, what will its survivability be to act as a valid deterrent, so that no one would ever dare start the kind of war that we are talking about. And on that basis, I believe that we are in a strong position.

The CHAIRMAN. Mr. Fulton.

Mr. FULTON. Mr. Secretary, we are glad to have you here. We in Pennsylvania are particularly proud of you because you are a Pennsylvanian. I might say it is a small world because I remember serving with you as a fellow lieutenant on a U.S. Navy carrier out in the

South Pacific in World War II. I might not have argued so much with Lt. Thomas Gates if I had known he was going to be the future Secretary of Defense.

We do have your statement here and I think it is an excellent one. As a matter of fact, you have made some definite comments which I think should be called directly to the attention of the committee and the public.

On page 3:

Today our ballistic missiles are reliable, accurate, and effective.

I would thoroughly second that and I would compliment you particularly on the Atlas and the fact that we have that operational at the present time and have had it for some months, when Russia is just now coming to the point where, on its specific tests, with no landfall, they are supposed to have come within a certain degree of accuracy which could be anybody's guess, at sea.

Secondly, on the Polaris system. I want to again compliment you, because that will outmode between 450 and 500 of the current type submarines that the Russians have, and when it becomes operational it makes a tremendous submarine gap because there is no possibility of Russia, with its current submarine fleet, meeting that opposition from the Polaris missile.

I note, too, on page 3 you state:

Our ICBM and IRBM boosters are adequate for our immediate needs for military satellites.

You are thoroughly convinced, as I am, that that is true?

Secretary GATES. Yes, sir.

Mr. FULTON. I want to compliment you, too, upon your effective distinction on intelligence between what we had to go on previously regarding estimates of missile capacity and production of our possible opponents, and what we now have—the ability to determine when the missiles are becoming operational. So that we have two factors that we can look at from an intelligence point of view, and, therefore, have a broader base upon which to make the estimate of our own posture. Is that not right?

Secretary GATES. Yes, Mr. Fulton, with recognition of the fact that intelligence is not an exact science.

Mr. FULTON. I agree on that, too. But we do have the broader base of intelligence upon which to make estimates of the capabilities and the operational capabilities of an ICBM nature of our possible opponents, is that not right? They are broader at the present time?

Secretary GATES. Yes. They have been more refined and are broader, that is correct.

Mr. FULTON. And might I say this: If we took a static position completely in the United States and simply tried to project the present generation of missiles ahead, you reach a much different result than if you look at the fact that some of our opponents might be changing, might be emphasizing other particular types of missiles or space vehicles. If we take that into consideration, on a dynamic basis, we will be preparing in a way that will not let that become a reality. Is that not right?

Secretary GATES. That is absolutely right. It is a matter of judgment how much is put into the missiles that are not as good as those to follow which we are pushing with highest priority.

Mr. FULTON. We are not trying to produce in great number these first-generation missiles on a department store basis, but rather are putting high priority on the ones we can see will be most effective based on the new and current intelligence.

Secretary GATES. The ones we conceive to be most effective based on military requirements.

Mr. FULTON. And you are finding that you are able to cooperate—I will ask Dr. York this, too—you are able to cooperate with NASA and the various agencies of NASA, completely. You are having no troubles of liaison, or finding any opposition or obstruction between your two departments and agencies?

Secretary GATES. I will testify first we are having no trouble whatsoever in working very closely.

Dr. York, I think, will say approximately the same thing.

Mr. FULTON. Is that right, Dr. York?

Dr. YORK. Yes.

Mr. FULTON. So there is complete harmony now as between the civilian and the Department of Defense on these projects, both of ballistic type as well as space vehicles. Is that right, Dr. York?

Dr. YORK. Yes.

Mr. FULTON. I have one-half minute yet and I have one more question:

At the present time when vehicles and various rockets can be used for a dual purpose, there doesn't seem to be much valid reason for trying to make a distinction between the military and the civilian field. Therefore, the question comes, on those areas where there is no clear division, which the chairman had referred to, is there adequate and proper cooperation, and is there good development teamwork, so that we in the United States are getting the proper results and the right kind of investigation to give us good research and development?

Secretary GATES. We have been able to divide these on a realistic basis between the two agencies responsible. If gray areas develop in the future when our requirements change, I am sure we will be able to do the same thing.

Mr. FULTON. Dr. York, you agree on that, too, do you?

Dr. YORK. Yes; we have made agency-to-agency agreements wherever there have been gray areas where that has been needed.

Mr. FULTON. There has been no particular large dispute as to jurisdiction that has held back any of these programs?

Secretary GATES. That is correct.

Mr. FULTON. Is that right, Dr. York?

Dr. YORK. That is correct.

Mr. FULTON. That is all, thank you.

The CHAIRMAN. Mr. Teague.

Mr. TEAGUE. Mr. Chairman, first I would like to ask if we will have a chance to hear the Secretary in executive session or not?

The CHAIRMAN. Well, let us see how we get along this morning, Mr. Teague, and then we can see what the requirements are, and what the Secretary can do. After we go a round on the open questions, we can make a decision on that.

Mr. TEAGUE. One question in open session: Recently Dr. Pickering came near to saying there was no sense of urgency in the White House or in the top echelon of Government.

My question is, is there a sense of urgency in your office and in the White House and if there is, what would indicate that, what evidence would tell us there is a sense of urgency?

Secretary GATES. Well, we have a great sense of urgency within the Department of Defense, as witnessed by the fact that we have expanded the ICBM program repeatedly, again expanded it in presentations before Congress for the fiscal year 1961. We have a sense of urgency about the space satellites that we are working on now in the Department of Defense.

Certainly the missile programs have the highest national priority as far as contractors and contractual arrangements are concerned and I would say that there is a military sense of urgency of great importance.

Mr. ANFUSO. Will you yield to me a minute?

Mr. TEAGUE. I yield.

Mr. ANFUSO. Mr. Secretary, what confuses me on this sense of urgency and also your statement that you find no military requirement for a larger booster, have you taken into consideration that with a larger booster you can get a greater range, a greater distance, and also put up a bigger payload?

Secretary GATES. Certainly, sir. We have adequate range in our present programs and we have big payloads and we have bigger payloads in the process of development.

Mr. ANFUSO. Well supposing, Mr. Secretary, there were to be a war—and God forbid that that should happen—the Russians at the present time have their bases, their launching bases, a good 7,000 miles away, or maybe more. The Atlas will never reach that.

Secretary GATES. The Atlas has been fired 6,300 in terms of statute miles.

Mr. ANFUSO. I read that, but, of course, it is not official as to when that will become operational and when you can classify that as being absolutely a correct feat.

Secretary GATES. This gets to be a definition of operational, sir. The Atlas is already operational at Vandenberg Air Force Base and it has already flown a distance that is satisfactory for its mission.

Mr. ANFUSO. Do you think the Atlas will ever reach a range of 8,500 miles?

Secretary GATES. I think it is highly conceivable that it will—yes, I think it will.

Mr. ANFUSO. Militarily?

Secretary GATES. But there gets to be a question of how far you must fly, sir, in relation to your objectives. There is no need to do that. But it could do it if necessary.

Mr. ANFUSO. What I am getting at is the launching bases which the Russians have. These can be put in North Manchuria, North Siberia, a distance of almost 8,000 miles, and I don't think we have anything now that meets it.

Secretary GATES. If they should happen to pursue the program that you are talking about, it would not require that much range.

Mr. ANFUSO. How about from Alaska—of course, I think there are shorter ranges. I can see that.

Secretary GATES. Yes, sir.

Mr. TEAGUE. Would you comment on your statement that this summary of the services of the Department of Defense offers no grounds for complacency or self-satisfaction?

Secretary GATES. Yes, sir. I think the worst thing we can do is to be complacent and I think the technical changes are coming so rapidly that the Department of Defense's total program must be on a continuous review basis. If we see an opportunity to make greater progress with a given system, we ought to be able to consider it and go ahead and do it, after it is properly evaluated.

I have a very strong worry about some of the implications that have been put on my testimony about being complacent. We are not taking the talk that we hear about peace and so forth at all seriously in developing the defense program. We believe that until the Soviet Union demonstrates by actions something in the way of progress toward disarmament, or something toward a better way of living together, and earn a Good Conduct Medal, that we should not take them seriously in the Department of Defense.

The CHAIRMAN. At this moment, gentlemen of the committee, the press has asked me if it is possible—it is so crowded that some of the members of the press have no place to sit. If it is possible for us to move in a little closer where we can. I know Mr. McCormack is in Boston and I know Mr. Martin is not here.

We could thus give the members of the press a place to sit.

If there is no objection, I will ask the clerk to change the nameplates.

Mr. Chenoweth?

Mr. CHENOWETH. Mr. Secretary, we are dealing, I think, with probably the most pressing question before the American people today. We are reading in almost every paper, every day, charges that we are unprepared from the missile standpoint and Russia has completely outdistanced us in the missile front and almost every other front. If that barrage continues, there will probably be some serious concern in this country as to just what our defenses actually are.

What is your position, Mr. Secretary? Do you feel any alarm or concern over these circumstances after knowing what the Russians are doing and what we have?

Just what would you tell the American people? What do you want us to tell the American people insofar as our defense picture is concerned today?

Secretary GATES. I think we have a strong deterrent posture and an ability to retaliate effectively against any attack on the United States. We are by no means a second-class military power. We are in a strong position.

Mr. CHENOWETH. You have heard nothing so far as the reports on Russia are concerned, which would indicate that we have anything to be seriously concerned about, insofar as immediate attack is concerned? We will be ready to take care of any military emergency which may arise. Is that your position?

Secretary GATES. I believe we are in that position; yes, sir. And I want to reemphasize as I just stated to Mr. Teague, that I don't believe in being complacent about it. And I also believe in continuously reviewing it.

We have the Joint Chiefs of Staff and the military advice that we get. And this is our mission. This is why we exist in the Department of Defense and if we were in any other position or were going to permit the United States to get in any other position, we have no business having the responsibilities we have.

Mr. CHENOWETH. Mr. Secretary, I have great confidence not only in you personally, but in the military leadership of this country and I have every reason to believe that what you are telling us is absolutely the truth. I hope we can get that message to the American people.

Now, the Atlas has been operational for several years, you mentioned?

Secretary GATES. No, sir. No, sir. It only became operational in September.

Mr. CHENOWETH. What is the picture on the Titan?

Secretary GATES. The Titan is not operational. The Titan is still under test. I think there have been six tests. Four were successful and two recent ones have been failures.

We believe we have identified the cause of the failure in the Titan and will go ahead with it on a program that will not slip too much from its original operational dates.

Mr. CHENOWETH. The Atlas is operational and we can expect the Titan to be operational in the near future?

Secretary GATES. Titan is coming along. It has growing pains, as some of these very complicated systems have.

It used to take us 10 years, you know, sir, to develop a fighter airplane. This was considered about normal. We have compressed a tremendous amount of technical change into a relatively short time, already. It is not unusual for us to have setbacks in test programs when we are trying to go ahead so rapidly. It is not at all unusual. We are working on the Titan program with, again, the highest priority. It has growth potentials over and above what the Atlas missile has and we have the confidence that we will solve our difficulties.

Mr. CHENOWETH. Would you want to make any comparison between our missile strength, today, or setup, with the Russians' or would you rather do that in executive session?

Secretary GATES. I would rather not do that, sir.

Mr. CHENOWETH. Mr. Secretary, as Secretary of Defense, you can assure this committee that the defenses of this Nation are ready for any emergency then that may occur?

Secretary GATES. I can, indeed.

Mr. CHENOWETH. I have every reason to believe that that is the case, Mr. Secretary. I certainly don't subscribe to these charges that we are a second-rate nation. I think we are still the No. 1 top Nation in the world. I recognize the heavy responsibility you have to see that we maintain that position and I have every reason to believe that you and those around you are going to do it.

Thank you, Mr. Chairman.

The CHAIRMAN. Mr. Anfuso.

Mr. ANFUSO. Mr. Secretary, I believe that you are going to become a great Secretary of Defense, but I most respectfully disagree with you in the line which you are following, which is the line of this administration—such as the President who said he knows more than any living general about what to do about this situation.

I disagree with you and the administration as to what we ought to tell the American people. I think that we have failed to tell the

American people the true facts. I think that we have failed to tell them that we are behind in the space race and we have failed to tell them why we are behind.

The result is, Mr. Secretary, as I find it in talking to constituents, that the people are not ready to back us here in Congress and the administration in an all-out effort to beat the Russians. I think that the American people today are much too complacent. They are absolutely divided on this question and they are divided because we have two schools of thought in Washington, one which says, "Let us tell them the whole truth," and another which says, "No; let's keep telling them we are strong, we are first, and no other country can ever beat us."

I think it is wrong. I think we ought to tell the American people that we are not as strong as some people here in Washington would have us believe and that we ought to appropriate more money in order to catch up with the Russians.

Don't you agree that that is a better way of meeting the situation?

Secretary GATES. I think it is very important that the American people understand the difference between the space effort of the Russians and the military programs of the two countries.

I have said in my statements which have been released that we are behind the Russians in the big booster program which gives them a capability of going to the moon and putting heavy payloads in space exploration. This has been admitted and it is true.

I have also said we are not behind the Russians in our military effort overall, in our military posture. We have deployed forces all over the world, we have a great deal of capability with these forces. It is one thing to admit that you are behind in the ability to put big payloads in space for which we have at the moment, no military requirement, and another thing to admit that we are behind in our total military posture.

I think the distinction should be made between these two efforts.

Mr. ANFUSO. Mr. Secretary, what I would like to get at is a total effort on the part of the American people to back the Congress and back any administration in being ahead of the Russians.

Secretary GATES. We all would like to do that.

Mr. ANFUSO. Is it not a fact, Mr. Secretary, that at some time in the last year or the year before, the Joint Chiefs of Staff said in a report made to the Secretary of Defense and to the President of the United States, that in order to get a lead over the Russians, they would require a budget of from $55 to $60 billion, and all that we have been able to appropriate for each one of these years is approximately forty-one point *x* billion dollars. Is that correct?

Secretary GATES. I don't believe they ever wrote a report to that effect, but if you took the unilateral military requirements of the services historically, you would find that they added up to a higher figure than any budget under any administration ever granted. This is traditionally and historically so.

However, the Joint Chiefs of Staff have assured me that they believe the total budget as presented in fiscal year 1961, is one that they can support.

Now, if each one of them had their own way, they would divide the money differently. They would like to do different things with it. Therefore, we reviewed the budget on a program by program basis and went to the scientists, where scientific vision was needed, we went to the military and tried our best to itemize the programs and determine in the best national interests which one we should pursue.

But it is historically true that the Chiefs of Staff, in looking at it from a service point of view, have military requirements that add up to a great deal more money than they have ever gotten in any program that is totally reviewed.

Mr. ANFUSO. But it still may have been insufficient.

General Taylor made that statement. It is no secret. He made that statement in his book, that there was an agreement by the Joint Chiefs of Staff when they went to the administration they would cut down.

He also said that military and civilian scientists and technicians have come up with fantastic new weapons and equipment, but just lack the money to buy them. He also made that statement.

Now, is it true that our own scientists, our own technicians have come up with new inventions, new things that could make a better-equipped Army, a better equipped Navy, and they have lacked the money to put these things into operation?

Secretary GATES. It is a question of deciding between good ideas, and everyone has an idea that maybe the idea that he is working on is better than some other ones. What we try to do is give it judgment and review, from a military, technical and scientific approach. And sometimes we don't pick everybody's good ideas.

Mr. ANFUSO. Mr. Secretary, I am going to insist and I am going to be one to continuously state now and in the future that we are not doing enough. The administration has conceded a 3 to 1 missile lead to the Russians and in 3 years time the Russians are going to have 1,000 ICBM's operational that can hit a target 8,500 miles or more. We are going to be in a pretty precarious position at that time, in 3 years time. And we are in a precarious position right now and are not going to be in a better position 3 years from now unless we double our efforts.

What I am telling you as a Member of Congress is just what Mr. Teague turned around to me and said, "Ask the Secretary what can we do as Members of Congress to help the administration? What can we do except to appropriate money? We want to do something, because we realize that we are not doing enough."

The CHAIRMAN. Mr. Van Pelt.

Mr. VAN PELT. No questions, Mr. Chairman.

The CHAIRMAN. Mr. Sisk.

Mr. SISK. As I understand you are interested in larger boosters and in the space program as it has been carried forward by NASA.

To what extent, Mr. Secretary, is research going forward with reference to the possible need of military application in space? I realize we talk about peaceful exploration of outer space and I hope it remains that way and I hope we can bring about some international agreement which would preclude it ever being used for the military. But I am curious to know to what extent you and Dr. York and others are concerned with this particular problem?

Secretary GATES. We are very concerned with having an adequate research effort behind our military requirements. I believe we have that. It has been very helpful, I might say, to have the new office which Dr. York leads, created under the Reorganization Act of 1958, because this has set up an authoritative office with ability to supervise the research programs of the services.

Therefore, I believe we have the research behind the immediate satellite programs which are important to us for military purposes. And we certainly have an enormous effort behind the intercontinental missile and the Minuteman, the Polaris and our weapons systems.

Now, maybe Dr. York would want to augment this answer to you, sir.

Mr. SISK. If I have interpreted what you have said, not only here this morning, but in the past, you feel that generally, so far as our strict military program is concerned, that we are in fairly good shape with the present boosters.

Now, of course, the point of my question goes to what extent you are concerned, for example, with the Saturn program and these other programs.

Secretary GATES. We are interested that it have a good healthy effort behind it because we don't know when we will get a military requirement that will require it. So we are very interested in having it supported and having it come into being.

The President has already made a statement concerning this program and his interest in it.

Mr. SISK. With reference to our present deterrent strength, which basically, I think, rests on SAC—or has, and probably will in the future for some time—dealing now with research and development, which is the jurisdiction of this committee, what is your present position on the B-70 program?

Secretary GATES. The present position on the B-70 program is that it is going ahead in a research program, backed by, I think the figure is approximately $75 million in fiscal year 1961 and it will require more, I believe, to accomplish it, to fly two prototype airplanes.

Mr. SISK. To what extent have recent decisions, Mr. Secretary, slowed down the B-70 program? This is not meant to be critical, but there has been a lot of stuff printed and I don't know how correct some of it is. I know in the Air Force—and I realize that they are concerned and are rather zealously guarding their prerogatives and concern about this B-70 program—I am interested in knowing to what extent you feel recent decisions may have slowed down the development of this program.

That is, how many more years will it be now before we would actually have the B-70, this bomber with the potential which was anticipated back—I remember 2 years ago when we were first given a review of this program?

Secretary GATES. Yes, sir. I can't give you an accurate answer. I will give you the thinking.

The Air Force program envisaged the expenditure of approximately $5.5 billion and operational aircraft in 1965. This was a weapons system and it was a brand new step forward, a quantum job for the state of the art of manned aircraft. It involved mach 3 speed, new components, new metals and so forth.

There are many people who have doubts that this Air Force program might not be somewhat optimistic both in terms of cost and in terms of time period. In other words, it might come into being later than 1965. It might be 1967 or 1968.

At this particular time we believe that we will have in being four strategic missiles systems. If you count the Polaris as an ICBM when you put it on a submarine, which I think you should, you would have Atlas, Titan, Minuteman and Polaris. So the B–70 comes in competition with the ICBM's to do a single purpose mission.

Now, specifically answering your question if the Air Force estimates were correct, we have slowed down the development of a weapons system by not going ahead with the full development of a weapons system, as opposed to going ahead with prototype airplanes. We have probably slowed it down by the months that we are dealing with the prototypes as opposed to dealing with a weapons system.

Actually whether we really slowed it down, assuming a year from now we decide to go ahead or not, is almost impossible to predict.

Mr. SISK. I realize it comes to a matter of judgment, Mr. Secretary, on the need. I personally would not think that cost, itself, would be too much of an item.

I realize that this $5.5 billion which was, I believe, the figure used back when we were first briefed on this program, is a lot of money. But I am hopeful that your decision has not been based strictly on the dollars and cents, but has been based on the fact that you think maybe you have some other program that is going to be better.

Secretary GATES. That is right, it is for the time being. We will have these four systems and in addition, we are developing what is known as the Hound Dog missile for the B–52 and another missile above that is in research which is a ballistic missile, being an improved version, you might say, of the Hound Dog.

And we have the B–58 which is an advanced airplane over the B–47 and it also has certain growth capabilities in it. So it is a decision based on what the total effort should be in terms of retaliatory and strategic weapons.

Now, we have not made a clear decision. We have postponed the decision, you might say, by, instead of completely canceling it or completely going ahead with it, we have said, "We will build two airplanes and take a look at how these other programs come ahead, their schedules and their operational dates."

These systems are all related to each other. You cannot look at any one in isolation.

Mr. SISK. In conclusion, Mr. Chairman, I simply want to say I appreciate the statements of the Secretary. The thing that sometimes we get a little concerned with down here is the postponement, Mr. Secretary, of these decisions and the delays that are caused in an apparent desire to make the right decision. I realize it takes time to make it, but I hope we don't miss the boat by being too slow.

Thank you, Mr. Chairman.

The CHAIRMAN. Mr. Riehlman.

Mr. RIEHLMAN. Mr. Chairman, I want to commend the witness for a very fine statement here this morning and one which I believe is factual and presents not alone to this committee, but to the American people our military posture as far as the missile program is concerned, and what we intend to do in that field.

Following a little bit what Mr. Sisk has had to say here, and I know it is uppermost in the minds of all the American people, we have heard it said by some of our leading people in the Nation that consistently our President and the Secretary of Defense and those in charge of our military posture are putting a balanced budget before our national defense and security.

With your experience and your understanding of this situation, I would like to have you tell this committee your own honest opinion as to whether or not there is any basis for such a statement to be made.

Secretary GATES. I would not hesitate, Mr. Riehlman, as I stated in my testimony before, I believe, every other committee, that if we got a little bit firmer basis to proceed—for example, on the Polaris weapons system—to go ahead at a more rapid rate, no matter what it cost, I would recommend to the President that we accelerate a program, when we get a little surer of our ground.

We have been going ahead, to give that illustration, on three submarines a year, and the missiles that are related to them. This looks like a sort of static program controlled by money. But it has little to do with money. Actually it is a $3½ billion investment in a system and we haven't fired a missile from a submerged submarine yet. This is something we know we are going to be able to do. We believe it will be successful. And when we find this system is on firm ground, it seems to me then three a year is wrong. Then we must decide the force levels required to do the job this way and go ahead and augment it.

Now, we are interested, as I think all Americans are, in a sound economy as a strong matter of principle. But Mr. McElroy, who had the responsibility for this budget and I who shared it with him, had no guidance on what the defense budget should be from the President of the United States or from anyone else. We set up our own guidelines and tried to devise the proper program.

Mr. RIEHLMAN. And you had no direction from the President or the Bureau of the Budget at any time to cut down on any program that you felt was essential to the defense of our Nation? For the purpose of balancing the budget?

Secretary GATES. No, sir. We have had advice from the Bureau of the Budget as to what their opinions are about programs, but for the purpose you state, we had nothing of that kind.

Mr. RIEHLMAN. Now, to get back to one of your statements in respect to the new payload that is under development right now for use in our defense arsenal: Will the present Atlas missile that we have be able to carry this additional payload or will we have to change the booster of the engines in the Atlas missile?

Secretary GATES. Perhaps Dr. York could answer that better than I could.

My understanding is that the growth potential in payload, readiness, and general overall capabilities is greater in the Titan than it is in the Atlas.

Dr. YORK. Did you want something further, Mr. Riehlman?

Mr. RIEHLMAN. I was particularly interested in whether or not the present Atlas would carry the additional destructive power—I might put it that way—that you are planning in the new hydrogen bomb that is under construction.

Dr. YORK. I am afraid I don't know what bomb you are referring to.

Mr. RIEHLMAN. Perhaps I haven't made myself entirely clear, but during the discussion the Secretary said that we have at the present time under construction, a missile with a greater bang—that is what I understood it to be—or payload, that is what I want to say, not a bigger bang—and I am wondering whether this present Atlas missile that we have can carry that load.

Dr. YORK. The present Atlas missile or the Titan missile can carry the military payloads that we now have in mind.

Mr. RIEHLMAN. And that we have under construction?

Dr. YORK. Yes.

Mr. RIEHLMAN. Mr. Secretary, one other question: I would like to have a bit of information for the committee as to exactly what progress we are making. It is mentioned in your statement with respect to the Minuteman.

Secretary GATES. Yes. The Minuteman is on its schedule in a research category. In addition to that, we have taken another forward step in the 1961 program by approving a production facility in advance of having the missile, you might say, in form to produce. We recommend that we go ahead and develop a production facility that will produce 30 Minutemen per month. We are pushing the Minuteman as we are the Polaris, with very high priority—the highest priority.

And so far we have confidence it will meets its schedules.

Mr. RIEHLMAN. Would you rather give this information in executive session, as to the timetable that you have for the Minuteman?

Secretary GATES. Yes, we would rather give it in executive session.

The CHAIRMAN. Mr. Karth.

Mr. FULTON. Do you have any time left?

The CHAIRMAN. The gentleman's time has expired quite a while ago.

Mr. KARTH. Without violating any security information, how many ICBM's do the Russians have at this time?

Secretary GATES. I can't discuss numbers of missiles that are included in intelligence estimates. I am sorry.

Mr. KARTH. It has been generally conceded apparently by people from your Department or those in the military or in relatively high echelons, that they have a so-called 3-to-1 lead. I suppose it is a matter of simple arithmetic, if we know how many we have. There has been open discussion on that.

Mr. FULTON. I raise a point or order, because any discussion of this pro or con would give valid information and I don't think we should discuss the amounts.

Mr. KARTH. I am not going to discuss the amounts, Jim. I just say the American people, I think, are pretty familiar with what this figure is.

Mr. FULTON. You came up with something that required a denial and I don't even want that.

The CHAIRMAN. The witness is capable, I think, of taking care of himself. He can decline on the grounds of security to answer any questions.

Mr. KARTH. And I certainly hope that he does, Mr. Chairman.

Mr. Secretary, I am leading to this question: I suppose that the military and your Department has answered this question on many occasions—and again I don't know if this is security or not, but I would like to have your viewpoints on it if possible: How many well-placed ICBM's—knowing the C.E.P. capability of the Russian missile—approximately how many ICBM's does your Department feel it would take, from a manufacturing, industrial, and transportation standpoint, to incapacitate the United States?

Secretary GATES. This is impossible to answer because it depends on the accuracy of a missile, which is an estimate. It depends on the time of warning, which is an estimate, that we get. It depends on a great many factors that produce a very difficult and complicated set of formulas. We war-game these formulas continuously under all kinds of circumstances. You get one answer one way and you get another answer the other way. You add 24 hours warning as opposed to 15 minutes, and you get a whole different set of answers. If you change the accuracy, you get a whole different set of answers.

So you have to look at every conceivable possibility. This is done continuously in the Department of Defense.

Mr. KARTH. You wouldn't care to make an estimate on overall——

Secretary GATES. Because of the questions that go into the formula, you can't make an estimate. It depends on what we are talking about. And also what strength we have in being at the time.

Mr. KARTH. Let me ask you this question then, Mr. Secretary: What is your posture insofar as it relates to detection and destroying incoming ICBM's?

Secretary GATES. There is no antimissile weapons system in being. We are doing a great deal—spending a great deal of money and effort on a full-scale testing of the Nike-Zeus system, which will lead not only to a decision on whether we ever put the Nike-Zeus into production or it will give us additional information on the anti-missile-missile problem. We are putting into being what is known as the ballistic missile early warning system, called the BMEWS System, and we have under research some other ideas on how to improve warning.

Mr. KARTH. Most or all of these things are in the state of research and development, rather than any operational posture?

Secretary GATES. The BMEWS is beyond that. It is through with research and development and it is being constructed.

Mr. KARTH. What capability does the BMEWS have if you care to discuss it in open session?

Secretary GATES. I prefer not to discuss it, sir, if that is all right.

Mr. ANFUSO. Will you yield?

Mr. KARTH. Yes; I yield.

Mr. ANFUSO. Mr. Secretary, would you concede that this country is at least three times as rich as Russia?

Secretary GATES. I don't know. I am not enough of an economist to know the exact ratios. I will concede we are richer.

Mr. ANFUSO. It has been reported we are at least three times as rich as Russia. Yet Russia has spent three times more than we have in this space effort. And the reason for that is that we have paid more attention to the principle of private comfort and private consumption and placed those things ahead of our national need.

Secretary GATES. I don't know that the Russians have spent three times as much. I have no knowledge of that.

Mr. ANFUSO. I think we ought to get those figures.

Secretary GATES. I wouldn't know how to get them, sir.

The CHAIRMAN. Mr. Hechler.

Mr. HECHLER. Mr. Secretary, have you consulted with Allen Dulles on this rather abrupt shift in the method of intelligence appraisal?

Secretary GATES. It is not an abrupt shift, but I have, of course, consulted with Mr. Dulles.

Mr. HECHLER. Were you at all deterred by his reactions to this?

Secretary GATES. No. We are trying to give the same facts. We belong to the same organization.

Mr. HECHLER. What I was getting at is, does this represent a new development in administration policy in the appraisal of intelligence?

Secretary GATES. No. It represents an improvement in intelligence. A refinement of former intelligence that hopefully gives us better intelligence.

Mr. HECHLER. This is with the full knowledge and consent of the President then, I assume, that this means of appraising intelligence has been initiated by you?

Secretary GATES. I haven't discussed the matter with the President. The President is, of course, aware of the national intelligence estimate which is the basis upon which we testify.

Mr. HECHLER. I share the feeling of concern of Mr. Teague, Mr. Anfuso and other members of the committee, that we don't have enough sense of urgency in this program.

I wonder if you have considered that your statements on intelligence have contributed toward lulling the American people into complacency?

Secretary GATES. I have no desire to lull people into complacency whatsoever. I have tried to say in every statement that this is one thing we should not be. We should not take the so-called spirit of Camp David seriously in the Department of Defense. We should go ahead with a proper military program. I have said that in every statement in every committee I have been before.

Mr. HECHLER. Mr. Secretary, how important is the Nation's educational system in relation to our progress in the space program?

Secretary GATES. I think Dr. York could better answer that than I. The question is how important is the Nation's educational system in our program?

Mr. HECHLER. I would prefer to have your answer, since I believe this is so important to the security of the Nation in the future. I would like to hear your personal answer as the Secretary of Defense.

Secretary GATES. I would only answer as a lay person in this regard. I would answer that it is very important. That it is extremely important to have coming on people technically trained and qualified in a world that is getting so vastly complicated, and where the technology is changing so rapidly, more rapidly than ever in our history. So I would say it was vital.

Mr. HECHLER. If you feel education is vital, have you communicated this thought to the President?

Secretary GATES. Yes, we have—when I was in the Navy, we instituted in the Department of Defense a great many programs for education of enlisted men, the advanced education of officers——

Mr. HECHLER. I am referring mainly to the general educational system in the country insofar as it contributes toward the production of the kind of people who can help us move forward in research and development.

Secretary GATES. Well, the President is well aware of the importance of this and is vitally and personally interested in getting qualified people in the Department of Defense.

I am sure that this is something where his answer would be the same as mine.

Mr. HECHLER. Have you ever consulted with Vice Admiral Rickover about his ideas on education?

Secretary GATES. I have never spent a great deal of time with Admiral Rickover on his ideas of education. I have heard them. I have read some of his speeches. My contacts with Admiral Rickover were on the business of building nuclear submarines, not on the business of education, upon which he is a great expert.

Mr. HECHLER. He believes, however, that the future defense and progress of this country depend upon our educational system and its ability to produce people who can help us move forward in this whole space program and in the development of new weapons that will assist us in gaining a stronger defense.

Secretary GATES. I know what Admiral Rickover believes. I have heard him. I heard him for a part of the time last night on television

Mr. HECHLER. That is all.

The CHAIRMAN. Mr. Daddario.

Mr. DADDARIO. Mr. Secretary, your position is that today we stand with such strength that no one would dare wage a war against us?

Secretary GATES. That is correct.

Mr. DADDARIO. It then puts us in a position that, assuming also what you say is correct about the Russian ability, that there is a sort of a balance of terror which exists. Our ability to destroy them as well as theirs to destroy us and I wonder how long will this go on? Is this going to be the situation for the next 10 years? Will we be able, say, projecting ourselves 10 years from now, be able to still say that we will have put ourselves in such a position that the Russians will not then, 10 or 20 years from now, be willing to take a chance in casting such a blow against us?

Secretary GATES. This will go on until controlled and proper measures toward disarmament take effect. I believe that as we both move toward more invulnerable methods of retaliation, this will continue to be an offset position until we can enter into a treaty in which we have confidence, a treaty that will be enforceable and real.

Mr. DADDARIO. Well, taking that into consideration, are we doing, then, enough in the civil defense area? Are we doing enough so that in case we are wrong, since there is no present capability of destroying any missiles which can come down upon us within 10 or 15 minutes, are we doing enough so that our people can be protected to the best of our capacity?

Secretary GATES. Well, the civil defense area, other than the military contribution to plans, are not my personal responsibility. Governor Hoegh is in charge of civilian defense. I think he would be the best witness in this respect.

Mr. DADDARIO. Isn't it part of our defensive capacity to be able to withstand a blow and get up from there? And taking into consideration that, plus the geographical distribution of the Russian strength over such a large mass area, doesn't it fit into the picture as to the kind of retaliatory blow we could strike against them, in order to paralyze them. Civil defense certainly has a part to play, does it not?

Secretary GATES. Unquestionably.

It is a piece of the problem and an important one. At the moment under my responsibilities, and the Joint Chiefs of Staff, we believe that the strategic capability we have from a military point of view is the deterrent.

Now a proper civilian defense program is also important as part of that deterrent.

Mr. DADDARIO. Do you think it is being adequately performed, insofar as programing into the future is concerned?

Secretary GATES. I think it is constantly under study and I believe there are five Governors here today discussing this very matter with the people who are responsible for the program, and reviewing it.

Mr. DADDARIO. I gather from that then, that you don't know?

Secretary GATES. I have stated that I felt it was important to have proper and adequate civilian defense. The degree to which the program and the details of that, I do not know because I have only the responsibility to supply the requirements that come to me from the military in carrying out these programs.

Mr. DADDARIO. That is all, Mr. Chairman.

The CHAIRMAN. Mr. King.

Mr. KING. Mr. Secretary, on the bottom of your first page and the top of the second page of your testimony, you point out that during the early days of our missile and space program we were confronted with an alternative. Either we devoted our efforts to reducing the weight of our atomic warhead, or we devoted our efforts to building up the thrust to accommodate itself to the larger warhead, and that we chose the alternative of working on a reduction of the size of the warhead.

Secretary GATES. That is right.

Mr. KING. Presumably the Russians were confronted with the same two alternatives. Presumably they chose the other course.

Secretary GATES. Yes.

Mr. KING. As a result of that, in part at least, they got into space first, they reached the moon first, et cetera, et cetera.

Would it be a fair statement then that the decision that we made was wrong and unimaginative, that we would have done better to have chosen the other course?

Secretary GATES. No. They made the decision sooner and probably with a less advanced technical knowledge.

We believe that the decision we made from a military point of view is correct. Because if we hadn't made this decision, we wouldn't be able to go into the more mobile, smaller systems that we see around the corner. So from a military point of view, it is more important to us to have a more invulnerable deterrent than it is to have very large weapons that are completely immobile. We believe the decision was correct.

It was not correct insofar as shooting the moon is concerned. Insofar as the scientific exploration of space is concerned. But from a military point of view, we believe it was correct.

Mr. KING. Then the Russians' advantage stemmed first from the fact that they did make this correct decision to start emphasizing larger boosters—that was advantage No. 1?

Secretary GATES. Sooner.

Mr. KING. And, No. 2, that they were in there a little before us. They were working at it 2 or 3 years ahead of us. Is that what you are saying?

Secretary GATES. They made it sooner, but they probably were making it on the basis of less scientific capability which permitted us to go the other direction.

Mr. KING. Well, was there any point of time in the development of our own history in which we officially recognized that the decision we made perhaps was a little shortsighted from the "exploration of space" point of view, and where we officially reversed ourselves and decided to emphasize size of boosters—or have we ever come to that stage?

Secretary GATES. We have not reversed ourselves from a military point of view.

Mr. KING. Perhaps Dr. York would like to explore that a little.

Secretary GATES. When we started the Saturn project is where we went into the big booster effort, without clear military requirements, for space scientific exploration—yes, Dr. York would be better than I am on this.

Dr. YORK. Well, those are the facts. I mean as far as the military missiles are concerned, we, to this day, believe that making them smaller is better than bigger and all of our advance programs are in that direction, the Minuteman and the Polaris.

With regard to space and particularly space exploration, the institution of the Saturn program was the first—well that, and the NOVA program were the recognitions of the need for larger boosters for space exploration purposes.

Mr. KING. When did we first conceive the Saturn program?

Dr. YORK. That was about 2 years ago.

Mr. KING. That was after Sputnik I, I take it?

Dr. YORK. Yes.

Mr. KING. May I ask one or two other short questions, Mr. Secretary: I am quite interested in the Minuteman. I have had some briefings on that by Dr. Ritchie and others, specialists in solid fuel.

I must confess, I can't see many, if any, advantages that the Titan and Atlas have that the Minuteman does not have, and I see many advantages that the Minuteman has that the others do not have, because of mobility which you referred to, because of its virtual instantaneous state of readiness to go off, and so on.

My question is, do your plans contemplate that the Minuteman will be given an increasingly important relative position to the other missiles? I believe you mentioned four major weapons systems. I would like to know what the relative position of the Minuteman will be as we look to the next decade.

Secretary GATES. We believe it would be relatively more important. However, we don't believe we will discard the inventory we will have of Atlas and Titan missiles when we get the Minuteman operational. We believe we will keep the alternative ways of doing the same—carrying out the same mission. But we believe it will be relatively more important because we can have more of them, they can become more dispersed and to some extent, can become mobile.

Mr. KING. What can the Atlas do that the Minuteman cannot do?

Secretary GATES. Carry a bigger warhead.

Dr. YORK. With more accuracy.

Mr. KING. I think I have just about 1 more minute. I am interested in this figure on page 7, of $2.4 billion which you refer to. This figure, you say, includes separately identified funds in the procurement budget for development tests and evaluation of large missiles.

Would you like to explain that figure just a little more? I want to be certain what that covers.

Secretary GATES. That is the figure that Dr. York's research and development organization is responsible for. It is the total research effort in missiles. It does not represent the production effort, the construction effort that is involved in the missile program which would have to be added to it.

This is the research effort in the total missile program.

Mr. KING. Would that figure cover both the DOD and the NASA?

Secretary GATES. No, this is Department of Defense.

Dr. YORK. It does not include the DOD space related programs, either.

Mr. KING. Would it be possible for you, offhand, to come up with a figure that would represent our total space budget, both DOD and NASA, both production and R. and D., the whole thing?

Dr. YORK. But this isn't space. This 2.4 is the missile program.

Secretary GATES. Mr. King, it is possible because we have in our budget presentation, that you can extract from the line items the information that you would want. Or we can help you do this for the record if you would like.

Mr. KING. You wouldn't have that figuer at your fingertips, would you?

In other words, when people ask me as a Congressman, "Well, what are we spending on space this year?" and when they say "space", they include missiles—they are wrapping the whole thing up in one package——

Dr. YORK. This includes missiles that go 4 or 5 miles, too, of course.

Mr. KING. What can I tell my constituents when they say, "What are we spending this year on space?" Is there some figure I can give them?

Secretary GATES. We are spending over a billion on Atlas, a billion on Titan, just under a billion dollars on the Polaris in the 1961 program.

On research, I would say we were spending $5 billion. That would have to be checked. That is the total effort, in round numbers.

Do you want space separated out from missiles?

Dr. YORK. Everybody has his own definition of space, Mr. King.

Mr. KING. I grant you that. Perhaps my question is an impossible one, but I was trying to get as big a package as possible.

Secretary GATES. $5 billion or $6 billion on space, plus missiles.

The CHAIRMAN. Mr. Roush.

Mr. ROUSH. Mr. Secretary, I want to be sure I understand your position. Do I understand your position to be that right now we have no military requirement for a larger booster?

Secretary GATES. That is correct.

Mr. ROUSH. Now, the military value of a missile is not restricted to its ability or inability to carry a bomb, is it?

Secretary GATES. The military value of a booster depends on the job you want to do. In the missile program, it is carrying a warhead. In the satellite program, it is for other purposes.

Mr. ROUSH. It has seemed to me that the Department has taken the attitude that its military value is restricted to its ability to carry a warhead. Now I want that——

Secretary GATES. No. No. No.

Mr. ROUSH. Isn't that the reason we didn't go into a larger booster back in 1953?

Secretary GATES. Yes; I think it is. We were trying to develop the most efficient intercontinental ballistic missile program we knew how to build. But we are not solely interested in intercontinental ballistic missiles. As I explained to, I think, the Chairman, in response to his initial questions, we have projects—and I have them listed in my statement—for reconnaissance, communication, navigation, and early warning that don't carry warheads. They are put up in space for other purposes.

Mr. ROUSH. Our present booster is sufficient to take care of our present needs in that field; is that correct?

Secretary GATES. That is correct.

Mr. ROUSH. Doesn't the possibility of a landing on the moon have military value?

Secretary GATES. Yes. We believe it will have. We haven't specifically spelled it out, but we believe when man becomes able to operate in the environment of space, military requirements will develop.

Mr. ROUSH. Doesn't the possibility of interplanetary travel also hold military possibilities?

Secretary GATES. Excuse me, sir, I didn't hear you.

Mr. ROUSH. The possibility of interplanetary travel, that also holds military possibilities, doesn't it?

Secretary GATES. I think anything that starts to use people in that environment is going to develop military requirements.

Mr. ROUSH. And doesn't the military contemplate moving supplies by missiles?

Secretary GATES. Probably somebody has a dream about it.

Mr. ROUSH. And also men?

Secretary GATES. Yes.

Mr. ROUSH. And the military contemplates using space platforms?

Dr. YORK. We contemplate the possibility we may need them and, therefore——

Mr. ROUSH. Well, those possibilities existed some time ago, didn't they, when we made our decision to go into the smaller booster?

Secretary GATES. The important thing from the standpoint of our responsibility is to be sure that we have proper retaliatory capability after we sustain a surprise attack, with Soviet initiative. We have contemplated building the best weapons systems for this purpose.

Mr. ROUSH. What I was getting at, Mr. Secretary, was that you stated from a military standpoint, the decision which was made to go to smaller boosters was not wrong?

Secretary GATES. That is right.

Mr. ROUSH. Well, these same possibilities that required a larger booster existed at that time and it would seem to me that it was a wrong decision from the military standpoint as well as from the civilian space program standpoint.

Secretary GATES. I don't know whether they existed in 1953 or not. This has moved terribly quickly.

Mr. ROUSH. The Russians seemed to see it.

Secretary GATES. I don't know.

Mr. ROUSH. Well, if we had spent more money at that time, we would have had both, wouldn't we? We would have had our space program and we would have had our defensive program?

Secretary GATES. I guess that is correct.

Mr. ROUSH. That is all, Mr. Chairman.

The CHAIRMAN. Mr. Secretary, may I ask you a question or two at this point: We are going ahead with the Polaris submarine although as you have stated there, it has never really been tested.

Secretary GATES. As a system, Mr. Chairman.

The CHAIRMAN. As a system, but regardless, we are going ahead and I want to commend you for going ahead with it. I think it is a good program.

Now, what do you think we should do with the Nike-Zeus program? That is the only system offered to us that has a possibility of defending our country against these Russian ICBM's.

Secretary GATES. The Nike-Zeus program, Mr. Chairman, was given the most comprehensive review by the scientific people both under the President and under the Department of Defense, having in mind making a clear-cut decision on whether or not we should go into production or whether we should continue with full-scale tests or whether we should cancel the program.

I mean to really make a decision on it. And the best judgment we can get is that we should do exactly what we are planning to do. That is to carry out full-scale tests in the Pacific to determine the future course of the system.

I would say that there are many more scientific and technical doubts—they may be proved to be false—but there are more scientific and technical doubts about the Nike-Zeus system than there are about the Polaris system.

The CHAIRMAN. The same decisions are involved, however, and that is whether you will go ahead. Now, Mr. Secretary, for the first time we are face to face with the fact that the Russians can reach us without ever leaving their homeland and destroy this land. And the only system that has been presented to this committee which would hold out the possibilities of preventing that from happening—except by retaliatory means—the only system is the Zeus.

Now, a year ago we took up the question and at great length we heard testimony of those proponents of the Nike-Zeus program who felt that we ought to go ahead with that program because it was the only hope that we had of preventing destruction and terrible devastation in this country in the future.

When are we going to finally make a decision on whether we will go ahead with that program?

Secretary GATES. It is a very important decision, Mr. Chairman, and the Secretary of Defense went to great means to try to get the best and most comprehensive advice that he could possibly get on it. There are technical difficulties with the Nike-Zeus that may be so serious that it might be unwise to go ahead with it. However, we are recommending a new obligational authority of a sizable amount of funds to find out exactly what the perimeters are of these technical problems. We know of no better way to proceed with a system of this magnitude and importance insofar as putting it into production is concerned, than to go ahead with testing as far as we are.

The CHAIRMAN. A committee mentioned by Mr. Teague has suggested we proceed immediately on this program. Is that correct?

Secretary GATES. There have been study groups who made that recommendation.

The CHAIRMAN. Did we overrule the study group?

Secretary GATES. I don't know exactly what study group Mr. Teague is referring to, but we reviewed it with great detail for 6 months.

The CHAIRMAN. My criticism would not be that you haven't taken long enough time to look into it. It is the reverse, that we haven't made a decision on the one hope that this country has of preventing devastation in the event actual hostilities should exist. And yet we pause and we study and we restudy.

Last year, as I say, this committee had a great deal to say about the Nike-Zeus and we went to Alabama to study the program down there, and Redstone, and we came back, many of us, feeling that that ought to go ahead at all possible cost.

Mr. FULTON. Not unanimously.

The CHAIRMAN. It wasn't unanimous, but the majority, I think, was with the program and certainly those who hoped we could prevent fearful devastation, recommended that.

Do you have any idea when we will reach a decision?

Secretary GATES. We will carry out comprehensive full-scale tests and will either prove that this is as good a system as it may well be, or it will prove that it is a system that has so grave deficiencies in it that it would be unwise to produce it.

In the meantime, Mr. Chairman, we are doing a great deal of research work on other possibilities.

The CHAIRMAN. Mr. Teague.

Mr. TEAGUE. Mr. Secretary, there is much concern in Congress that a lot of these decisions are monetary decisions.

Secretary GATES. This one was not.

Mr. TEAGUE. I was interested that the President did not direct your budget, but that the budget was made up within the Defense Department.

Secretary GATES. That is correct.

Mr. TEAGUE. That was your statement, was it not?

Secretary GATES. That is right.

Mr. TEAGUE. Of course, we all understand that your Joint Chiefs would disagree on where the money should go, but you did say that on an overall basis, there is agreement on the budget among the Joint Chiefs?

Secretary GATES. The Joint Chiefs assured Mr. McElroy and when I took office, I confirmed it with them. They will support the total program.

Mr. TEAGUE. One other question: It was reported in the press recently that considerable money was not spent by the Defense Department this last year, that Congress appropriated. Was that a Defense Department decision, or a Bureau of the Budget decision?

Secretary GATES. A Defense Department decision.

Mr. TEAGUE. Those are all my questions, Mr. Secretary, but if my recollection is correct, Mr. McElroy appointed a study group on the Nike-Zeus?

Secretary GATES. That is correct.

Mr. TEAGUE. And they recommended to go ahead with it and then at Dr. York's level, it was overridden?

Secretary GATES. It wasn't only Dr. York's level, good as that level is. This was done by the President's Scientific Advisory Group, also, in addition to the Department of Defense consultants, we brought into it.

This was a very vital decison from the standpoint of national security and I assure you that it was made with the best technical advice that we could get.

Mr. TEAGUE. And a lot of money, too?

Secretary GATES. If the Nike-Zeus system was ever put in production and installed in the United States, it would be the most expensive thing we have ever done, but this is beside the point if it is the only antimissile system and if it is really effective. This is something that we have to consider.

The CHAIRMAN. It is worth almost any price if it is effective.

Mr. Fulton?

Mr. FULTON. And that, of course, is the statement par excellence, whether the Nike-Zeus system is effective. So far, it has not been proved by anybody to be effective and to be able to stop incoming missiles in an effective way so that we would in the United States get defense. The whole problem has been to see whether the Nike-Zeus could have a wide enough reception of an angle of attack that it would really defend the United States.

Secondly, what parts of the United States could be defended? Because nobody ever said that it could defend the whole United States. Thirdly, on the type of missiles coming in, nobody has ever claimed it would protect against missiles launched from submarines or IRBM's, as distinguished from ICBM's.

Under those circumstances, it is a question of whether to go into the reception of missiles at the tail end of their trajectory or to try to intercept them at an earlier date in the trajectory and I, for one, hope that you will continue your research on trying to get something which will intercept these ICBM's or will identify them at a much earlier date nearer their point of launch, and not be standing under an apple tree with an apron trying to catch every apple that falls off the tree. Because one of them is going to bang you on the head. And I think that is a strategic, basic error of the Nike-Zeus system; that we are under the apple tree with an apron trying to catch them, and all they have to do is flood the system. I don't know whether I am allowed to say the number we were thinking about, 3, 4, 5, or 6, we will say, where the defense of the whole United States from one direction is involved, and if we put them to the north and the east, it wouldn't defend you from the northwest, the west, the southwest, the south, the southeast, or the east. And it would not in the least defend you against short distance missiles like IRBM's or missiles launched from submarines.

Is that not correct, generally?

Secretary GATES. You have expressed some of the doubts that caused the decision to be made. That is to have full-scale tests rather than to go into production.

Mr. FULTON. I have felt all along that should be done, and I thoroughly agree that it is a correct course and hope you will continue it.

I might say, with a grain of seriousness, I still hope you will try the Fulton system. It may end up in a different kind of a war, but I would get some sort of a system when these missiles start off, to energize them from the rear. All you do is keep passing them over instead of trying to stop them. Just give them another shove. It might end up like a volleyball game where each one keeps pushing the other's missiles on around the world. If it misses the United States it will land in the Pacific Ocean, in China or maybe in Russia.

May I compliment you on a couple of things. I want to compliment you particularly on the handling of the boron high-energy fuel program, and the changes there have been since the B–70 requirements have been minimized. I do hope that you will keep all the scientific teams working on those high-energy fuel programs in existence and move other projects to them. I feel as a matter of policy, the United States should not disband these scientific research and development teams.

Secondly, I want to compliment you on Maj. Gen. Donald Yates that you have named as the DOD Coordinator for the Project Mercury support. I feeel that he is doing a good job. I served under his command down there as a naval officer at the Atlantic Missile Range, and I think that he will be a very excellent person to be reporting directly to you, Mr. Secretary, through the Joint Chiefs. I am glad to see that that is cutting out redtape and making a direct access.

Another thing I would like to say is that because some of us sat quiet here, does not mean that we agreed that more money or not enough money is spent on claims of fantastic weapons. I hope you don't get us off on a lot of these projects that some people claim will solve everything and that are very expensive.

Another thing I want to compliment you on is that you have not gone into a department store type operation on first generation missiles when we can see ahead of time these will not have a long enough strategic life.

For example, there have been claims last year that we should immediately get into production on some missiles that we then had, because we could look ahead and see in 1962 or 1963 that if Russia kept producing at her then capability, that we would then have much less in number of that type missiles than she had.

As a matter of fact, in missiles and rockets, I disagreed with one of the presidential candidates, about 6 or 8 months ago, Senator Symington, of Missouri, who had taken that strong position. I had disagreed with it and I hope you will continue with the line that the administration has been taking.

Now, may I finally end with this: We have not had a war since 1953, so that obviously from that very fact, the Department of Defense has been doing a good job of preventing war and having a sufficient production and force level to prevent war. Is that not right?

Secretary GATES. We believe so, Mr. Fulton.

Mr. FULTON. And the second point is this: We should not begin to look at the Russian-type production as beginning in 1952, 1953, in looking at these missiles and their progress, but we should look at the period of 1945–46 when they really began to move ahead on these so-called space, or missile programs.

And if you take that whole period of development, you can then see how we, since about 1953, have not only been catching up to the tremendous lag that existed at the end of 1952, but we are also leapfrogging them in many fields. And we have certainly been competent and I would say that it has been a real race. Would you not say that is correct?

Secretary GATES. There is no question about the fact that they started earlier with a big booster effort and I feel that we have made enormous progress in very difficult times of technical change, in a way that has historically never been equaled before.

As I pointed out, the comparison between an ordinary airplane weapons system, and the time we have really been developing these complicated missiles. I think we can take great pride in what we have accomplished and I would like to continue to try to separate the military and the purely space exploration problem.

Mr. FULTON. I think that is a very good distinction that you made and I think it has been pointed out several times here that if we talk space and do not make our terms explicit, it then includes many of the military fields when as a matter of fact, this committee has no jurisdiction in the military field of space.

I want to say this. It has been, on the military level, on the Department of Defense budget, as far as appropriations have gone in the past few years, a matter of pride of both parties that the votes have been unanimous on the final votes for providing the Department of Defense with the money; isn't that right? In the House they have been unanimous votes.

Secretary GATES. Yes.

Mr. FULTON. So we have agreed across party lines as to what is necessary for the defense of this country during the past several years on appropriations. Is that not right?

Secretary GATES. I believe so; yes, sir.

Mr. FULTON. And, as a matter of fact, on that particular point in each case, the House of Representatives agreed unanimously on an amount less than the various services themselves totaled up, had asked for originally; isn't that the case?

Secretary GATES. Yes; this is historically correct.

Mr. TEAGUE. Say that again, Jim. That the Congress has given them less than they asked for?

Mr. FULTON. Less than each individual service had first come in asking the Joint Chiefs for in the budget for the particular year.

Secretary GATES. That is correct.

Mr. TEAGUE. Mr. Secretary, I am going to disagree with both of you because I think you are wrong. It is unimportant, but didn't the Congress give the Defense Department more money last year than they had asked for, and didn't they the year before? Didn't we provide, for example, 200,000 men in the Marine Corps and the money was not used?

Secretary GATES. I don't have the overall data—you did do that; yes, sir. And there have been individual items where there have been great differences, but I don't believe the total difference was very great in the total dollars. There were differences within the dollars.

But Mr. Fulton's point was that within the Department of Defense, the service submissions have always been greater, if they were added up, than the Department of Defense—the President's budget.

Mr. FULTON. And, secondly, that the Congress unanimously gave, too.

Secretary GATES. That is correct.

The CHAIRMAN. Mr. Anfuso.

Mr. ANFUSO. Just to finish up that point, when Congress finally got the figure, it was the administration figure that we got and we appropriated more money than has now been spent by the administration. I think you will concede that.

Secretary GATES. That is very definitely true in certain programs. For example, there was $137 million to put Nike-Zeus in production that has not been spent, based on this decision.

Mr. ANFUSO. Mr. Secretary, I don't want to get political, and I have never been political on this committee. I hope as long as I remain a Member of Congress, I won't be political on this committee because the subject is of too much importance.

I think you will concede that if we had gone ahead, as you said we could have in 1953, with a massive rocket at the same time that we tried to develop a warhead, today we would be that much further ahead; isn't that correct?

Secretary GATES. We would be further ahead in the ability to put large payloads up in space for space exploration purposes; yes.

Mr. ANFUSO. We may have hit the moon before the Russians, we may have circled the moon before the Russians, we may have done those two things?

Secretary GATES. That is correct. We probably would have had to begin before 1953.

Mr. ANFUSO. Perhaps the reason we didn't do it is because we placed budget requirements ahead of defense requirements?

Secretary GATES. No, sir. We placed military requirements ahead of peaceful exploration of space.

Mr. ANFUSO. I hope that you will do that, Mr. Secretary. I said that you will be a good Secretary and I hope that you will be a lot different Secretary of Defense.

The CHAIRMAN. With reference to the question Mr. Fulton asked about the intercepting of these ICBM's at an earlier point in their arc than would be intercepted by the Zeus program, could I ask you here in open session, what progress, if any, we are making in that respect?

And how much money is being spent on that program?

Dr. York. It is still in the idea and study stage. There are a number of proposals from within the Air Force and from outside sources with regard to those possibilities.

The Chairman. So it hasn't gone beyond the study stage.

Now, let me say further, I agree with my colleague from Pennsylvania, Mr. Fulton, that we ought not to get into these ethereal realms, but as far as developing fantastic weapons is concerned, we certainly have to meet the Russians in their fantastic developments. I think that we ought to match blow for blow with the Russians, achievement for achievement.

Now, I haven't heard the Secretary refer to the guidance system, whether our guidance system is equal to that of the Russians, or whether theirs is superior to ours, but I have been watching these developments very closely and it seemed to me that the Russians are developing or have developed their guidance systems that are perhaps superior to ours, and I would like to get your statement in that reference.

Secretary Gates. I would like Dr. York to testify on guidance systems, Mr. Chairman, but I agree with you, I don't feel that we want to react to the Russians. I think we want to make progress and we want to pick up ideas that show promise and we try and do this in a very large research effort.

As I said earlier to one of you gentlemen, I think it is a question of selecting among good ideas. A lot of these ideas are good. Which one is better than good? When it is a little better than good, then we go ahead with it.

I believe we want to be on top of the Russians in everything, including space.

The Chairman. That is right. We want to be No. 1, not No. 2.

Mr. Fulton. Will you yield?

The Chairman. Mr. Fulton.

Mr. Fulton. I can't let the record stand that the possible interception of ICBM's from an enemy is simply at the study stage when the question comes up as to what research and development there might be before the Nike-Zeus system. I am a Reserve officer in the U.S. Navy and I can at least say for the Navy that there is something a lot more than study on previous interception of ICBM's. I won't go into the details, but it is certainly not study.

Secretary Gates. I think the indication is that there is nothing in development. There is real money spent on some of these ideas.

Dr. York. What I meant by study is the fact that there are study contracts let by the services to industrial groups, which are trying to determine on paper the feasibility of such systems.

I was answering in the short form rather than the long form.

To go on, most of them involve components of the type that are taken from other systems so that there is development work going on in most of the areas that would be needed if we were to exploit these ideas, but not under a contract which specifically sets out in a missile interception system, other than Zeus.

The Chairman. Mr. Secretary, if some of the members wanted to ask some questions in executive session, would you be available this afternoon for a while to be in executive session?

50976—60——7

Secretary GATES. Mr. Chairman, I would like very much to be available to you and to the Congress. I have been testifying every day but 1 for 2 weeks and I would very much prefer to be excused, unless you consider it terribly important.

The CHAIRMAN. Dr. York will be available as a witness tomorrow, will he not?

Secretary GATES. Yes, sir.

The CHAIRMAN. Mr. Secretary, before we adjourn then, I want to say this, that if this committee at times seems to be a little critical, it is because of the anxiety that we as members of the committee have, regarding the security of our country, and I think that we are all certainly facing that direction and working in that direction.

I want to say personally, I have known you a long time. I have seen you move up in the Defense Department from one branch of the service to another, and I think you are most competent and capable and I want you to know that you are going to have in this nonpartisan committee, you are going to have the cooperation of the committee insofar as we are able to give you cooperation in defending this country and keeping it from becoming a devastated, washed-out country as a result of ICBM attacks.

I want to thank you very much for coming here and we appreciate it.

Secretary GATES. I appreciate your generous remarks, Mr. Chairman. I consider the committee is only carrying out its responsibility.

The CHAIRMAN. Thank you, sir; and the committee will adjourn until tomorrow morning at 10 o'clock.

(Whereupon, at 12 noon, the committee adjourned to reconvene at 10 a.m., Tuesday, January 26, 1960.)

REVIEW OF THE SPACE PROGRAM

TUESDAY, JANUARY 26, 1960

House of Representatives,
Committee on Science and Astronautics,
Washington, D.C.

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

The Chairman. The committee will come to order.

I want to say in advance of hearing testimony this morning that from now on all of our witnesses ought to be sworn. For that reason, I will start this morning by administering the customary oath to the witnesses.

We happen to have a very distinguished friend of ours this morning as our first witness. He is Dr. Herbert F. York, Director of Defense Research and Engineering. He is accompanied by Brig. Gen. Austin W. Betts, Director of ARPA, and William H. Godel, also of ARPA.

Now, we all know Dr. York. We know his background. We have had the privilege of hearing from him before. We are delighted to welcome you back, Doctor. We all have a few questions we will want to ask you this morning, so we will begin this morning with Dr. York.

I will ask you if you will, Doctor, to stand up—in fact all three of you at one time would be better.

General Betts. Could I add Mr. Sutton to that. He is our Chief Scientist.

The Chairman. They all should give their names to the reporter, so he will have them.

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

Dr. York. I do.

Mr. Godel. I do.

General Betts. I do.

Mr. Sutton. I do.

The Chairman. You are all distinguished witnesses and we are happy to have you all.

You may proceed.

STATEMENT OF DR. HERBERT F. YORK, DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING, DEPARTMENT OF DEFENSE; ACCOMPANIED BY BRIG. GEN. AUSTIN W. BETTS, DIRECTOR OF ADVANCED RESEARCH PROJECTS AGENCY; WILLIAM H. GODEL, DIRECTOR, POLICY AND PLANNING DIVISION, ADVANCED RESEARCH PROJECTS AGENCY; AND GEORGE SUTTON, CHIEF SCIENTIST, ADVANCED RESEARCH PROJECTS AGENCY

Dr. York. Mr. Chairman and members of the committee, I welcome this opportunity to appear before you today and present information regarding the Department of Defense research and engineering program, particularly the space effort as it is integrated into the overall defense posture of the United States.

In regard to the broad Department of Defense policy on the role of space in our overall defense effort, I would like to refer to the statement made by the Secretary of Defense yesterday which pointed out that we are directly concerned only with those space activities having direct military applications, and supplement this by stressing that the objectives of the defense efforts in space are (1) the development, production, and operation of space systems where it can be demonstrated with reasonable certainty that the use of space flight will enhance the overall defense program, and (2) the development of components which would be needed in systems which cannot be clearly defined at this time, but which will develop as the future unfolds in this new sphere of activity.

I would also like to talk further on the organizational changes as related to space activities and the basic reasons therefor. It was decided in September 1959 that the satellite and space vehicle operations of the Department of Defense would be assigned to the appropriate military department after consideration of the primary interest or special competence of the respective services. Where no one military department has primary interest or special competence, consideration will be given to special competency in associated fields of development. The responsibility for the development, production and launching of space boosters and the necessary systems integration incident thereto has been assigned to the Department of the Air Force. The Air Force is now completing the development of the Agena–B, upper stage vehicle for Discoverer, Samos and Midas, which was initiated by ARPA, and since transferred to the Air Force.

Also, the improvement programs of our current ICBM missiles will undoubtedly povide improved components and considerably increased weight launching capabilities which will be utilized for some of our military space requirements as well as increased payload capabilities for our ICBM's. The Air Force will also, as required, develop the necessary upper stages for these improved boosters.

The specific assignments of the payloads for space and satellite systems are being made separately to the appropriate military department which, in addition to budgeting for the payload, will also budget and reimburse the Department of the Air Force for the necessary boosters, launching vehicles and other unique equipment required in launching and for the necessary system integration. At the present time, the Discoverer (engineering development and test satellite), Midas (early warning satellite), and Samos (reconnaissance satellite) projects have been transferred to the Air Force. Transfer of these projects was effected on November 17, 1959. The remaining space oriented systems of communication (Notus) and navigational satellites (Transit) will probably be transferred during the latter part of this fiscal year.

A recent analysis of the programed space systems funding of the Department of Defense for the current fiscal year, exclusive of the Saturn project which is planned to be transferred to NASA, indicates that approximately 85 percent of the reorganization of the DOD space-related programs, as measured in dollars, has already been accomplished. The remaining 15 percent of the Department of Defense space systems effort is principally under ARPA management, the remainder expected to be transferred to the military services by the end of this fiscal year.

As you already know, the Centaur space booster project was transferred to the National Aeronautics and Space Administration last year. The transfer of the Saturn booster project and the development division of the ABMA to NASA is currently pending congressional approval. The National Aeronautics and Space Administration and the Department of Defense will coordinate their requirements and thus eliminate the need for both agencies developing these very large space boosters. Even though these superbooster programs are now being pursued by NASA, the Department of Defense strongly supports these programs and considers that there will be a requirement for them in future military applications.

The DOD-NASA working relationships over the past year have become better coordinated, with many members of my staff, ARPA, and the services meeting frequently with their counterparts in the NASA. These meetings are taking place at various working levels on a day-to-day basis. In addition to mutually supporting relationships on the related space projects of the Department of Defense and NASA, our national missile ranges have been supporting the research and development programs of both NASA and DOD. It is expected that integration of range support for both missiles and space vehicles will be given increasingly greater emphasis as both the missile and space efforts continue to grow. As an interim measure until a permanent management scheme can be developed to coordinate all launching and tracking support activities, Gen. Donald Yates, commander, Atlantic Missile Range, has been appointed as coordinator for all DOD support to Project Mercury.

The currently programed defense systems having space subsystems are Samos (reconnaissance satellite), Midas (early warning satellite), Notus (communications satellite), and Transit (navigational aid satellite.). The two most advanced, and probably most important, space systems are the Midas and Samos. The remaining two space systems are less far along and the scope of their use is less clear. It is expected that considerable effort will be required to implement both Samos and Midas with a major part of the effort lying in the fields of data tracking, data transmission, data reduction, and data anlysis.

Other space-related programs in the Department of Defense include Dynasoar, which is an aerospace exploratory development program designed to investigate the problems of controlled flight at speeds up to Mach 25 (i.e., reentry velocity), and at altitudes up to several hundred thousand feet (i.e., reentry altitudes); components development research in such fields as auxiliary power and advanced propulsion methods; and Projects Shepherd and Vela, described below in the summary of present ARPA activities.

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

I have brought a number of charts indicating the concept, goals, and funding of the various defense space systems and related space projects, which are available for presentation to the committee after the reading of this statement, if so desired. However, a few of the charts are of a classified nature and can be shown and discussed only in an executive session.

In addition to these specifically identified space-related programs, the technology, facilities, and components developed and built for past and present missile programs have provided the major source of, and support for, today's space programs, and the future missile programs will continue to be a major source of support, in all aspects, to the future space programs, both military and civilian. The total research, development, test, and evaluation program for all missiles in fiscal year 1961 will be approximately $2.41 billion. These figures include both the missile items in the RDT & E appropriation, and the separately identified DT & E items, principally for the ICBM's, in the procurement appropriation.

Further, many of the basic and applied research projects of ARPA and the Services will contribute to progress in rocketry for either missile or space flight applications. These include such projects as the ARPA Principia program, and numerous programs in the Services in such fields as rocket propulsion, guidance and control methods and mechanisms, propellant chemistry, and electronic components development especially as related to reliability, long life, and miniaturization.

All together, the above programs in space-related programs, missile research and engineering, and rocket oriented applied research, constitute approximately one-half of the total defense RDT & E budget request.

The projects which will remain in ARPA after the presently planned transfers are accomplished are: Project Defender, which is a research, experimentation, development and systems feasibility demonstration undertaking to obtain technologically advanced defense against extra-atmospheric offense vehicles, including ballistic missiles and space vehicles. The project is aimed toward exploration of fundamental phenomena, development of new systems concepts and the application of new techniques.

The Defender project now consists of more than 50 programs in the area of missile flight phenomenology, characteristics of the upper atmosphere, radar development, reentry body identification, etc.; Project Principia, which is a research program to develop more optimum performance for solid propellants for missiles and space boosters; Project Pontus, which is concerned with basic research in materials—it includes fundamental theoretical and experimental work aimed at realizing a major advancement in structural and power conversion materials; Project Longsight, which is a series of studies and systems analyses in the military sciences field to obtain on a continuing basis recommendations as to projects which should be initiated to satisfy the future military needs of the various services; Project Shepherd, which provides for the development of a satellite detection and tracking system which will include a National Space Surveillance Control Center; and Project Vela, which provides for the development of adequate means for the worldwide policing or surveillance of a moratorium on atomic weapons testing. The new obligational authority being requested for fiscal year 1961 for these ARPA programs is $215 million.

This concludes my prepared statement. I have with me Brig. Gen. A. W. Betts, the newly designated Director of the Advanced Research Projects Agency; and Mr. William H. Godel, the Director of the Policy and Planning Division of ARPA; and also Mr. George Sutton, who is the Chief Scientist of ARPA; who are prepared to discuss in more detail the ARPA program within the Department of Defense, and I will be glad to attempt to answer any questions the committee may wish to put to me.

The CHAIRMAN. Thank you very much for a very good presentation and statement. It is a little difficult to follow you because you jump from one thing to another so rapidly. However, your statement is excellent and I want to thank you.

May I begin the questioning this morning by asking you this: Yesterday and in preceding hearings there was a lot said about the military requirement for certain projects.

What is really meant by military requirement?

Dr. YORK. Well, we use that term in a rather special sense. What we mean is that when we state there is a military requirement, we mean there is a specific need for a fairly well defined system to accomplish a military objective. So that we say there is a military requirement, for example, for the Midas system, because we need to increase our capability in early warning and so on for the others.

The CHAIRMAN. Who sets that military requirement? Does DOD set it or do the several services initiate the military requirements?

Dr. YORK. They are set variously. Mostly by the service involved. If there is a question about it, then it may be set by the Joint Chiefs or by the Secretary of Defense.

The CHAIRMAN. Now, with regard to requirements for space activities, who sets those? Does the Joint Chiefs, the military department, or the DOD?

Dr. YORK. Actually it is really all three, but these have—in the case of these space-related programs, these have been all gone over with the Joint Chiefs of Staff.

The CHAIRMAN. All of them have been approved by the Joint Chiefs of Staff, is that correct?

Dr. YORK. The four which are to gain specific objectives. The weapons system, the navigational aids satellite, and so on. The Dynasoar project, I don't believe has gone to the Joint Chiefs of Staff.

The CHAIRMAN. Have all your other programs gone to the Joint Chiefs and been approved? When you say "gone to", do you mean they have actually been approved or not?

Dr. YORK. In the case of those four, I am not sure what is in writing, but I am sure it is accurate to say they have been approved by the Joint Chiefs. The Dynasoar program has not, nor have most of these component development programs.

The CHAIRMAN. Which four are you talking about that have been approved?

Dr. YORK. Early warning, reconnaissance, navigation, and communication.

The CHAIRMAN. Don't those projects have a requirement for a large booster?

Dr. YORK. They require ICBM-type boosters in order to achieve them.

The CHAIRMAN. Will anything less than a million pound thrust booster be sufficient for those projects?

Dr. YORK. Oh, yes.

The CHAIRMAN. Can you handle those projects with a small ICBM?

Dr. YORK. Yes. The payloads as they are now understood for all of these are quite well within the range of an ICBM base booster system.

The CHAIRMAN. Then according to your testimony, when those programs are completed or ready for operation, the booster system is now available for that purpose?

Dr. YORK. For these programs as we now see them. But we are sure that other things are going to develop that we don't foresee and, therefore, we very strongly support the development of a bigger booster system.

And furthermore, we are developing ourselves ICBM base systems that will launch two or three times as much, 2 or 3 years down the road, as we can launch this year. I mean we are much interested in larger payloads.

The CHAIRMAN. When these satellite programs are further developed and they need larger payloads, they will need larger boosters.

Dr. YORK. When they need much larger payloads, that is right.

The CHAIRMAN. What troubles me is the fact that I understood yesterday the Secretary of Defense to say we had no present requirement—meaning present military requirement—for a large booster. It seemed to me that if we wait until we have the military requirement to develop the large booster, we are in serious difficulty.

Dr. YORK. Precisely, and that is why we do support the development of larger boosters.

The leadtime on boosters is so long that we can't afford to wait until we have a specific military requirement to then start the booster. Therefore, we have a program underway to uprate our ICBM's and to optimize their use for launching. Through this mechanism, we can get payloads about three times bigger than we foresee the immediate need for and we support the Saturn program very strongly and the Nova program.

The CHAIRMAN. It seems to me when you say you have no present military requirement, actually you are straining a little bit because the requirement can't wait until the missile is perfected.

Dr. YORK. That is right.

The CHAIRMAN. Your requirement is made ahead of time.

Dr. YORK. That is right.

The CHAIRMAN. Just like the requirement for the Navy project.

Dr. YORK. We don't propose waiting for the specific requirement to develop.

The CHAIRMAN. Now, who set the figures for the required funds for these projects?

Dr. YORK. Well, they are a result of what I am sure you all understand, in outline at least, of the budget process in the Department of Defense. These are figures which, first of all, come from the services. These figures largely came from ARPA. Some of them came from the Department of the Air Force in their first cut at their plans for the year 1961.

These then were worked over by the Office of the Secretary of Defense, we, the Comptroller, and the Joint Chiefs. The Secretary discussed yesterday how he had discussed with them the question of the total size of the budget. The decisions are reached through a series of conferences between the interested parties.

The CHAIRMAN. Now, in working out this new proposed legislation amending the Space Act, were you consulted on that?

Dr. YORK. Yes; we were consulted.

The CHAIRMAN. By whom were you consulted? The President? Dr. Glennan? Dr. Kistiakowsky?

Dr. YORK. There were numerous meetings between primarily Dr. Glennan and his people and the Secretary, the Deputy Secretary, myself and others, in the Department of Defense.

The CHAIRMAN. Did you assist in drafting the bill?

Dr. YORK. I didn't assist in drafting the bill in the sense of getting right in and working on it. Our legal people, as well as our other administrative people, went over the thing and made many suggestions as to changes, and so forth.

The CHAIRMAN. You consulted the military services?

Dr. YORK. Yes; we consulted them at various times.

The CHAIRMAN. And you support the bill?

Dr. YORK. Yes.

The CHAIRMAN. Mr. Fulton.

Mr. FULTON. We are very glad to have you here, Dr. York, General Betts, and Mr. Godel.

You say that by the end of the year the remaining 15 percent of the Department of Defense space efforts will have been assigned to the Armed Forces.

That leaves the question of what will happen to ARPA when this is accomplished?

Dr. YORK. It has the remaining space programs that would be transferred. On page 6 of my prepared statement is a list of the projects that will remain with ARPA after the presently planned things are accomplished.

These are the things related to ballistic missile defense, but in addition, there are some—call them basic applied research programs, basic programs in materials, solid propellants, and in general, studies and analyses; and also, at least for some longer time, the Project Shepherd and then Project Vela, also is an ARPA program, so it is a sizable number of programs, but they are all nonspace.

Mr. FULTON. I am glad that you brought out the facts on Project Defender, overall, because actually the Project Defender is not a substitute for, but it is one of the same type of projects as the Nike-Zeus defense project, the antimissile project.

Secondly, it has 50 separate program ramifications, doesn't it?

Dr. YORK. Yes.

Mr. FULTON. So in that field we are not without doing something, when we don't make the final decision on putting the Nike-Zeus project into operational status, because we are advancing in many other fields. Is that not the case?

Dr. YORK. Project Defender is about a $100 million program altogether.

Mr. FULTON. Likewise, when we get to these other projects like Project Vela, for example, your Principia program, your Midas, your Samos, your Notus, and your Transit programs, all would have a bearing on an antimissile defense. We are learning the characteristics of these missiles, on their flight, their reentry, on early warning, on communications, on navigational points. So we really are moving ahead on research in the Nike-Zeus field without putting the particular Nike-Zeus equipment into operational status. Is that not right?

Dr. YORK. That is right. There are some other things, too, that relate to antimissile defense which are not in Defender. The Air Force has separate studies on the question of possible new antimissile systems and the Navy has a small study project. A study project, here—just to amplify that—that is another technical term we use. A study project may be a million dollars effort in engineering. It simply means that we are not going ahead and building something right now, but a study is a sizable effort.

Mr. FULTON. It is a research project which is in action rather than just a piece of paper, sitting on somebody's desk, or in somebody's mind. It is actually a project that is under contract in many instances, to outside institutions or companies, or even within your own DOD.

Dr. YORK. Normally, they are outside. I mean they are by contract, contracts running from a half million dollars to a million dollars.

Mr. FULTON. I am not going to use the rest of my time, but I certainly would like to see the charts you may have that could be made public.

Could we see those?

The CHAIRMAN. Are they available?

Dr. YORK. We have them here. Do you want to do that now?

Mr. FULTON. I would like to see that.

The CHAIRMAN. Why not do this, Mr. Fulton? I think in fairness to you, that shouldn't be taken out of your time.

Mr. FULTON. I am through, but I think if we are going to go into the budgets and what these projects are, these charts that can be made public would be very helpful.

The CHAIRMAN. When would be the best time to take them up, Doctor?

Dr. YORK. We can take them up now. I don't claim that they add an awful lot to what is here, but I can take them up now.

The CHAIRMAN. Before we recognize Mr. Teague, we will take them up, and then I will recognize Mr. Teague.

Mr. FULTON. Just while you are setting that up, Doctor, you do recommend the legislation that has been submitted to Congress for the transfer of the programs from the DOD to NASA, do you not?

Dr. YORK. Yes.

Mr. FULTON. So that the Saturn project is to be transferred and the vehicle that has been prepared is satisfactorily capable of performing that function?

Dr. YORK. That is what we have tried to make sure of, that there would be a sufficient and proper effort on that.

The CHAIRMAN. You may now proceed with the charts.

Dr. YORK. These are charts prepared for a multiplicity of uses. They describe military programs using space subsystems. We have said it that way just to point out that in most cases the problems to be solved are not so much problems in rocketry as they are problems in data acquisition, data transmission, data reduction, and so forth.

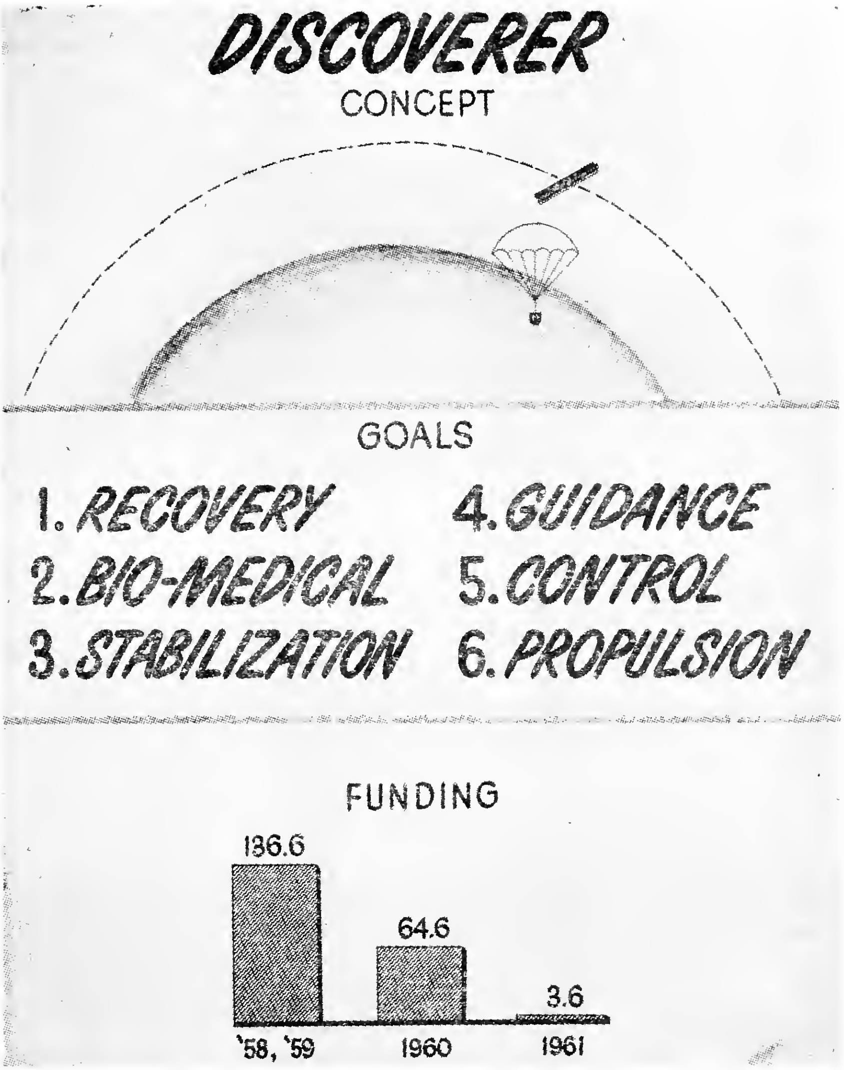

FIGURE 1

The only two charts not here relate to reconnaissance and to a summary of the complete program.

The Discoverer program is an engineering research program whose purpose has been to check out the equipment needed for recovery, stabilization, guidance, control, and propulsion; equipment that will be needed in all of our future programs—Midas, Samos, and so forth.

The reason for the Discoverer program is that using a smaller booster, the Thor-type booster, we can get enough of this kind of equipment into space to check it out prior to the availability of the Atlas booster which would be needed to check out a complete system.

It is possible to include in some of these flights biomedical payloads.

Funding in 1959–58 was $136 or $137 million, and in 1961 it goes down to $3.4 million.

That is because the big booster is available and the work done with the Thor booster will now be done in connection with the complete system.

The CHAIRMAN. That is phased out at the end of 1961?

Dr. YORK. Yes. The work that is being done in this will be done under the heading of Midas, Samos, and so on.

This was an interim program designed to enable us to get ahead with engineering prior to the availability of the big booster.

The early warning satellite, or Midas, the ultimate goal here, is early warning of ballistic missile attack. The purpose of the immediate program is to determine the feasibility of infrared detection for the purpose of perfecting a data processing system on the ground and in space, with special emphasis on reliability (fig. 2).

The program has been going from $23 million up to $102 million. The question of what 1962 will be will depend very critically on how it goes. That is, when it begins to actually start using this system for early warning, the costs will mount very rapidly.

But reliability of the equipment—that is, obtaining long life—and simply determining how the earth looks in infrared, what the background problems are——

The CHAIRMAN. What do you envision to be the ultimate cost of that program?

Dr. YORK. It depends critically on reliability, because that determines the number of satellites per year that you have to actually launch in order to have them working and it depends on the capability for controlling the orbit, because this determines again the number you need in order to get high percentage coverage. If everything goes well, a few hundred million dollars a year.

Mr. FULTON. That is really Midas, isn't it?

Dr. YORK. This is Midas.

The navigational satellite is a smaller one. Its purpose is to provide a navigational aid which works in a fashion similar to the way the old astronavigation works, except that we provide the star, ourselves, instead of using a natural one, and we detect and locate ourselves with respect to it by means of radio, so it works on cloudy days and what have you (fig. 3, p. 106).

The immediate goals of the program, the ultimate goals for location of ships, submarines and potentially, aircraft. The early phases involve cleaning out the feasibility of the Doppler technique, and correction of ionospheric refraction and that sort of thing.

This funding is only sufficient for doing these first experiments and feasibility correction.

If it works out to be an important navigational aid, that those concerned with navigation like, then the funding has to rise considerably. But with that and with the other one, the one important point to emphasize is that the future course of the funding, or of this program, the navigation program and the early warning program, don't depend on the future course of space programs in general, but rather, on how important is early warning and how good is this way

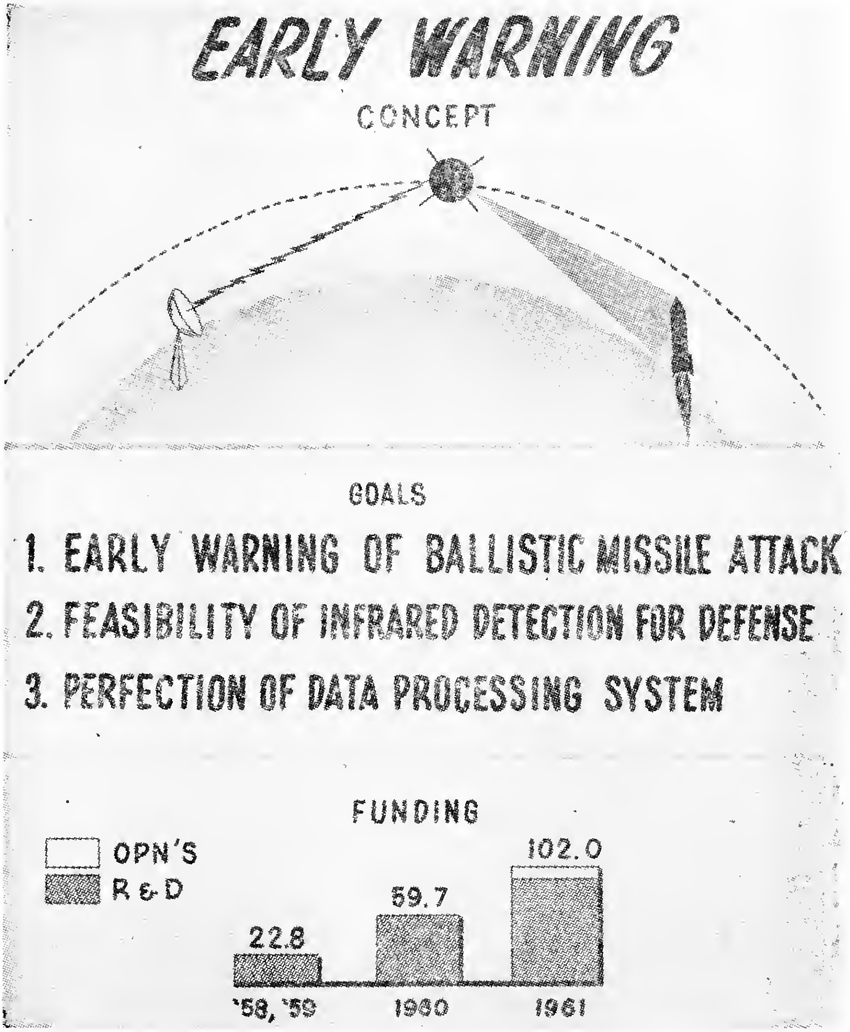

FIGURE 2

of doing early warning as compared with others, how good is this way of doing navigation as compared with others.

Mr. FULTON. Your name for that is Transit?

Dr. YORK. This is Transit.

In other words, to go back, we judge these all on their functional bases, when it comes to funding or otherwise and not on an environmental basis. Not as a space program, but as a navigational program.

This is a simplified chart of the communications concept. This is the Notus program which has several parts to it. The ultimate goal here is real time global communications (fig. 4, p. 107).

We have also the Courier program which is communications, but not real time. The Courier is the one where you load a tape recorder with

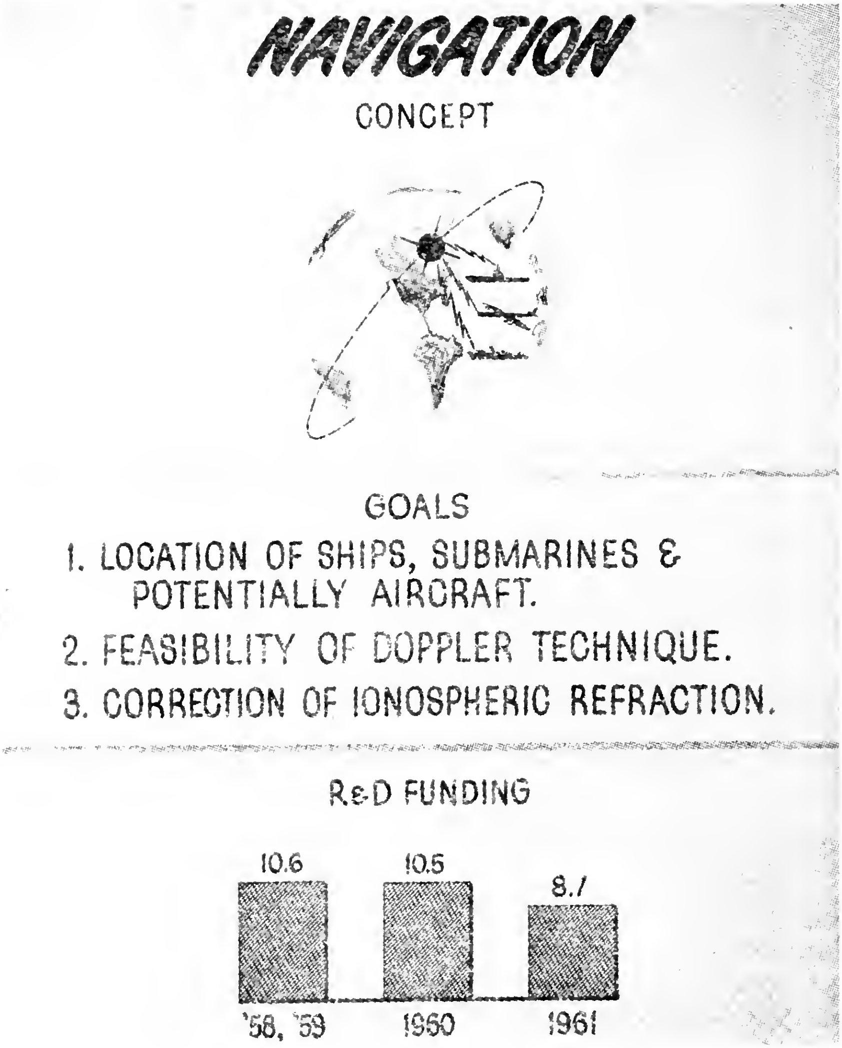

FIGURE 3

data and at a later point in its orbit, you use an electronic key to get it to disgorge. But ultimately we are talking about a real time global system.

Communications is one of the big military problems that has been with us, always. The total amount of band width we need is continuously rising and we are getting into more and more difficulty trying to use the existing techniques and expand on them, so this is important as a means toward expanding a military communications capability.

Eventually we hope also to be able to use this to get a link with aircraft and ships in the polar regions and we want to get a large worldwide traffic capability.

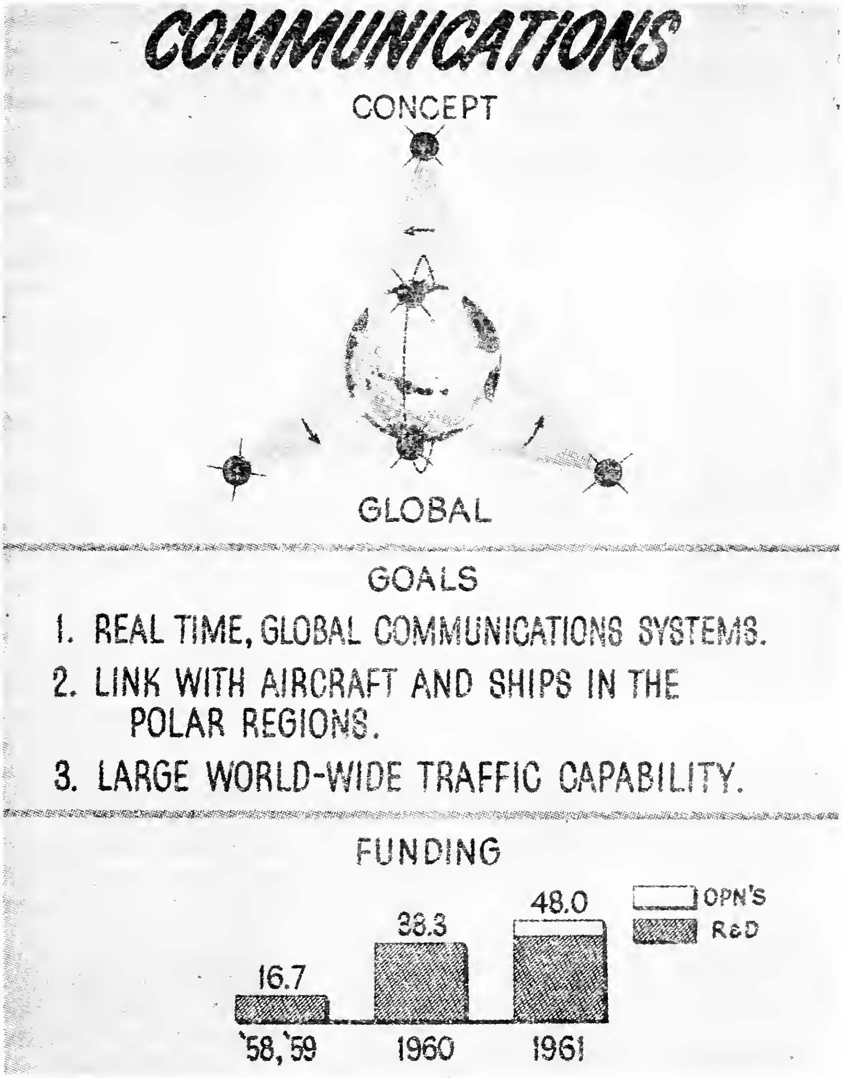

FIGURE 4

To do that, in addition to the Courier, which is short term, we conceive of a system that is based on the so-called stationary satellite, where you have three satellites in a so-called 24-hour orbit. These can reach all parts of the earth except that within 20 degress of the poles. In order to reach the poles, we have to have in addition, a number of satellites at a lower, but polar, orbit.

The funding goes from $17 million to $38 million to $48 million, but if this develops as a useful communications system, again there will have to be a marked rise in the future, perhaps even in 1961.

Mr. FULTON. When is your target date on that and would it mean the establishment of a worldwide television and radio system?

Dr. YORK. The capability of a 24-hour satellite is within the television and radio range.

I might say on the communications program, this is one of the gray areas where the question is, is it military or civilian and it has been settled easily by just executive agreement.

There is another way to go about this which involves the use of passive satellites. I didn't mention it, but these are active. That is, each one of these satellites has in it a receiver, an amplifier and a transmitter. Therefore, it is a powered signal which comes back.

There is another concept based on the use of simple radio reflectors which is called a passive system. NASA is exploring that, but this system might very well be used for television. But the basic work that has to be done is similar, whether this is for a large number of voice channels for the Department of Defense, or data links, or whether it is a television system for commercial use.

The CHAIRMAN. Doctor, that system might be self-supporting, might it not?

Dr. YORK. You mean in——

The CHAIRMAN. Communications.

Dr. YORK. A commercial system presumably would be, but the heaviest loads in international traffic today are military. Presumably if this was in, that would probably continue to be the case, perhaps not.

Mr. FULTON. Could you tell us when we could have worldwide television and worldwide radio communication?

Dr. YORK. It is a number of years off. The biggest question here, as with several of these others, is the question of getting a good reliable system, because if you have to put these up at the rate of one a month, you won't do it, because the costs will be too great. If you can put these up at the rate of one a year or two a year, then it becomes a competitive system.

It is very hard to predict when that will happen. This is one of the programs that requires a bigger booster than is available in 1961, a better system. This requires the ICBM, with the Centaur stage on top in order to accomplish it.

The CHAIRMAN. What are the interests of the military in television?

Dr. YORK. From the point of view of commercial television, not particularly great, but we do have information to get around that uses a band almost as broad as television for certain of the kinds of data we want to get, with the speeds we want to get.

We are interested in a large number of voice channels, other communications channels, a number such that it is equivalent to television. I did not say we were specifically interested in television.

Mr. BASS. How can you keep such a system exclusive, except by agreement?

Dr. YORK. This again, is a problem in electronics. There are various things you can do, depending on exactly what you think the problem is. Such as have a coded key that has to be sent up before you can get into it, and things of that sort. And then, of course, you keep it confidential by means of using coded messages, the same as we do with broadcasts, now.

Mr. FULTON. As a matter of fact, for a military application, that kind of communications system could be used for jamming. Then if your radio bands and communication bands were narrow enough so that they were practically line-of-sight, nobody else could jam you. There is that tremendous gain. I don't see why we don't move faster to get that ability to jam out all other ordinary radio communications, not only in the atmosphere, but on the ground level. For example, tanks would be blocked. When we do have a system that would jam everybody and they couldn't jam us, it would seem to me to be of tremendous military gain.

Dr. YORK. Well, we are concerned with the question of how this might be jammed and what you do about it, and there are real possibilities here, but now this comes to the electronic game of measures, counter-measures, counter-counter-measures and so on, and we wouldn't be discussing just how we plan to go about achieving the security of the system.

Mr. FULTON. Could I finish with one thing. General Electric of Philadelphia had some people here, I believe, Mr. Chairman, a year or so ago and they felt they could get up three communications satellites within a 2-, 2½-, or 3-year period that would have the capability of four bands apiece and the equivalent of handling 500 digits a second on each band. That would be 2,000 units a second on each of the satellites.

What has been done on that? I am surprised to hear that the point in time is now receding when we have had testimony previously that it could be done quickly.

Dr. YORK. These are not contradictory, really. You can get a satellite up that will do that in a couple of years, but it probably cannot be a reliable component in an important worldwide communications system at that time.

There will be satellites flying within a couple of years in this program. When I made my first remarks, it was with respect to when you could expect to have a reliable communications system for an important purpose.

The CHAIRMAN. You are not getting all the money you really can use or need on that program, are you?

Dr. YORK. You could make it go faster with more, but this seems to be the best balance.

Mr. FULTON. How much would you recommend more, then?

Dr. YORK. This is the figure we are recommending in the 1961 budget.

The CHAIRMAN. What did you recommend before the Bureau of the Budget got hold of you?

Dr. YORK. As Mr. Gates has described a number of times, the services and ARPA were asked to submit two figures: A lower one and an upper one for each of these programs.

This is somewhere between the two. I don't remember what the figures were. I am informed they were both the same.

Well, there is the ARPA submittal to the Department of Defense.

The CHAIRMAN. How much more could you use to speed that program up?

Dr. YORK. What the more would mostly go into would be long-lead-time items for use out in 1961. I can't answer the question directly.

Mr. FULTON. Could you prepare that for us? To my mind, after hearing this previous testimony from other people, it seems as if this program is being lengthened by several years over what I thought was applicable.

Dr. YORK. I don't think that these two pieces of testimony really are in conflict.

Mr. RIEHLMAN. Do I understand correctly that you do have a target date of at least 2 years before something constructive can be done?

Dr. YORK. No, there are satellites in orbit, in this program sooner than 2 years. There are satellites in orbit this year in this program.

The problem is trying to make a judgment as to when you can get necessary reliability and component work done. It is not a problem in space flight.

Mr. RIEHLMAN. Do you have any idea when that could be accomplished?

Dr. YORK. Several years before this can be a useful military communications system.

The CHAIRMAN. Doctor, if you had all the money you needed for that program, and I think it is vital, when could you make it workable?

Dr. YORK. You couldn't speed it up with more money right now. The question is, we are still a year and a half from the end of fiscal year 1961 and we have the problem here that we have with all development programs, of trying to predict what we are going to need almost two years from the time we make the prediction.

If this program needs more and if in terms of military requirements and communications, it is deemed worthy of more, then we will see what we can do about getting more.

Mr. FULTON. Could I ask you this question along those lines: General Electric, Philadelphia——

Dr. YORK. General Electric is one of the contractors on this.

Mr. FULTON. They said that for one to two hundred million dollars there could be three satellites up, each with a capability of 2,000 units per second in operation within a 2-year period from about a year ago. Why aren't we doing just that? It seems to me we get so refined and try to put so much in them. Why don't we just go for a straight-out satellite that can give us that kind of a transmittal or——

Dr. YORK. Our purpose is to solve the military communications problems and to solve the military communications problem, we need a reliable communications system.

We are, in fact, going ahead on a rapid basis with respect to Courier, which is a smaller item than the present communications system.

The CHAIRMAN. I am going to suggest at this point the doctor be that they are dead or that they were put up by someone else, with an opportunity to ask any questions.

Dr. YORK. This is the development of the system and, in fact, the use of the system that is in operation now, whose purpose is to detect nonradiating satellites. Nonradiating for whatever reason, either that they are dead or that they were put up by someone else, with an attempt to hide them, and to keep track of them (fig. 5).

There are a number of reasons for wanting to do that. One is we just want to know what is going on. Second, we want to have a good catalog of these things to avoid spoofing of our ballistic missile early warning system. We need to keep track of all satellites.

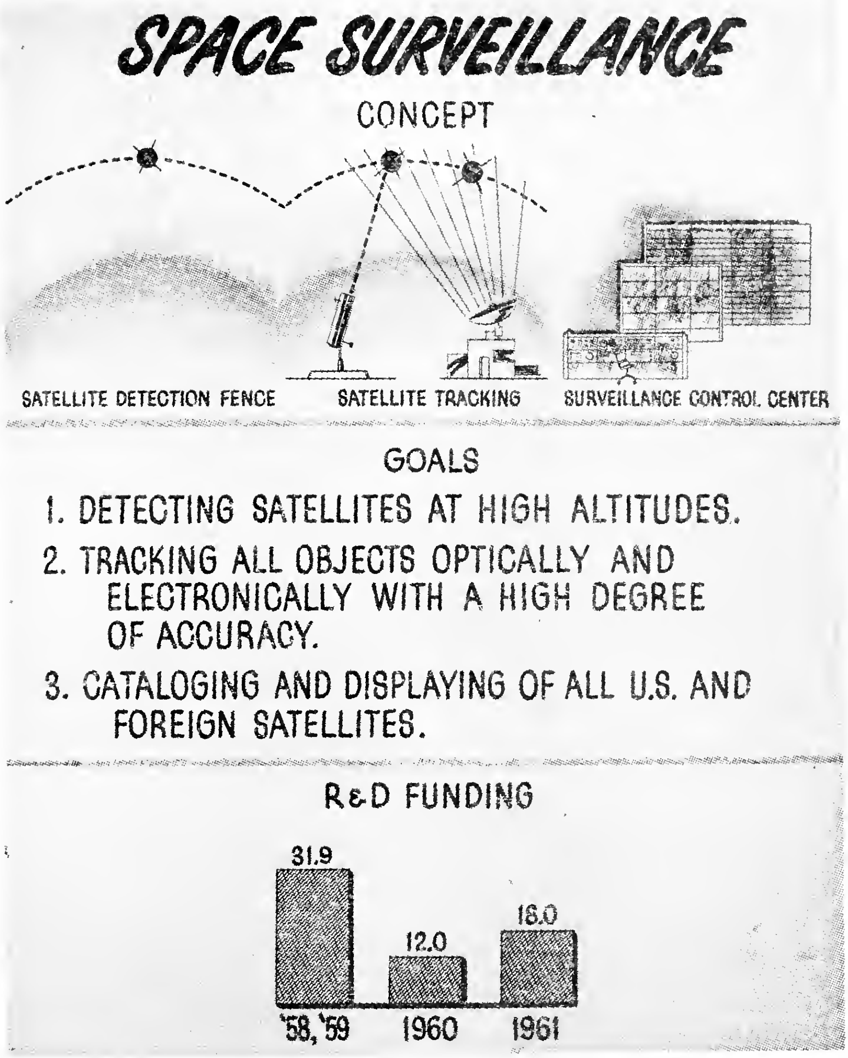

FIGURE 5

There is a system in operation now and the R. & D. indicates an improvement in that.

We have a number of things going on in studies and component development which we have mentioned. We are looking into new types of power sources. We are looking into advanced propulsion techniques, the general application of satellites, the development of components for more than one project—the Discoverer program, for instance, is similar to these, and looking at the development of components to test feasibility of projects which are not now fully approved for development (fig. 6, p. 112).

FIGURE 6

The total amount of money in this—this is not a particularly good picture of what is going on because a quite large amount of money in this field is carried in the applied research budgets, particularly of the Air Force, but also in the other services, and doesn't show as being separately related to space, but nevertheless, makes a direct contribution.

We have carried on vehicle development. The money singles out the Agena program which is the second stage for use with Thor-Atlas. There are others. There are being carried on, again

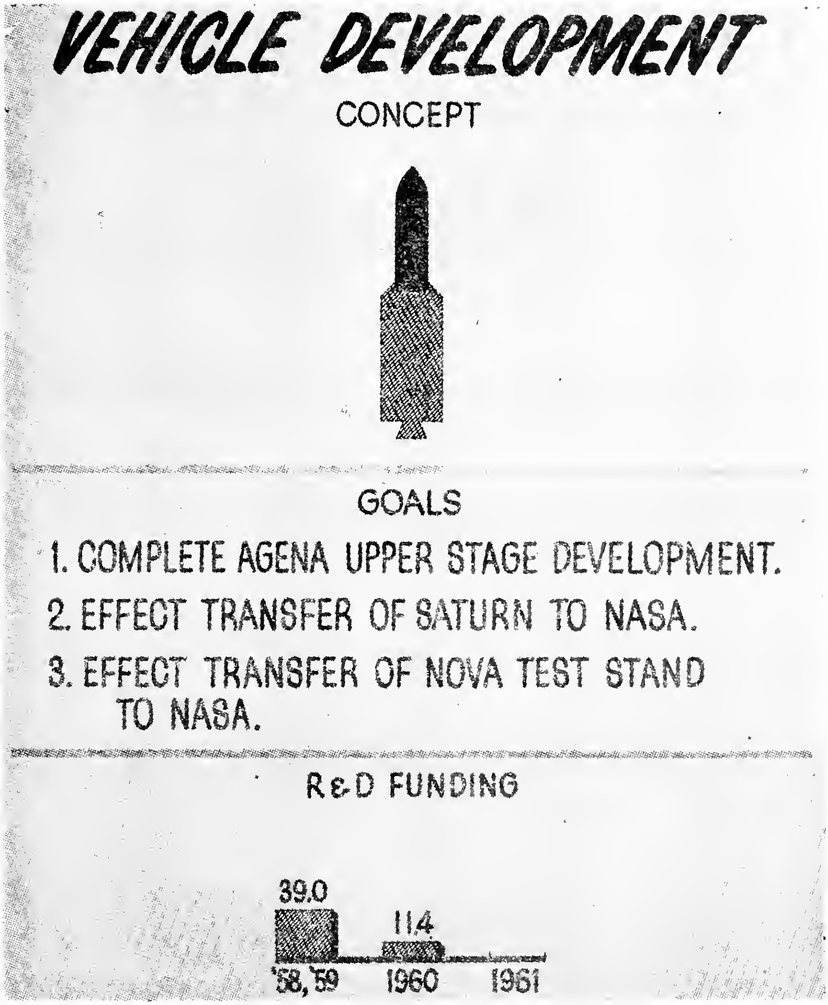

FIGURE 7

either in the applied research projects or as part of one of the programs. This was brought for assistance in comparing with past budgets when there was a separately identified item (fig. 7).

The goal here is really research in manned aerospace flight. With the X–15 we get up to mach 6. We would like to know for whatever reason we may need the information, what the problems and possibilities in controlled flight up to mach 25 are, up to extremely high altitudes (fig. 8, p. 114).

One possible application of knowledge in this field is for controlled reentry from orbit.

If there ever should develop a manned military system, we are surely going to need to be able to get the man back in a controlled fashion, and where and when we want him.

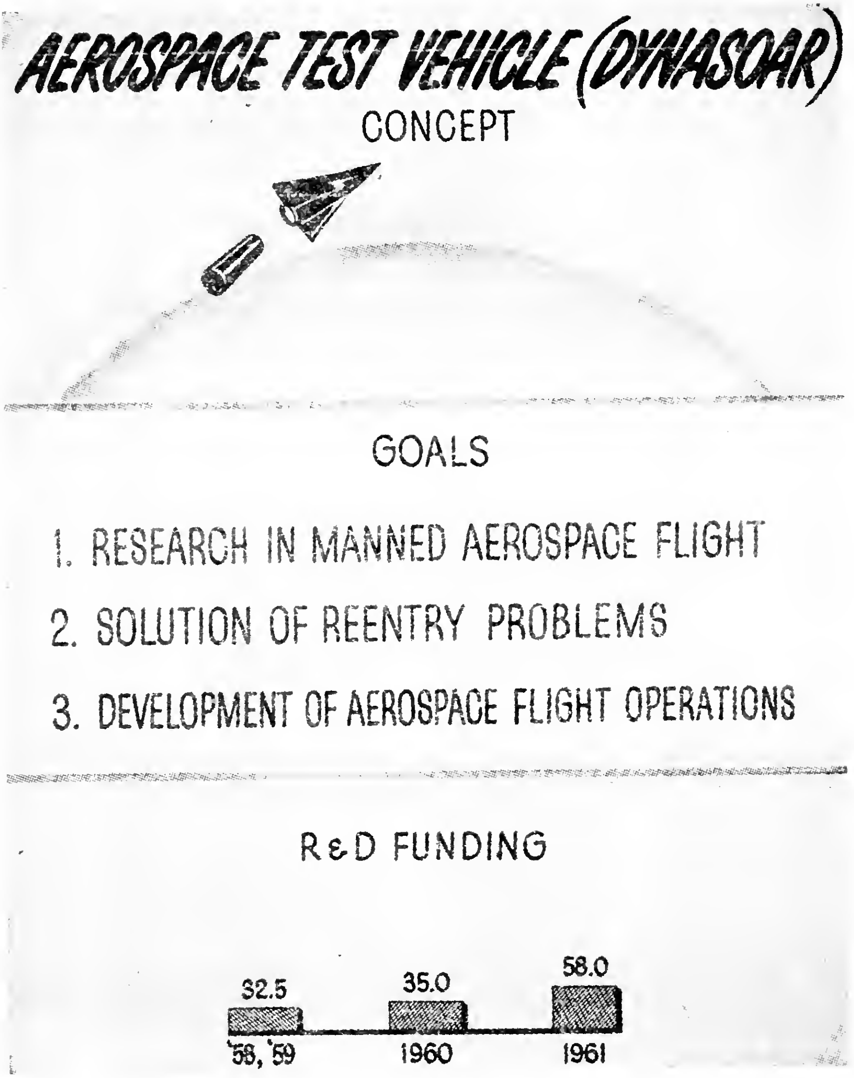

FIGURE 8

There is no specific military requirement for a man in space, but there is just our recognition of the fact that one may develop and the lead time is so long that you have to get at this program now.

Mr. ANFUSO. Mr. Chairman, could I ask a question before we lose the thought: Dr. York, wouldn't you require at least a million pounds thrust to get the Dynasoar up and make it stay up for a long period of time and to have it maneuver as you would want it to?

Dr. YORK. To do everything you might want to do, you require a considerably bigger thrust. On the other hand, for the purposes of simply carrying out an exploratory development program of an aerospace test vehicle, this can be done—it either can be done entirely or it can be done almost entirely with uprated boosters of the ICBM type.

Mr. ANFUSO. But you are working on a larger thrust?

Dr. YORK. This is one of the reasons we are interested in a much larger thrust rocket is because ultimately—what we are talking about in the early phases of this program is the development of a glider that can fly up to reentry conditions.

With the existing boosters uprated, you can get either all the way or nearly all the way with that. On the other hand, if you start using this for something, you have to do more than just come back. Presumably you went up there for some reason other than to just come home. This is for the purpose of exploring how to come home. If you ever start using it, you will need a bigger booster.

Definitely if we are going to have manned space systems of any sort that do more than just explore the problems, such as Mercury does in the short term and Dynasoar does in the long run, you need bigger boosters. It is for men that you need bigger boosters.

Mr. ANFUSO. Thank you Mr. Chairman.

The CHAIRMAN. Thank you, Doctor.

Now, Mr. Teague?

Mr. TEAGUE. We admit we need bigger boosters. Why aren't we working on something bigger than a million and a half? Why aren't we working on a two, a four, a six or a ten?

Dr. YORK. We are. That is we, the United States. NASA has a program called Nova which is a million and a half pound single-barrelled rocket engine. You can get it better from them what their plans are, but it is planned to ultimately multiplex this up to 6, 9, or what have you, million pounds of thrust.

I think that is very important, incidentally, because really for space exploration, Saturn is quite a bit bigger than what we have got, but we are going to need something bigger.

Mr. TEAGUE. Could we go faster in this program?

Dr. YORK. Which program?

Mr. TEAGUE. Development of larger engines?

Dr. YORK. You probably could.

Mr. TEAGUE. Is it money?

Dr. YORK. That is a NASA program.

Mr. TEAGUE. The military is not interested in larger boosters?

Dr. YORK. We are, but when you get down to program details, you would have to ask them. I mean we are interested in seeing bigger boosters come along.

Mr. TEAGUE. Did you do anything along that line before it was taken away from you and given to NASA?

Dr. YORK. We were in the big single-barrelled booster program, but it was really hardly started by the time the present arrangement was made.

Mr. TEAGUE. From an engineering or scientific standpoint, is that what is holding us back, that we don't know enough to build a larger engine? Why should we have a contract now for a million and a half pound thrust when we know we are going to have to have about 10 million pounds at least?

Dr. YORK. I think you are going to have to have a 10 for space exploration, but it is a NASA program and basically also a NASA requirement.

Mr. TEAGUE. It was under you for a long time. Why didn't you——

Dr. YORK. No, it was not. The Nova engine was—the Air Force had it for some time, but it was a study program and that was one of the earliest things transferred. I am not sure I remember when, but probably at the very beginning. At the very creation of NASA, that was one of the programs sent over.

Mr. TEAGUE. What is the estimated size engine for a reconnaissance satellite?

Dr. YORK. That we plan to do with the Atlas booster, with considerable leeway.

The CHAIRMAN. Thank you.

Mr. Bass?

Mr. BASS. No questions.

The CHAIRMAN. Mr. Anfuso?

Mr. ANFUSO. Doctor, are you satisfied with the progress that we are making in trying to catch up with the Russians?

Dr. YORK. What program are you referring to?

Mr. ANFUSO. The programs that you are working on, the programs that NASA is working on. All these programs which have a connection with space. Do you think that we are doing enough or that we could do more?

Dr. YORK. As far as the Department of Defense is concerned, we are working on our programs because we need the results which they will produce and we would be working on them whether there was a Russian program or not.

Programs in space flight per se, and space exploration, are NASA programs.

Mr. ANFUSO. Can't you give me a "Yes" or "No" answer whether or not we are doing enough?

Dr. YORK. Their program is accelerating, but you would have to ask them whether they are doing enough.

Mr. ANFUSO. You feel that the scientists could do more, don't you?

Dr. YORK. It is always possible to do some more.

Mr. ANFUSO. Now, if the Russians 3 years from now have a tremendous advantage on the ICBM's—let us say they have 1,000 ICBM's compared to a possible 300 that we may have, wouldn't that permit them to almost wipe out any important installation that we have in the United States, as well as devastating a great number of our population?

Dr. YORK. Well, there would be enormous devastation with that number of rockets. This is again not really a research and engineering problem, which is what I am responsible for, and there has been a lot of testimony from other people whose responsibility it is. The Secretary, the Chiefs of Staff and so on.

They have pointed out this balance depends on a great many different things, such as the total number of weapons systems involved, the total amount of warning.

The reason we are so interested in the Midas program is because of the importance of warnings, for example. This can make a big difference with respect to how important any particular numbers in balance may be.

Mr. Anfuso. Dr. York, I am asking you as a scientist, if the Russians should have that kind of an advantage, wouldn't the prospects for peace be minimized?

Dr. York. If they thought—it depends on what they think about it. I mean if they think they have got a good chance, then it minimizes the possibilities of peace, but it depends on their point of view of the total balance and what we would have left.

Mr. Anfuso. Do you still have reservations as to the Nike-Zeus?

Dr. York. As to whether we should go ahead with production on Zeus, yes.

Mr. Anfuso. When do you think that these reservations of yours will be resolved?

Dr. York. I really don't know. The decision to not go into production I hasten to add, is not based entirely on my reservations, at all. A production program is a matter where my responsibility is one of making recommendations to the Secretary. The Joint Chiefs make their own and then it is the Secretary's problem to see what to do.

Now, it happens that my recommendations and those of the Chiefs are the same.

Mr. Anfuso. Do you agree with what General Taylor says in his book, that Secretary of Defense McElroy appointed a committee headed by Dr. Hector R. Skifter, which recommended the operation of the Nike-Zeus?

Dr. York. Yes, I agree with that. We discussed that last year at this same time.

Mr. Anfuso. Do you agree with the report?

Dr. York. I agree that it happened. I thought you asked me if I agreed——

Mr. Anfuso. Do you agree with the report of the committee?

Dr. York. No.

Mr. Anfuso. Again I am going to ask you as a scientist, Dr. York, this question: We could have commenced work on a larger booster as far back as 1953. At least that was the testimony of Secretary of Defense Gates yesterday.

Dr. York. Yes. We would have commenced even earlier than that.

Mr. Anfuso. If we did, we would be that much further ahead. We have lost 7 years, haven't we?

Dr. York. We would be further ahead if we had commenced both a larger booster and boosters of the present size. If we had started only a larger booster, we would be further ahead on space, but not as far ahead with respect to missiles.

Mr. Anfuso. We have wasted 7 valuable years, haven't we?

Dr. York. 1953 is kind of arbitrary. It could have been started before or it could have been started any time.

Mr. Anfuso. All of the experts say we could have started in 1953.

Dr. York. That is true. We could have started in 1950.

Mr. Anfuso. It is your knowledge on that that all the experts said we could have started in 1953——

Dr. York. We could have started at any time after World War II.

Mr. Anfuso. We had the capability of starting in 1952.

Mr. Bass. Or 1946.

Dr. YORK. We had it at any time.

Mr. ANFUSO. I don't know about 1946. I do know about 1953.

Dr. YORK. Only because it is one of the years in that span.

Mr. ANFUSO. Dr. York, I am interested in this and I think the American public is interested in this: Do we have any scientists connected with the Bureau of the Budget, besides mathematicians?

Dr. YORK. There are some people with technical backgrounds.

Mr. ANFUSO. There are some people?

Well, isn't it a fact, Dr. York, that the Bureau of the Budget has steadily recommended a lower appropriation for space exploration? These figures were reported not so long ago. For instance, for fiscal year 1959, they recommended $140 million. For fiscal year 1960, they recommended $454 million, and for fiscal year 1961, they recommended $407 million.

That is why I asked you whether we have some scientists there, or are they all mathematicians with a pencil trying to balance the budget?

Dr. YORK. I am not aware of that figure. Within the Department of Defense, we balance our own programs.

Mr. ANFUSO. Well, do you think that these are the figures? They were reported in the New York Times not so long ago.

Dr. YORK. I really don't know.

Mr. ANFUSO. If they are the figures, Dr. York——

Dr. YORK. They could be.

Mr. ANFUSO. There is something wrong with the Bureau of the Budget, insofar as the defense of our country is concerned?

Dr. YORK. The Bureau of the Budget is not responsible for going ahead with space and so on. They are responsible for the budget.

Mr. ANFUSO. The President of the United States is taking their recommendations.

Dr. YORK. The Department furnishes their own figures.

Mr. ANFUSO. The President of the United States has placed balancing the budget as being far more important than protecting the lives of our citizens.

Dr. YORK. He gets recommendations from many sources.

Mr. ANFUSO. That is all.

Mr. FULTON. Just because there is no negation of some of these statements, I hope the record doesn't show the rest of us agree.

The CHAIRMAN. Mr. Riehlman.

Mr. RIEHLMAN. Dr. York, of course, I take an entirely different position than my colleague from New York, because we are not here to try to establish whether or not the President has put pressure on the departments to balance the budget, in respect to the safety of this country.

I do not agree with it and I am sure the gentleman from New York has more respect for the President than to say he would jeopardize the safety of our Nation just for the sake of balancing the budget.

Mr. ANFUSO. I don't say he has done it intentionally, but the figures speak for themselves.

Mr. RIEHLMAN. Well, I am not going to agree with the figures, either. But the thing I think we are vitally interested in, Dr. York, is whether or not in your own position, you personally feel that we are doing everything we can, constructively and realistically with the money we have allotted to these programs for the defense of our country and for future exploration of space?

Dr. YORK. Well, I am not involved with future exploration of space.

Mr. RIEHLMAN. Well, you certainly have had some interest in it, and you do have, I am sure. It is definitely tied in with our defense program.

Mr. YORK. We are considering all the things we have got to do and the people and other resources we have to do them with. We are going ahead as best we can.

Mr. RIEHLMAN. Well, if we had additional millions or billions allotted to your own assignment, have we the people and the wherewithal to constructively spend this money?

Mr. YORK. Well, we are getting into diminishing returns. There is a shortage of really first-rate people to spend any more. You could get more results with more, but the fractional increase in the results would be less than any fractional increase in money.

Mr. RIEHLMAN. That is all I have, Mr. Chairman.

The CHAIRMAN. Mr. Sisk.

Mr. SISK. Mr. Chairman, I have one or two questions.

Dr. York, with reference to the recommendation for the transfer of ABMA to NASA, would you comment as to your position on that?

Dr. YORK. I am for it. The point here is that—one of the major points here is that without this transfer, we have, to say the least, a difficult organizational problem, because the way it has been, there are two large projects in the very big booster field. There is the Nova project, and there is the Saturn project.

Prior to this arrangement for transfer, there were three management or administrative level agencies, executive agencies, involved in these two programs. This transfer accomplishes an objective of having one executive agency in charge of the two.

What I mean is that prior to this, we had the NASA as the executive for the Nova program. We had ARPA as the executive for the Saturn program, and we have the Army, the Department of the Army, as the executive for the agency that was doing the Saturn program, so there were three executive agencies involved with just two programs. That didn't seem like a particularly neat organization and this puts all of the big booster efforts in one place.

Mr. SISK. In other words, you actually recommended this transfer, did you, Dr. York? Or were you asked for your recommendation?

Dr. YORK. Yes; I did have to do with it.

The primary objective was to get this organization and these two programs in one place. Consistent with the Space Act of 1958, the place seemed to be NASA, but I think it was essential to get these two programs in one organization, under one executive, and that is the primary motivation as far as I am concerned.

Mr. SISK. Well, let me say that I agree with you, and I am not being critical. I simply wanted to know specifically what your own personal thinking was.

Now, I have introduced a resolution calling for the immediate turnover without waiting for the March 14 date, which under law would otherwise be required. Would you support an immediate turnover?

Dr. YORK. Yes. Now, that is without personal knowledge of every detail with regard to how NASA and the Army, where they stand with respect to who is going to run the water system. I don't know exactly where they are, but barring any funny administrative problems like that; yes.

Mr. SISK. Well, the purpose, of course, that I had in mind was to expedite the transfer of ABMA to NASA, to have it done as expeditiously as possible. By the resolution, of course, we would simply free the Department to go ahead and work out these details as quickly as possible. I assume they are already working on the details.

Dr. YORK. They are working on the details. On Saturn, we made arrangements immediately after the President's decision whereby the Saturn program has been under the control of NASA now for several months.

Mr. SISK. Would you feel that because of the difficulty in working out these details there might be some delay in the project?

Dr. YORK. No; there shouldn't be. There is no reason for it.

Mr. SISK. I would hope there would not be. I know that has been one of the only reasons why there may have been some opposition to the transfer. Now, there may be other opposition. I know there is opposition, of course, to the transfer but some of it has been predicated on the idea that this will tend to slow down ABMA operations.

In your opinion, you do not think the transfer will tend to slow down ABMA? Do I understand you to say that?

Dr. YORK. That is right.

Mr. SISK. That is all, Mr. Chairman.

Mr. FULTON. Would you yield to me, Mr. Sisk?

Mr. SISK. Yes; I yield.

Mr. FULTON. We might put in the record that we feel the transfer in no way reflects on the Army Ballistic Missile team and that General Medaris and Dr. von Braun and their staff have done excellent work. I have been very much impressed with it.

Mr. SISK. May I conclude by saying that I have been one of the greatest supporters of General Medaris and the Von Braun team and I believe one of the greatest mistakes you and others have made is not unleashing that team and letting them go a long time ago.

I am very critical of that. In my opinion, this transfer is a decision that has been made more or less by the Executive, and I think what we should do now is face up to that situation and try to put it under a single head and move as rapidly as we can.

I agree completely with the gentleman from Pennsylvania.

The CHAIRMAN. Let me agree, too, with what the gentleman has to say. We might have been ahead of the Russians today had we given them more latitude with reference to their teamwork.

Mr. Quigley?

Mr. QUIGLEY. Dr. York, in your colloquy with my colleague, Mr. Anfuso, you made the statement that within the Department, itself, you try to present a balanced program. Now, this was in your discussion over the influence of the Budget Bureau on these decisions.

I am interested in your use of the words, "balanced programing." How were you using those words?

Dr. YORK. We have a great many programs we have to sell. We have the missile programs as distinct from the space programs. We have small-range missiles for air defense, for surface-to-surface use. We have antisubmarine warfare. We have communications. We have intelligence within—I am talking now just about research, development, test, and evaluation—we have basic research, applied research, and so on. And within these we have a great many objectives we have to achieve and we cannot allow a single objective to let us forget others.

Also, something like the early warning satellite, as I have said several times, we judge that on the basis of how it competes with other ways of doing early warning and not according to what environment it operates in.

Mr. QUIGLEY. What I am trying to get at is, which comes first, the chicken or the egg? Do you know what you are going to have to spend, or do you know what you are going to have to do?

Dr. YORK. We know what ball park we are going to be in and we also have a pretty good idea of what we have to do. There is no date before which we know nothing and then suddenly we find out one of these.

Mr. QUIGLEY. When you say you know what ball park you are in, are you telling us now that you know how many dollars you are going to be allowed?

Dr. YORK. I am telling you that I know now within 5 or 10 percent, and I know that for 1962 as well as 1961. As a working hypothesis, I have to make some kind of an estimate about what the resources are going to be. I know that it was clear that 1961 was going to be about the same as 1960, certainly within 5 or 10 percent, and it doesn't matter whether it is precisely or whether it is 5 or 10 percent different. Unless something major occurred, a great increase in the threat or a decrease, or some other military activity, under which circumstances, any extra money would have gone for things that wouldn't ever be anticipated anyway—so as a practical, working hypothesis for planning, I assumed the money was going to be about the same for 1961 as for 1960, within a couple of billion dollars on the total.

And I think that is going to turn out to have been a really good guess.

Mr. QUIGLEY. I have no criticism of your ability to guess, but I am critical and, in fact, I am frightened by the whole system which, in effect, corrals and puts within a little fence the defense and the security effort of this country.

It seems to me the defense of the country, the security of the country, has to come first and the amount of dollars has to follow this. If necessary, this Congress and the administration have to get these dollars. I think you are doing it just the opposite, and I think Mr. Anfuso's comments come pretty close to the truth. The budgetary considerations are taking a priority over this country's security.

Dr. YORK. They certainly play a role.

Mr. QUIGLEY. They certainly play a role, but they could play a very decisive and a very fatal role.

Now, without being partisan, I think this committee, I think the Members of this Congress, and I think the American people are ready to spend what we have to spend to protect and keep this country secure, and to make us tops in every field, including outer space.

Doctor, in answer to Mr. Teague's question, you made a statement which also bothers me and frightens me. You said the military, or the Department of Defense is interested in seeing a bigger booster and your words were "come along."

Now, how is it going to come along unless you make it?

Dr. YORK. The big booster programs are NASA programs. Whether it comes along or not depends on whether you support their program. And I gather from everything I have heard, you are going to.

Mr. QUIGLEY. Well, is this the easy answer, is this the convenient answer, that this is the responsibility of NASA?

Dr. YORK. There is a National Space Act of 1958 and a number of actions that have been taken consistent with that. To duplicate another booster within the Department of Defense would be in the interests of nobody. It would simply dissipate resources and be a diversion.

Mr. QUIGLEY. But if the Department of Defense is interested in seeing a bigger missile come along, don't they have the responsibility, either within their own Department, or within the administration, through NASA or someone else, to take positive, consistent actions to see that it happened?

Dr. YORK. We have taken quite a few actions to see that it happens. In connection with arranging for the early discussions concerning the transfer, we made our position entirely clear to those who were responsible, that we believed the country must have a big booster and that, although we had no specific requirement for one, we could not foreclose on one.

So that, in connection with the transfer we made it clear to all involved that, to the extent one can do this, that we were trying to make a stipulation that these big boosters would go ahead as a result of this transfer.

Second, in connection with all of these booster programs—and furthermore, in Mr. Gates' statement, my own, and any further questions you ask me on the subject, I will say we support vigorously this program before the Congress.

We provide most of the facilities that are going to be needed for their booster program.

Now, these boosters, for example, will be launched from military missile ranges. The equipment at these ranges is equipment that was installed in very large part for military missile programs. Some of it subsequently for space programs.

They are using contractors that acquired their know-how through participation in military programs and so on.

I think we are doing everything that can be done by an agency that is not directly responsible and that does not directly receive the authorization, the appropriation for the program.

Whenever there are discussions between ourselves and NASA, or between NASA, ourselves, and someone else, be it the Bureau of the Budget—the same as the Congress, we strongly support this program.

The CHAIRMAN. Mr. Karth?

Mr. KARTH. Doctor, in the name of security yesterday we were not given the answer as to how many destructive missiles we think the Russians have. Obviously not for the purpose of telling the Russians, because they know, so it must have been because we don't want the American people to know, but that isn't my question today.

Dr. YORK. That is quite right, but if that is not your question, I won't answer.

Mr. KARTH. It is not because we don't want the Russians to know?

Dr. YORK. Because we don't want the Russians to know what we know and how we find it out.

Mr. KARTH. I see.

My question today, Doctor, is—and I understand your reservations about the Zeus system, which is an early warning system.

Dr. YORK. It is an interception system.

Mr. KARTH. Last week the commander of the U.S. Strategic Air Command, Gen. Thomas Power, said—and in his speech that was quoted in italic apparently for the purpose of designating importance, it was that the Soviets could virtually wipe out our entire nuclear strike capability within a span of 30 minutes with only some 300 ballistic missiles. Not all ICBM's, he said, a part of each.

That leads me to a very important question—at least I think it is important: How long do we have to wait, at your earliest possible estimate, for a dependable warning system so that our whole retaliatory power may not be destroyed on the ground without having fired a shot, so to speak?

What is your earliest possible estimate of a warning system?

Dr. YORK. We have a warning system going in now. I don't want to discuss in open session the dates on the warning system, but there is a warning system being installed now, for missiles.

Now, there are warning systems existing that are suitable for giving warning to one place when another place is struck earlier. You see in General Power's statement he talked about half an hour. If he means that there was a salvo that landed all within zero time, that is one thing. If he means it was spread out over a half an hour, then you have a warning system just by getting the word around from one place to another.

Any nonsimultaneity in attack constitutes a warning. Now, that capability already exists.

In addition, there are warning systems being installed now.

Mr. KARTH. Now, my next question—and maybe we can get at this in closed session—What kind of an antimissile missile programing do we have that could be effective, if you could discuss that in open session?

Dr. YORK. That would be effective—you have to also say when. And, of course, also against what?

Mr. KARTH. Against ICBM's.

Dr. YORK. Yes, but it depends upon what kind and what time scale you are talking about then, too.

We don't have any that would be effective now. It is an easy answer for this year. None.

Mr. KARTH. Would you care to discuss the possibilities of when you think we might have one?

Dr. YORK. The earliest system that has been taken at all seriously is Zeus and that is quite a few years off.

Mr. KARTH. That is all, Mr. Chairman.

Mr. ANFUSO. Will you yield for one question?

Mr. KARTH. Yes, I yield for a question.

Mr. ANFUSO. Dr. York, I don't want you to take any criticism that may have been made here this morning as directed against you personally, because I for one, have the greatest respect for your ability and we don't want you to be going off and resigning like some other people and joining private industry.

Dr. YORK. I won't.

Mr. ANFUSO. We want you to stay in Government and continue to do the job that you are doing under the limitations which have been placed upon you.

Dr. YORK. No limitations have been placed on me that keep me from doing my job.

The CHAIRMAN. Mr. Hechler?

Mr. HECHLER. Dr. York, do you believe we are in a missile and space race with the Russians?

Dr. YORK. Yes.

Mr. HECHLER. I was a little disturbed by what you said earlier, that you would be doing all these things without any reference to what the Russians were doing.

Dr. YORK. That is correct, with respect to those programs which are fully within the responsibility of the Department of Defense; early warnings, reconnaissance, and so forth. If the Russians had never launched a satellite, we would still be—I hope we would still be doing those.

Mr. HECHLER. Would it be correct to say that programs under your direction are more or less cut to fit the size of the budget cloth?

Dr. YORK. That depends on how generally you are willing to take that. In the sense that they are cut to fit a budget of the order of $41 billion or somewhere between 39 and 43, or 45, or what have you, one does have to consider all the things that have to be done and how to fit them together.

Mr. HECHLER. At the bottom of page 4 you give some figures on increased amounts for funding of space-related programs for fiscal 1959, fiscal 1960, and fiscal 1961, which would seem to give the impression——

Dr. YORK. These are for defense program.

Mr. HECHLER. I beg your pardon?

Dr. YORK. These are for defense program, only.

Mr. HECHLER. Which seems to give the impression of a steadily increasing funding.

As I understand it, funding could be interpreted as paying out for past programs and I wonder if you could give us, perhaps, more significant figures which would be figures for new obligational authority?

Dr. YORK. This is direct obligations. I mean there are those three. This is very closely the new obligational authority. I don't have it, but the new obligational authority is very close to these. These are not expenditures. These are the planned obligations to be made in the future and that have been made in the past and they are very nearly the same as the new obligational authority requested. Expenditures are growing faster than this.

Mr. HECHLER. If you could give those specific figures for the record, I would appreciate it.

Dr. YORK. Yes. Expenditures, of course, are much harder to estimate when you are talking about the future than obligations. They would show a somewhat faster expansion.

(The information requested is as follows:)

DOD space related programs (new obligational authority)

[In millions]

	Fiscal year 1960	Fiscal year 1961
Navy: Military astronautics		1.3
Air Force:		
Dyna Soar	35.0	58.0
Samos, Midas, Discoverer	275.2	333.1
Other military astronautics	3.7	5.8
	313.9	396.9
ARPA	104.7	67.0
Grand total	418.6	465.2

Mr. HECHLER. I would like to ask you the question which the Secretary of Defense started to pass to you yesterday and I didn't give him an opportunity to, because I wanted to get his own answer.

Do you think that the status of the educational system in our country has any relation to our future progress in missile and space programs?

Dr. YORK. Yes, I do, because we can—I would very much like to see right now more very good people in these and all of our other research and engineering programs. And the people we have are the product of the educational system.

Mr. HECHLER. I am glad to hear you answer that. I would certainly like to see if some leadership, too, could be provided from the Department of Defense and at the Presidential level to pinpoint the necessity of strengthening our educational system.

This seems to me to be the central point of our whole national defense, which we are neglecting.

Dr. YORK. The central point of our future.

Mr. HECHLER. Well, aren't we all living for the future?

Dr. YORK. Yes. Yes, I agree with you, Mr. Hechler.

Mr. HECHLER. Would you be willing to consider that possibly it would be advantageous to take away some of the appropriations for the Department of Defense to divert them to strengthening our educational system?

Dr. YORK. I would make an alternative suggestion of making an effort to finding some other source. I am not eager to have any taken away from the Department of Defense.

Mr. HECHLER. In other words, you feel what you are spending on research, hardware, and development is more important than education?

Dr. YORK. No, I don't think it is more important, but we are not the only source of funds available in the United States.

Mr. HECHLER. I just wish I could get the people in the Defense Department interested in education enough to——

Dr. YORK. A great many are, but not perhaps to the point of being inspired to suggest a decrease in our own programs.

Mr. HECHLER. Well, I just feel, myself, that I am not going to vote for any more defense appropriations until we get an aid-to-education bill. So far as I am concerned, education is the most important thing for the future defense of our country.

Dr. YORK. I agree it is very important, but the immediate problem of survival is also very important.

Mr. HECHLER. Thank you, Doctor.

The CHAIRMAN. Mr. Daddario?

Mr. DADDARIO. You have said, Dr. York, with reference to the Nike-Zeus system, that your recommendations were the same as those of the Joint Chiefs of Staff. Now, what were those recommendations?

Dr. YORK. That we should not at this time go into production of a $15 billion system, or whatever it might be, but that we should continue the research and development program into 1961 and further.

Mr. DADDARIO. Well, was your recommendation then based on the $15 billion estimate which you have made, or was it on the scientific basis of something wrong with the system?

Dr. YORK. As far as my part of the recommendation was concerned, it was on technical grounds.

Mr. DADDARIO. What are those technical grounds?

Dr. YORK. I don't think we should discuss this at too great length, here, but they have to do with the question of what the probability of Zeus working is in the face of a probable attack. There are sufficient numbers of unsolved technical problems so that this probability seems quite low, as of today.

Mr. DADDARIO. In reference to that, do you mean it would not be 100 percent successful? That it would be zero effective, or that it would have some effectiveness somewhere along the line, between the zero and the 100 percent figure?

Dr. YORK. It would be somewhere between zero and 100 percent, but if the things we are at the present time dubious about were true, it would be much closer to zero than a hundred. In other words, we are not quibbling about the difference between 98 and 100, Mr. Daddario.

Mr. DADDARIO. If you look toward the date when Nike-Zeus might have become effective, taking into consideration the deficiencies you feel it apparently has, are there other programs in mind, either theoretical or those that you have some great faith in, which might be developed to the point where they might be effective at the same date Nike-Zeus might have been produced and put into the field?

Dr. YORK. Probably none of these could be effective at the same date Nike-Zeus might have been effective. But there are others that we are somewhat hopeful about and that we are trying to explore further.

Mr. DADDARIO. Then we can look forward, as I understand it, to a gap between the time when our potential to attack with ICBM's, and the Communist's potential to attack us becomes effective, to a period when there will not be a screen against that attack.

Dr. YORK. Yes; but that has nothing to do with administrative decisions. This is based on facts and nature.

Mr. DADDARIO. I am not basing my question on the administrative decisions; I am basing it on the scientific knowledge available to us and this apparently is the scientific position at the moment.

Dr. YORK. Yes. If I understood your question correctly; yes. They have already got ballistic missiles and we don't have any antiballistic missiles.

Mr. DADDARIO. And it seems that the answer to preventing an attack by ICBM's is somewhere in the distant future.

Dr. YORK. No; the answer to intercepting an attack. The answer to preventing it lies in ballistic missiles, not in antiballistic missiles.

Mr. DADDARIO. You are talking about retaliation?

Dr. YORK. We are talking about deterrents.

Mr. DADDARIO. That is sort of a continuation of a balance of terror between ourselves and the Communist world.

Dr. YORK. Yes.

Mr. DADDARIO. And can there be something done in reference to that? Is there anything within the Department of Defense to take care of the gap by minimizing the blows that might be followed through some sort of buildup in our civil defense system.

Dr. YORK. Well, the civil defense system is not in the Department of Defense. As far as what is in the Department of Defense is concerned, we do a great deal along that line because the direct military problem is one of how to make the retaliatory force survive a first blow. And we have taken every route that has been suggested to us, every technical route, hardening, dispersal, concealment, mobility, and so on.

Mr. DADDARIO. When you say hardening, concealment, and mobility, you are talking about the Defense Establishment alone?

Dr. YORK. Talking about the survival of the retaliatory power.

Mr. DADDARIO. How about the millions of Americans who don't have the same ability to be mobile, to conceal themselves, or to put themselves under some hardening device to prevent themselves from being killed in the event of an attack? Isn't that part of our defensive capacity, for the civilian population to survive the blow?

Dr. YORK. It is not, as the Department of Defense's responsibilities have been defined, a part of the Department of Defense program. If you use defense in the broad term, then it is part, but insofar as the Department of Defense's programs are concerned, it is not a part. It is OCDM.

Mr. DADDARIO. Then, as I understand you, we can look toward a period of time when we have no intercepting device and the protection of the people of this country will depend more upon the protection of the Defense Department and not the entire population of the country?

Dr. YORK. The protection of the deterrent is the responsibility and we don't have to look forward to it; we are already there.

Mr. DADDARIO. That is all.

The CHAIRMAN. Mr. King.

Mr. KING. Dr. York, I have just one question. The question has been asked at least five times this morning, but I guess each Congressman reserves the right to ask it again in his own words and in his own context. It is, I would imagine, the most important question that faces us in this decade.

By way of background, Mr. George Allen, Director of the USIA, this week, testifying before our committee, stated that—we all knew it, but he stated it authoritatively—that our reputation abroad had suffered very seriously because of the spectacular progress made by the Russians, that they were outpacing us and that in the minds of many of the people in the world, progress in rocketry was equated with progress in all fields of science. Many, many peoples in the world were now concluding that Russia had outdistanced us in the general field of science, which conclusion is incorrect; but it is a fact, nevertheless, that they so interpret it.

So, with that background, let us assume hypothetically that the United States has established a national policy of trying to overtake and surpass the Russians in the field of rocketry, in the field of exploration of outer space, and in the field of rocketry for defense purposes.

Assuming hypothetically that that is our national policy, my question is: Are we now doing everything that is reasonably possible to achieve that policy?

Dr. YORK. It depends on what action is finally taken with respect to the NASA budget. With the question of support for NASA, because these programs that have the big psychological effect, that have done and are doing what you have described—which all of us in Defense agree with, incidentally—are the NASA programs. These are the ones that have the psychological and prestige associated with them.

Mr. KING. Dr. York, are you saying that if the Congress of the United States approves the NASA budget, which is now before it, as submitted by the administration; if it does, then the answer to my question would be: "Yes, we are doing everything that is reasonably possible"?

Dr. YORK. I can't quite say that. You can always do a little more. I don't know what NASA's plans are with respect to requests to Congress. I think you will have to ask the NASA people about the NASA program.

Mr. KING. You can only answer insofar as my question refers to the Defense aspects of this, the military aspects?

Dr. YORK. Well, you mentioned that the prestige of the United States and so on is greatly affected by what the public sees about our progress in space. What the public sees are the space programs related to man in space, the lunar activities and so on. These are not in the Department of Defense.

Mr. KING. Then you are disqualifying yourself from aswering that portion of my question, which applies to the NASA, and that is all right.

Dr. YORK. I guess that is right.

I do want to say that we do agree that this is a very important matter because the basic facts about a deterrent has two sides to it. One thing is how good it really is, and how good the other fellow thinks it is, and how good the other fellow thinks it is depends on what he thinks the Russians and we are doing, independently of what we really are.

Mr. KING. You have knowledge of what NASA is doing, of course, working so closely with them. You have knowledge of their budget. Just based on your observation, would you think that the budget is adequate to accomplish this national policy which I stated?

Dr. YORK. It is an expanding budget and you would have to get from them what their plans are for further expansion.

Mr. KING. Let me direct my question to a place where you are an expert: Assuming it is our national policy and I am sure it is—this is not purely hypothetical—for us to overtake the Russians and to pass the Russians in the matter of the use of rocketry in its broadest sense for defensive military purposes, are we doing everything that is reasonably possible to achieve that national policy?

Dr. YORK. In research and development, I think we are probably doing so near to everything, that we are doing what we ought to be doing.

We have improvement programs going on our missiles, we have very large programs for the finishing of the development of the Atlas and Titan, for moving them beyond their present capabilities as required, for developing the Minuteman, for developing the Polaris, for eventually moving on with the development of the Polaris to a better Polaris, working in other strategic systems.

It is always possible to do some more, but this involves judgment and it seems to us we are doing about the right thing as well as we can make the judgment with regard to the development of strategic systems, principally missiles.

Mr. KING. Let me ask this: Would the appropriation of more money—shall we say another billion dollars, to take an arbitrary figure—add significantly to the progress that you are making?

Dr. YORK. Yes, you could go faster with more money, but again—and this is especially true with the military missile programs—you wouldn't go very much faster. With a lot more money, you would go a little bit faster.

The CHAIRMAN. Mr. Roush?

Mr. ROUSH. Dr. York, the reason we are behind Russia today is because of decisions which were made in the past few years which did not prove to be good decisions, isn't that correct?

Dr. YORK. It is based on a history that goes back to the end of World War II.

Mr. ROUSH. The reason we are behind Russia in the eyes of the rest of the world is because we made the wrong decision in giving, say, Project Vanguard emphasis instead of the Army project, and as a result, the Russians beat us with their sputnik, when we could have put a satellite in orbit before them, is that correct?

Dr. YORK. We bet on the wrong horse, there, with respect to getting a satellite in orbit first.

Mr. ROUSH. Dr. York, on this matter of a large thrust vehicle, we also bet on the wrong horse there, didn't we?

Dr. YORK. I don't think that is as well understood as it might be. As of the present time, there are two distinctions between the boosters we have used in space and the ones they have. First of all, our biggest booster is only half as big as theirs and, second—and this has had a much greater influence on how we have been compared in the last several years—our big booster was behind theirs in time.

We have not yet in our space programs, not in any important way—even used our big booster. All of our space programs up to the present time have been based on smaller boosters, smaller, both in thrust and in the other factors, the total impulse that goes to make up the kind of velocity increment they can get.

In other words, the ratio between the size of the American satellites and Soviet satellites has been 100 to 1. I mean various numbers.

The primary reason for this large factor is not that our biggest booster is only half as big as theirs, it is because we haven't even used the biggest booster for these space programs.

Mr. ROUSH. What is our biggest booster?

Dr. YORK. The biggest in terms of thrust is the Atlas, but in performance, Atlas and Titan are about the same.

Mr. ROUSH. It was the wrong decision, wasn't it, Doctor?

Dr. YORK. The "wrongest" thing, if you want to put it that way, was not starting several years earlier.

The big difference that we now see—there would still be a small difference, but it wouldn't be the difference that we have been living with for the last 2 years.

Mr. ROUSH. Dr. York, not very long ago I saw you on a television program and thought you conducted yourself very well, but in discussing this Atlas vehicle of which you just spoke, as being our largest, you stated that we deliberately made the choice to cut the size in half.

Dr. YORK. Yes.

Mr. ROUSH. And at that time, we were capable and there was on the drawing boards and plans presented, of an Atlas which would have had a thrust of about 650,000 pounds, is that correct?

Dr. YORK. Yes. It wouldn't have been here today. I mean had we made that choice, we wouldn't have had an ICBM today.

Mr. ROUSH. Why not?

Dr. YORK. Because it is enough more complicated, it would have taken enough longer to do, that we wouldn't have had it today.

Mr. ROUSH. Apparently the Russians were able to create such a vehicle.

Dr. YORK. Yes, but that is this timing matter, now. They simply started their bigger program sooner. They both enter into it, but the timing is more important than the decision on size.

Mr. ROUSH. Speaking of time, Dr. York, when was this 650,000-pound Atlas booster first presented by Convair?

Dr. YORK. I don't know, but it was carried really as a study program with some experimental work until 1954.

Mr. ROUSH. But it started back in the 1940's, didn't it?

Dr. YORK. On paper, yes.

Mr. ROUSH. When was it Project Saturn was first considered?

Dr. YORK. About a year and a half ago. Going on 21 months.

Mr. ROUSH. What date would that put it at?

Dr. YORK. That would put it in the fall of 1958.

Mr. ROUSH. In the fall of 1958. We knew, didn't we, Dr. York, when the Russians launched Sputnik I, October 4, 1957, that our great need was a big booster?

Dr. YORK. From the first few sputniks that were launched, it is not obvious that the booster was as big as we now know it to be. The first sputnik was 180 pounds, as I remember it.

Mr. ROUSH. When was the second one launched and how much did it weigh?

Dr. YORK. The second one was 1,100 pounds, and it was launched about 3 months later.

Mr. Roush. Yes, but it took us all this time to decide that we needed a bigger booster?

Dr. York. You see, for those sizes you don't need a bigger booster. You need an Atlas-size booster, but at that time the only thing you could say from these weights is that we were behind in having a big booster available. You couldn't say—it is not obvious from 1,100 pounds that their booster is as big as it is. It is not until you get much farther down the road, and furthermore, to add ancillary information which is available since, that it is obvious their booster is as big as it is.

It was not obvious the Russian booster is as big as it is, back in late 1957 and early 1958.

Mr. Roush. The reason I ask these questions is not because I just like to look behind and be critical, but it seems to me occasionally we have to be critical in order to forge ahead and it seems to me that the decision to develop this huge booster was late in coming and that wrong decisions were made.

I am very pleased that we are going ahead and I wish we could go ahead faster, because this is the one key, the one thing that will take us to a position equal to that of Russia. Every time we have had testimony here, we have heard people say that the reason we are behind is because we don't have a booster. We are only behind in the area of thrust.

Time and time again that has been stated here before this committee and I wonder if we are placing enough emphasis on this program, and I am convinced that we have not placed enough on it in the past.

That is all, Mr. Chairman.

The Chairman. Thank you, Mr. Roush.

Doctor, let me ask you a question or two, now. You refer repeatedly to our balanced program. I suppose you mean both missiles and space, because it is hard for me to distinguish between missiles and space.

Now, will our balanced program bring us to the point where we will overtake Russia in its development and if so, when will we overtake Russia?

Dr. York. The Department of Defense program is not designed to overtake Russia. The programs—in terms of these space programs that you are primarily interested in. It is the NASA programs that are designed to, as Mr. Roush has said, to produce a booster that will in terms of payload size, overtake the Russians.

The Chairman. Now, why shouldn't the Department of——

Dr. York. I wasn't speaking of that in my remarks.

The Chairman. Why shouldn't the Department of Defense programs be designed to overtake Russia?

Dr. York. Because the responsibility for space flight and space exploration, which is what it is that requires these big boosters, is the NASA program and if we were to start another program in that size, this would result in nothing but diversion and dissipation in resources. It wouldn't be correct for us to start another big booster.

The Chairman. You don't refer to the ICBM in space, then?

Dr. York. We do have a second generation coming along, but it is smaller because we believe that is the direction of progress on ballistic missiles. Such as the Minuteman.

The CHAIRMAN. Referring to your program envisioned for the ICBM, under the military; will it overtake the Russian programs?

Dr. YORK. I am not sure I entirely understand the question. As far as development is concerned, the important things now—both the Russians and ourselves have a missile that will work—that will go the required distance. It will go there with reasonably good accuracy and with a big explosion. From here on out, the problems are related to matters like survivability, reliability, improving the accuracy further, improving the effectiveness of the weapon, enabling you to make it mobile and things of that sort. There isn't any nice, simple thing like payload to define who is ahead and who is behind in development here. That is good for the space program, but not for the missile programs.

The CHAIRMAN. The reason I ask you is that you refer to the programs one after another which are——

Dr. YORK. These are not parts of overtaking. These are legitimate ends in themselves.

The CHAIRMAN. I know; but will they overtake the Russian programs?

Dr. YORK. So far as I know, Russia doesn't even have an early warning satellite, so I guess it will. I don't know whether they have a reconnaissance satellite with the kind of resolution we are talking about, so I suppose it will. I don't know if they have a communications satellite. They show no evidence of it. I am sure we will overtake them in these objectives.

They are not designed to be big boosters. They are designed to be early warning programs, reconnaissance programs, navigations programs, and communications programs.

The CHAIRMAN. Don't you need the big booster for those programs? The man in space program, you said, was very important to the military.

Dr. YORK. That is because of the possibility of unforeseen requirements arising, we feel that we must have the—we feel that this country must have for that reason, as well as for prestige reasons, a big booster program, a going, an impressive big booster program.

The CHAIRMAN. Well let me put it another way then: Dr. Glennan made the statement, as I recall, that we could not hope to catch up with Russia, where Russia is at the present time, under 5 years.

Dr. YORK. Yes, I agree with that.

The CHAIRMAN. Do you agree with him on that?

Dr. YORK. That is right. That is especially as measured in payload. But the Department of Defense's programs—the Department of Defense is very interested in that because of its influence on our prestige and the status of our deterrent and so on. But the Department of Defense's programs are for objectives which are legitimate ends in themselves and don't have to do with this particular race.

We think this is very important but our programs are not designed as entrants.

The CHAIRMAN. With reference to the interest of the Department of Defense in the program, in your opinion, it is not intended to overtake Russia?

Dr. YORK. The Department of Defense's programs which I outlined here are without—are intrinsically not a part of a race in space. The

Department of Defense is interested in the question of payload and the question of catching up in the terms of payload, which is what this 5-year item refers to. And we regard these as very important objectives and strongly support them. But in our programs, in the programs we are running, these are not part of the objectives.

The CHAIRMAN. They are needed for our defense, are they not?

Dr. YORK. They are important for defense.

The CHAIRMAN. And yet, you agree with Dr. Glennan that we will not catch up with Russia for 5 years?

Dr. YORK. In terms of payload, that is correct, and that is the most convenient measure.

The CHAIRMAN. As I read his statement he said in 5 years we will be where Russia is today.

Dr. YORK. I don't think that is what he meant.

The CHAIRMAN. But you think we are——

Dr. YORK. If that is what he meant, I don't agree with it, that it would take 5 years to be, in terms of payload, where they are today. To catch up with them, it is certainly a matter of at least 5 years.

The CHAIRMAN. And then it is questionable, depending on the pace that Russia makes——

Dr. YORK. It depends on what they do.

The CHAIRMAN. That is right, and what I want to know is this: I don't disagree so much with the spending. Where I disagree is in the priority given these projects.

Now, can you say that all of the projects you have referred to today have had the topmost priority in the award of funds?

Dr. YORK. Within Defense, no, they have not.

The CHAIRMAN. Which ones don't have the top priority?

Dr. YORK. The navigational satellite and the communications satellite.

The Samos program has highest national priority. The other three do not have highest national priority. By highest national priority, I mean a specific priority system set up by the President that relates to all programs. It includes these: I believe it includes Saturn, it includes Mercury and includes Samos as far as space is concerned. It includes Atlas, Titan, Minuteman and so on.

The CHAIRMAN. Now, let us be frank about this: Don't you think that the navigation project, for instance, ought to have top priority?

Dr. YORK. No. No navigation project that I know of has highest national priority. If no navigational project does, there is no particular reason why the navigational satellite should. The fact that it uses space environment is not a measure of priority. Its priority has to do with how important navigation is.

The CHAIRMAN. What would you say about the Samos project?

Dr. YORK. It does have the highest national priority.

The CHAIRMAN. How about the early warning?

Dr. YORK. That is under discussion right now. It will probably end up in that category.

The CHAIRMAN. Do you think it should have highest priority?

Dr. YORK. I think that is how we will come out when we go over it.

The CHAIRMAN. But thus far it doesn't have?

Dr. YORK. It is pretty close, but not quite.

The CHAIRMAN. I hope you will stick with that idea and help it.

Dr. YORK. There is not much difference between where it is and highest national priority, so-called.

The CHAIRMAN. How about the communications project. That is Notus.

Dr. YORK. Well, Notus does not.

The CHAIRMAN. Shouldn't it have highest priority?

Dr. YORK. You can't have everything have highest national priority and have the word mean anything.

The CHAIRMAN. You might take a little bit away from foreign aid there, and put it all in this project.

Dr. YORK. I am talking about a formal system of priorities and so far as I know, foreign aid is not in it, that has to do with development programs. This started out with Atlas and Titan and it has kind of gotten longer ever since. You wonder what highest national priority means after a while.

The CHAIRMAN. Well, of course, it means preserving the integrity of the United States of America. That is really what it means to me.

Dr. YORK. Communications just is not, in our judgment, as important as either missiles or early warning. That is what it amounts to. Communications is very important, but not everything can be of equal importance.

The CHAIRMAN. Does your vehicle development program have highest priority?

Dr. YORK. It depends on whether it is necessary for something else which does and thus far, the principal parts of it have been related to Samos and since Samos has highest national priority, so do those parts of the vehicle development program that relate to it.

The CHAIRMAN. The other parts don't have the highest priority?

Dr. YORK. No.

The CHAIRMAN. Is that the reason some of them have lost funds—because they don't have the highest priority?

Dr. YORK. Which funds are you speaking of? I know of no vehicle programs that have lost funds?

The CHAIRMAN. I don't mean the vehicles, but I mean all of these programs. Some of them have lost funds over the recommendations, I understand.

Dr. YORK. But as Mr. Gates described yesterday and as I think everyone knows, the initial request for funds is vastly more than what we finally end up with. If you judge that as being loss of funds, we lose funds for everything. But in no case has a going program been reduced.

The CHAIRMAN. Mr. Anfuso.

Mr. ANFUSO. The intelligence from CIA is made available to you, is it not, Dr. York?

Dr. YORK. By and large, yes.

Mr. ANFUSO. Could you this afternoon in executive session, tell us what our intelligence is with respect to the warning systems that we know about that the Russians have against the Polaris and against our ICBM's?

Dr. YORK. I will see what I can do.

The CHAIRMAN. Now, one question from Mr. Hechler.

Mr. HECHLER. Dr. York, don't you feel someone should have central leadership and direction over the whole space and missile program, to give highest urgency to this, so the American people would know precisely where we stood?

Dr. YORK. Centralizing direction of the space and missile programs, I think would be a mistake.

What we have now done is that those programs needed for the big booster programs, the programs in space flight is an end in itself, programs in space exploration are all centralized in NASA. The programs remaining in the Department of Defense are those which have end objectives which are specifically for defense purposes and which we regard as essential or we wouldn't be doing them. These are not programs in rocketry primarily, these are programs in electronic components, both spaceborne and groundborne, and to disassociate them from the using service, or from the people who have the—to disassociate the rocket part from the part that has to do with the data handling which is in most cases the bigger part, would do nothing but lengthen the programs and confuse matters beyond all recognition.

Mr. HECHLER. I submit they are not getting central leadership and direction at the present time.

The CHAIRMAN. Now, I will say at this point there that the Doctor has some testimony he hasn't given us which he wants to give in executive session and also in executive session, I would like to take up one matter with the committee.

My thought is this, that we recess until 2:30 this afternoon and we will resume the questioning and will recognize Mr. Fulton.

Is there any objection to that? If not, we will adjourn until 2:30

(Whereupon, at 12:05 p.m., the committee adjourned to reconvene at 2:30 p.m. of the same day.)

AFTERNOON SESSION

The CHAIRMAN. The committee will come to order.

Now, at the time we recessed for lunch, Dr. York was testifying and the Chair agreed to recognize Mr. Fulton. I now recognize Mr. Fulton of Pennsylvania.

Mr. FULTON. I am glad to have you gentlemen here. I hope we can keep this on a nonpolitical level, because it seemed to me this morning that this was the first time a Presidential campaign had been started in space instead of throwing the hat into the ordinary atmosphere.

I do realize there have been some comments made by some so-called advisory committees of scientists that were released very peculiarly on Monday, January 25, just at the time this committee starts in action on these particular space hearings. So we do have running along with us possibly, a political group looking over the shoulder. I might say that some of the questions this morning looked to me a little bit as if they might have received some suggestions from those questions.

Now, I want to clarify the history a little bit of our missiles progress because the year 1953 has been mentioned with a certain remarkable regularity as a turning point in the development programs of our missiles.

Actually the U.S. missile program did not begin in 1953, but began clear back with the forerunner of the Atlas. That was in 1946, and the Atlas program went along until the year 1949 when it was cut out in the defense cutbacks. Then it progressed on a private basis—the Atlas was on a private basis under research and development for 2 years. Then it was revived in 1951 and only as a low-level national effort.

That means that the Russians during this period from 1946, on through, have emphasized their long range ballistic missiles, where, as a matter of fact, we have started and stopped in the United States and then started again. It has only been since 1953 that we have emphasized the operational feasibility of these long range ballistic missiles.

I want to ask the good Doctor, Dr. York, if that isn't the case? It has been a matter of decision, not on party lines, but a matter of decision over a period of years, really involving both parties?

Dr. YORK. There is a long history to this matter, involving not just ballistic missiles, but also air-breathing missiles, matters involving what appeared to be the best idea at the time that might look different in hindsight, but which was not such a bad—but looked good at that time, and so on.

Mr. FULTON. Actually, of the ballistic missile programs that are now in process and that we are working on, there is only one, the Atlas, that began before 1953. Our whole missile spread, really, has been the development in these last 7 to 8 years, is that not correct?

Dr. YORK. In the big ballistic missiles; yes.

Mr. FULTON. Then I would like to read the statement of Dr. Teller, to the Senate Preparedness Subcommittee. He said:

> In 1946 right after the end of the war, we could have said, "Let us develop ballistic missiles." Well, we did go into the development of ballistic missiles, but at an exceedingly slow and small rate. Years later, we determined to start a very vigorous program on the guided missile and on the ballistic missile. It has been an excellent and excellently managed program, but it came too late. The Russians had started on their ballistic missile program from all we know, right after the war and they kept at it.

Do you agree with that statement, Dr. York?

Dr. YORK. That is what I understand to be the case; yes.

Mr. FULTON. Then let me read you another statement of Dr. Wernher von Braun when he was asked, on November 10, 1957, the question of where we stood in our ballistic missile programs in the United States, vis-a-vis Russia.

Dr. von Braun said:

> The main reason is that the United States had no ballistic missile program worth mentioning between 1945 and 1951. These 6 years during which the Russians obviously laid the groundwork for their large rocket program, are irretrievably lost. The United States went into a serious ballistic missile program only in 1951, with the decisions to weaponize the Army's J.P.L. rocket developed at Redstone. Our present dilemma is not due to the fact that we are not working half hard enough now, but we did not work hard enough during the first 6 to 10 years after the war.

Do you agree with Dr. von Braun's statement as to the early developments as I have just read them to you?

Dr. YORK. Yes.

Mr. FULTON. There is another matter that we should look into, and that is the emphasis on the various programs. You were certainly correct this morning when you said that every program cannot be made a program of first national priority because it destroys the priority system. That must be kept fairly exclusive or, I would say for myself, it becomes another OPA and the system goes backward. We don't have the materials or the personnel or the administrative guidance to carry them on at the level of priority that has been assigned to them.

Would you comment further on the necessity for these national priorities in your missile programs?

Dr. YORK. They are used actually primarily in connection with priorities with regard to materials and matters of that sort. They have proved very useful in getting ahead with the programs that have had this highest priority.

Mr. FULTON. Now, I had referred to the so-called Scientific Advisory Committee of 17 scientists that on Monday, January 25, 1960, and in the Washington Post, had made certain statements.

These scientists contended, says the Post, the Mercury-manned satellite project had "little military or scientific justification." They charged it was being pushed too fast, with insufficient funds to be safe and sound. A quick but risky way of achieving a first. They also likened the Mercury program to the ill-fated Vanguard project.

They said the Mercury program should be put in its "logical place," and suggested the target date be delayed 3 to 5 years.

In my book it is necessary that we go ahead at once with the Mercury or the man-in-space program because there is a clear military necessity that we can see at this point. If we don't have quick action, the United States will be outflanked strategically in this very important region.

Would you please comment on that?

Dr. YORK. Well, the Department of Defense and NASA and the administration as a whole, have all agreed that the Mercury program should be pursued vigorously and it has the highest national priority. It is a necessary precursor to any application of man in space, and, of course, it also has interesting psychological and prestige factors associated with it. For whatever purpose you may use men in space, you need to find out about their reaction and that is what this program is mainly for, from a technical point of view.

Mr. FULTON. You disagree then with the statement that the Mercury manned satellite project has little of military or scientific justification?

Dr. YORK. This particular program, Mercury, is more scientific than military, except that again it is one of these things where the programs take so long that if there is going to be a military use for man in space, that is one of these things we are in favor of getting at now, so we will have the information when we need it.

Mr. FULTON. You, therefore, specifically oppose the recommendation the Mercury program should be put in its "logical place," and the target date be delayed 3 to 5 years?

Dr. YORK. Yes. We in Defense have always felt that this should be done as soon as possible, as soon as reasonably safe—as soon as possible with due regard to safety, and so forth, and NASA feels the same way.

Mr. FULTON. This committee has said this:

> A stepup and realinement of the entire space program with more emphasis on projects that will pay off in immediate and military scientific benefits and less emphasis on man-in-space projects.

I disagree with that statement, because I think we must emphasize both and keep the front of progress moving on all these fields and not move back one step by lowering the priority. What do you think?

Dr. York. I agree with the way you put it, Mr. Fulton.

Mr. Fulton. Do you feel that your Department of Defense understands the depth of the Russian challenge to our U.S. security and our defense of this country?

Dr. York. Yes, I think so. That would require being able to peer inside of people's heads to answer thoroughly.

Mr. Fulton. Well this committee says that you don't and I wondered whether you did.

The Chairman. What was that committee?

Mr. Hechler. What are you attributing to the committee, if the gentleman will allow me——

Mr. Fulton. The committee feels that the Defense Establishment does not understand the problem of the Russian threat. I wonder if you do in the Department of Defense and in the administration, understand the depth of the Russian threat to the security of the United States and the defense of this country?

Dr. York. I think we do.

Mr. Fulton. Now, should we have another military-civilian type liaison group set up in order to handle or resolve priority conflicts that might occur between military and civilian projects, space projects and to take care of the gray area where there may be overlapping in type of projects?

Dr. York. Well, we do not need not "a body," but bodies of that sort and we do have them.

Mr. Fulton. And they are operating now, according to your statement, on a day-to-day basis, very satisfactorily in this realm of the melting, or the meeting of the need, so that we get projects that are worked out without disputes between military and space?

Dr. York. In my opinion, yes, and I think that Dr. Glennan would say the same thing.

Mr. Fulton. Would you comment on the amount of the budget which you are now receiving and also will receive for the coming fiscal year as programed? Tell us whether you feel that you can operate well within that budget, tell us if there is any area where it pinches you, and thirdly, tell us if that budget in any way endangers the security of the United States through pennypinching?

Dr. York. That is a series of questions.

I am sure that if we take the funds we have got for this year and the next year and spend them right that doing so and using these amounts would not endanger the security of the United States, and I am, of course, speaking about—I like to limit myself to my own responsibility, which is research and engineering.

Mr. Fulton. When we were developing missiles clear back in 1946 we started out with the air-breathing type. I believe two of them would be the Snark and the Navajo, and we made considerable progress with those missiles, did we not? They have formed a position in our strategic posture which has been very worthwhile, would you not say?

Dr. York. Doing those programs has contributed a great deal of information that was invaluable in carrying out the ballistic missile programs later.

Mr. Fulton. So really you got from the Navajo launcher the liquid propellent booster fluid, didn't you?

Dr. YORK. Yes. Also the development of the guidance system for that was an essential starting off point for the development of guidance systems for ballistic missiles.

Mr. FULTON. So these particular programs, while they have been discontinued, are nevertheless, programs on which we could say the Atlas, the Thor, the Jupiter and the Redstone, as well as maybe the Navy Viking, have obtained a lot of the groundwork upon which these later programs have advanced, such as the Polaris and so on in the Navy?

Dr. YORK. That is right.

Mr. FULTON. Is there any area in programing that the Joint Chiefs have overridden you and that would in any way effect the security of the United States adversely which we on this committee should know about in order that we can give you the money to correct it?

If so, I would like to have it specifically stated.

Dr. YORK. Not to this point.

Mr. FULTON. And you are then satisfied with the treatment you have gotten from the Joint Chiefs of Staff, as well as from the Congress on the amount of money you have received for your programs?

Dr. YORK. Yes.

Mr. FULTON. The Strategic Missile Evaluation Committee. Would you comment on what they said on February 10, 1954? I believe they were the ones who talked of the significant breakthrough on the warhead size, were they not?

Dr. YORK. I don't remember about the particular date, sir, so I may not——

Mr. FULTON. Well, that is the date and it was a recommendation for early availability of ICBM's.

Dr. YORK. What the Von Neumann committee pointed out—and I was a member, myself, at that time, so I have some personal recollections involved, was that you could get—taking into account progress in nuclear weapons which we were certain would obtain, taking into account guidance that we were certain would obtain, taking into account progress, or the possibilities of developing a proper reentry method, which again we were quite confident about by and large, that putting all of this together meant that an ICBM could be produced that would be a very useful weapon from the strategic point of view and the best way to do this, considering everything: The state of the art, the programs that were then in progress, the surest way to do it was the Atlas route, which was a 1½-stage missile with 250,000-pound engines which were to be based on the 135,000 pound engines then under development and that a second way that wasn't quite so sure, but that—I am not quite sure about the dates, because there were a lot of meetings—but a second way wasn't quite so sure, but in principle, would be better, would be to build a true, two-stage rocket. That was the Titan program.

Mr. FULTON. This took place in 1954, approximately, and actually as a result of your Von Neumann committee recommendations, a Gillette group was set up, wasn't it, to accelerate the ICBM program?

Dr. YORK. I think the considerations of the Gillette group were made just prior to my joining the committee and I am not sure about that.

Mr. FULTON. And before the Von Neumann committee we had the Joint Resources Command set up.

Dr. YORK. The Joint Ballistics Commission was set up at that same time and the Von Neumann committee addressed itself to a streamlined setup for this program on the grounds that was a serious program and needed unusual organizational attention and special organizational setup to push it as rapidly as possible, breaking across the usual lines of authority in coordinating control and so on.

Mr. FULTON. As a result of both the Von Neumann committee recommendations and the Gillette group, the Secretary of the Air Force then assigned an extremely high priority to the ICBM projects, and that was clear back in 1954?

Dr. YORK. That is right. And set up a special organizational system. The Air Force Ballistic Missiles Division, the Air Force Ballistic Missile Committee, and the then Assistant Secretary of the Air Force, Trever Gardner, played a major role in all of this and was given special authority with respect to these programs, too.

General Schriever was the BMD commander in those days.

Mr. FULTON. So full authority, responsibility and accountability for the project was given to General Schriever and the Atlas then became the basic mission of the Western Development Division of the ARDC, with Schriever commanding, is that not correct?

Dr. YORK. Yes. He was given unusual authority in comparison with the normal way of doing even other high priority programs.

Mr. FULTON. And then you were there, too, through the remainder of 1954 when the ARDC with its contractors made an extensive technical review of the Atlas program and focused further attention on the acceleration of these ICBM programs; is that not right?

Dr. YORK. Yes, that was a continual subject of discussion in those days. How much—what was the maximum amount that could be used in these programs.

Mr. FULTON. And then in February 1955, it was the Killian committee which recommended, concurrently with this ICBM effort that was already installed that we were talking about, that there be an equivalent IRBM effort to be carried on at the same time, is that not right?

Dr. YORK. That is right.

Mr. FULTON. And I might say to you that by the spring of 1955, that meant the Atlas program was expanding rapidly and further, that a $3 million program for the Atlas in 1953 had gone to $14 million in fiscal 1954 and it was $161 million in fiscal 1955. That would show quite a strenuous effort to push the Atlas ICBM programs and the research and development work along these lines; would it not?

Dr. YORK. Yes.

Mr. FULTON. Now, on the ICBM research, the question then had come up earlier, when the highest national priority was given to the Air Force ICBM work. That occurred when the President, in September of 1955, approved the assignment of the highest priority to the ICBM research and development program, is that not right?

Dr. YORK. Yes, but the Air Force had already given its high priority about the year prior.

Mr. FULTON. But the President then gave it the highest national priority by assigning it in September 1955, as well; is that not right?

Dr. YORK. That is as I remember it.

Mr. FULTON. And then likewise, the Titan ICBM project was established, so it ran along at the same time on a high priority?

Dr. YORK. Yes, it was started a little bit later. It was felt that we should start one that we were sure of, get going on that, and then start what we thought would be better, but were just not so certain on.

Mr. FULTON. And then just finishing this, to show that there has been ample administrative effort and attention given to these ICBM programs during this period, it was on November 8, 1955, that Secretary of Defense approved the formation of the Defense Ballistic Missile Committee and ordered organizational changes in order to handle better the ICBM and the IRBM programs, is that not right?

Dr. YORK. Yes. That was for the purpose of again taking this program out of the regular channels and setting up special streamlined channels for this purpose.

Mr. FULTON. And likewise, in that particular period, it was in November of 1955 that the Navy set up a sea-based projects division for the IRBM. They created, I think it was on November 7, the Office of Special Projects.

Dr. YORK. Yes.

Mr. FULTON. And on the outcome of those seaborne missiles we have had the development of the famous Polaris project.

The question is: Have we changed the standards? As I recall, there has been not one change in the size of the Polaris ever since the original supervising committee of the Navy set the project up, isn't that correct?

Dr. YORK. Well, there was a study for quite some time, using a liquid fuel missile, but all this time the progress in thermonuclear weapons was still going forward and we came to another point similar to that we arrived at in 1953, when it turned out—it became evident that we could do considerably better in the way of yield-to-weight ratio than we had predicted in 1953.

So the program was reoriented with a much smaller warhead as far as weight is concerned, but a size that permitted the use of solid fuels—which always have a somewhat lower performance—and permitted a generally smaller and more compact rocket so that you could get a lot of them on a single submarine.

Now, since the basic decision to go to solids and to the light weight warhead was made, there have been no important changes in standards as we went along.

Mr. FULTON. So, there was no avenue down which the DOD had gone which later had to be abandoned and we were still following pretty much the same conformity.

Dr. YORK. Still following the basic designs set down when we first changed over to solid propellant systems.

Mr. FULTON. I have just one more question and I am through.

The CHAIRMAN. Make it an even 3 o'clock.

Mr. FULTON. The Von Neumann Committee actually did not really go out of existence. It became the Scientific Advisory Committee, didn't it, and was transferred from the Air Force to the Office of the Secretary of Defense, and is still in existence.

Dr. YORK. Still in existence and reports to the Secretary through me, now under the chairmanship of Dr. Millikin who succeeded Dr. von Neumann, following Dr. von Neumann's death.

Mr. FULTON. Thank you, and you have made a very good witness. I appreciate very much the statement you have made.

The CHAIRMAN. Mr. Hechler.

Mr. HECHLER. I would like to commend the chairman for the nonpartisan approach that he has taken and has insisted that this committee take because I think therein lies the strength and prestige of this committee. Without taking the time of the committee, I would like to put some comments into the record.

The CHAIRMAN. Are there any objections to the comments in the record?

If not, it is so ordered.

(The comments referred to are as follows:)

Mr. HECHLER. In his remarks at the outset of this afternoon's session, my friend and colleague, Mr. Fulton, referred to "some comments made by some so-called advisory committees of scientists that are released very peculiarly on Monday, January 25, just at the time this committee starts in action on these particular space hearings." Mr. Fulton characterizes these comments by scientists as made by a "political group."

Mr. Fulton prefaced his remarks by stating that "I hope we can keep this on a nonpolitical level." I am delighted that Mr. Fulton has contributed so richly to our nonpolitical literature in his searching, "nonpolitical" questions and observations.

The January 25 report to which Mr. Fulton refers, and to which he has attributed direct quotations, is simple to identify. The story is clearly told in the February 5, 1960, issue of the magazine Science, published by the American Association for the Advancement of Science, at page 340:

"The Democratic committee of 17 scientists was organized last spring under the chairmanship of Ernest C. Pollard, head of the department of biophysics at Yale University. Since that time it has analyzed a number of critical areas in which it believes scientific advice is important to national objectives. In addition to the peace agency proposal, the committee has issued a statement describing the relation of science and technology to our foreign and military policy, a statement on nuclear test suspension, and a statement on science and politics.

"At present the committee is working on an evaluation of the space program and its objectives. In this connection, there was a meeting on January 24 at Democratic Advisory Council headquarters in Washington. A midday press conference opened vigorously because a 25-page committee working paper that was sharply critical of the U.S. space efforts had somehow reached the Baltimore Sun. The Sun article conveyed the mistaken impression that the committee was suggesting that the Government delay Project Mercury, the NASA man-in-space program.

"Pollard said emphatically that the report quoted in the Sun contained 'anything but' the final thinking of the committee. He explained that committee working papers are prepared by only a few members and that they are especially designed to be challenging and therefore contain as many points of controversy as possible, including statements that are deliberate 'jabs' to stimulate the committee members and keep them alert."

Thus what Mr. Fulton has done is to quote from a "working paper" which has absolutely no official standing within the committee, which certainly does not represent the conclusions of the full committee, and which was not officially released to the press. Obviously, therefore, the committee of 17 scientists, contrary to Mr. Fulton's allegation, made no release whatsoever which was timed to coincide with the opening of the hearings of the House Committee on Science and Astronautics.

So far as Project Mercury itself is concerned, I cannot speak for the committee of scientists which will make its official report in due time. As of February 25, 1960, the committee had not made its official report. I feel constrained to say, however, that those scientists on the committee with whom I have talked fully recognize the fact that the United States is publicly committed to Project Mercury, and that it is useless to argue about the wisdom of that decision. Accepting that decision, this group feels that NASA and Project Mercury itself should be adequately funded to speed the successful attempt to put the first man into space and to insure that if we should happen to be second we have an adequate backup of scientifically, technically and militarily valuable experiments. In this way, the United States can regain prestige and at the same time obtain data of value to tomorrow's science and technology.

The CHAIRMAN. Are there any further questions? Mr. Anfuso.

Mr. ANFUSO. I asked you this morning whether you were able to get some information from the CIA. Were you able to get that information?

Dr. YORK. This information concerned the Soviet Ballistic Missile Early Warning System. We believe we should hold that for executive session.

Mr. ANFUSO. Do you have that information?

Dr. YORK. Yes.

Mr. ANFUSO. I expect to go into it in executive session.

In line with that intelligence, I would like to mention something which will be published. A statement quoting British experts said that Russia is working on a missile with range between 10,000 and 12,000 miles and that this weapon will be available within the next 2 or 3 years.

Have you heard of such a weapon?

DR. YORK. I haven't heard of a weapon with those range figures. In fact, for a ballistic missile, those are fairly difficult ranges because that happens to be just halfway around the earth and it is hard to make—because of the way the trajectories work, that is harder than going more than halfway.

Once you get up to 5,000 miles, it doesn't require much in the way of change to get on to 6,000, 7,000, 8,000 and so forth.

I haven't heard of it, but if they wanted to build one at 10,000 miles, I am sure they could. I would have the same feeling about ourselves.

Mr. ANFUSO. Do you believe that the British have the wrong information or the wrong intelligence?

Dr. YORK. I really don't know. I am not familiar with this particular item. It is a rather odd sounding range, frankly.

Mr. ANFUSO. Of course, you know it has been stated time and time again that the Russians will have three times as many missiles as we have during the next few years. They will have as many as three times what we will have in the next few years.

You have heard that statement?

Dr. YORK. Yes; I have heard it.

Mr. ANFUSO. Do you agree with it?

Dr. YORK. This lies pretty far outside of research and engineering also, Mr. Anfuso.

Insofar as the Department of Defense is concerned, Secretary McElroy said that on the information he had some time ago he believed that they could and that he was making his plans on the basis of what they could do.

Since then there has been testimony from those within the Goverment who are responsible for these matters that they have readjusted this particular outlook.

I don't have anything to add to what has been said either way.

Mr. ANFUSO. Dr. York, with respect to that, General Power, the commander of the Strategic Air Force, upon which we are going to rely a great deal, has recognized the problem. He said, "In this period of time the Soviet Union will be able to virtually wipe out our entire nuclear retaliatory strike capability within a span of 30 minutes."

Dr. YORK. I believe that General Power said that 300 ballistic missiles could do that. I don't believe that he said the Soviets have these 300. I haven't really read—I have only read excerpts from his statement.

As I understand it, but I am not sure of it, he did not say that they had 300. He said if they had 300 or if they launched 300 simultaneously that they could do this and I presume he was talking about the present.

Mr. ANFUSO. Well, we have no right or at least we should not take the risk of assuming that they won't have that capability, should we?

Dr. YORK. Well, we should and we do take into account that things may be much worse than our mean prediction and we take it into account in many ways. The purpose of developing an on-the-shelf capability for airborne alert is one recognition.

The programs for mobile Minutemen and mobile and concealable Polaris are based on the fact that things may be worse than, again, the average prediction.

Our procedures for hardening and so on are based on assumptions that are not based on our predictions of what they can do, but on a considerably worse set of possibilities.

Mr. ANFUSO. Not taking into consideration the Polaris and the A-bombs—and I am not going to assume the Russians don't have a warning system for the Polaris and I am not going to assume that the Russians are going to allow the Polaris within devastating striking distance—but just taking this very statement made by our commander of the Strategic Air Force, General Power, it is safe to conclude that the Soviet Union would no longer be deterred, since it could knock us out before we could answer back.

Dr. YORK. Excuse me. Just your last sentence——

Mr. ANFUSO. I think if they have that striking capability—300 bombers, and they probably will have 300 of these intercontinental missiles—they will wipe out all of our basic military installations within a span of 30 minutes; they will knock us out before we could answer back.

Dr. YORK. Again I didn't read General Power's statement. I think he said, "if" they had 300 now they could do that.

The testimony of the people in Defense responsible for this particular matter—the Secretary and the Chairman of the Joint Chiefs—has been to the effect that when you take everything into account they couldn't knock it all out.

Now, they are the responsible people in Defense for this matter and that is what they have said.

Mr. ANFUSO. Well, I would like to assume that we have sufficient retaliatory power to make this impossible. But even if we assumed that, isn't it fair for me or anyone else on this committee to draw the conclusion that the chief weakness with our program is that, in the general field of rockets, and the exploration of space, we are not holding our own? We are behind, aren't we?

Dr. YORK. We are, taking all of these things that you mention and adding them all up, I think it is right to say we are behind. That is a fairly broad spectrum to put into all one pot.

Mr. ANFUSO. Isn't it also the truth that if we continue to go at this snail's pace and if they continue to go at this rabbit pace, that they will be even that much further ahead?

Dr. YORK. If they were going at a rabbit pace and we were going at a snail's pace, I guess so, but we are putting $2.9 billion into just research test and evaluation of missiles and military related space programs alone next year. That is a lot of snails or whatever you want to say.

Mr. ANFUSO. Well, compared to the wealth of the Russian Government and that of the United States, and considering the fact that they are still spending three times more than we are spending, I think we are proceeding at a snaillike pace and they are proceeding at a rabbit rate.

Dr. YORK. I don't know where you get that three times as much. That would be almost their whole defense budget, very nearly.

Mr. ANFUSO. No one has contradicted me in that figure yet and we asked Mr. Dulles for certain figures—I know the figures he gave us. He testified in executive session.

Dr. YORK. For spending in missiles and space?

Mr. ANFUSO. That is very important to me as a Congressman to know if that is true, and if it is not true——

Dr. YORK. Well, you can ask Mr. Dulles. It is not true to my knowledge, but Mr. Dulles is the expert. That they are spending $9 billion on development in this field?

Mr. ANFUSO. I am not giving any information, but I think the American people will want to know whether it is true that this rich country of ours cannot at least spend as much money as the Russians in this effort, at least.

Now, I didn't say that the Russians are spending three times, although I believe they are, but I say at least we should spend as much.

Dr. YORK. Our total expenditure in this field is about $6 billion, and if you multiply it by three, I don't think the Russians are doing that.

Mr. ANFUSO. It would be very important to get those figures, Dr. York.

Dr. YORK. I can only give them to you for us.

Mr. ANFUSO. We shouldn't do as much as the Russians; we should do a lot more if we are going to catch up. We should do three times as much, not that they should do more than we are, we should do three times as much in order to catch up. Don't you think so?

Dr. YORK. If we are going to catch up, we have to do more; that is correct.

Mr. ANFUSO. Three times as much.

The CHAIRMAN. Now, gentlemen of the committee, we have here General Betts, who is also a witness today. My thought is this: We have given General Betts' statement to the press so it is released as though he testified already before us today. It is important for that reason that we do hear him. My thought is, if we hear the general now, then we can ask further questions in an executive session because Dr. York has certain classified information he would like to give us. What is the will of the committee?

Gentlemen, if there is no objection, we will be happy to proceed with the general's statement.

I think everyone has a copy of your bibliography here.

The general is a very distinguished American. I recommend to your attention his record, his promotions and his honors. We are happy to have you here, sir.

If you will proceed with your statement, we will appreciate it.

STATEMENT OF BRIG. GEN. AUSTIN W. BETTS, ADVANCED RESEARCH PROJECTS AGENCY

General BETTS. Thank you, Mr. Chairman. It is, as always, a pleasure to appear before you, this time to report on the activities of the Advanced Research Projects Agency during the past year.

Secretary Gates and Dr. York have reviewed the recent changes in ARPA assignments with you, and Dr. York has outlined the range of advanced research projects currently under ARPA management. I should like to speak more directly to them.

The work begun last year on ballistic missile defense, Project Defender, has been continued in an attempt to discover adequate means to counter operational ballistic missiles in the future. About one-half of the ARPA budget is devoted to this activity. Our thinking is geared beyond the more conventional Nike-Zeus concept which involves, as you know, destruction of a missile toward the terminal phase of its flight.

ARPA is studying missile interception at the early, midcourse, and terminal phases of flight by means extending beyond the current state of technical knowledge. To do this, we must explore all of the phenomena associated with missile flight which might be helpful; that is, we must become intimately familiar with both the natural and disturbed conditions of the upper atmosphere and the space beyond. Such familiarity is practically nonexistent.

Measurement of the properties of the various constituent elements of the atmosphere and space qualifies as a fundamental scientific unknown. The nature of even the undisturbed atmosphere is poorly understood; our problem, of course, goes beyond that to study of the interaction between the atmosphere and solid objects passing through it at high speeds. We seek not only the knowledge itself, but improved methods of obtaining that knowledge.

The study of such things as atomic cross sections, changing molecular relationships and electron densities is involved. We are experimenting with the release of chemicals at high altitudes and the observation of artificial electron clouds and luminescence in order to determine basic data which will enlighten our understanding of the medium in which our weapons systems, and those of the enemy, will have to operate.

We are also examining a variety of techniques which might be helpful in solving the problems of detection, identification, intercept, and kill of ballistic missiles. Further advances in our knowledge of radar, infrared and optical sensing systems are required, as well as the development of a capability to receive, process, communicate, and effectively use the data collected by such sensing elements in a matter of minutes or fractions of minutes.

For example, once a missile or warhead is detected, it may be necessary to determine whether it is fully armed or merely a decoy designed to saturate or confuse our defense. The offense may also employ jamming devices for the same purpose. It is incumbent upon us, then, to consider the development of a capability to discriminate between "duds" and the real weapon and to neutralize jamming techniques. In other words, we are seeking a counter-counter-measure capability.

Once a ballistic missile is detected and identified, a "kill mechanism" must be employed to destroy it or its reentry warhead. Obviously, a warhead traveling at great speeds and built to withstand the tremendous stresses involved in atmospheric reentry will be difficult to bring down.

The data processing system required to structure or order the operation of a complex missile defense system is a crucial factor—consideration of the "judgment" which must be built into the system is a sobering yet exciting challenge. We are giving it close attention.

In the face of these unknowns, there are a few important resources available to us. The U.S. ballistic missile test program presents us with a first-rate laboratory in which we can undertake actual flight measurements. A complex of ground, ship, and airborne instrumentation will be used at the Atlantic and Pacific Missile Ranges to collect this valuable data. Radars, of course, are the basic tool in experimental measurement work of this kind, and we have produced a program of radar development which will hopefully increase the limited range and resolution capabilities of conventional radar equipment. The results achieved thus far in this area have been very encouraging.

Project Principia connotes the ARPA effort to develop more efficient solid propellants for use in missiles and space vehicles. Our objective is a solid propellant with at least 10 percent higher specific impulse than any now under development.

The current plan of attack is twofold: (1) the synthesis of new propellant combinations which have never been made before and testing them in small-scale engines, and (2) accomplishment of the related supporting research required for effective utilization of the new chemicals as they become available.

The great advantages of solid propellants, as compared to liquids, are instant readiness and reliability. Unfortunately, existing chemical and explosives technology has been almost fully exploited. It is our judgment that any further large improvement will require a chemical breakthrough.

During the last year the Agency has also been assigned responsibilities in the field of advanced materials research and more recently in the field of research and development relating to techniques for inspection of a possible nuclear test ban.

The objective of the materials program, Pontus, is the strengthening of the U.S. basic research capability in the field of materials. The chemical and physical properties of materials now available constitute major limiting factors in the development and performance of most weapons systems. The revolution in materials requirements stemming from the accumulative scientific and technological advances of this century, and highlighted by the special case of nuclear energy development, has resulted in a serious national deficiency. The evolution of new weapons systems designed to perform under severe and previously unknown operating conditions has placed a great strain on existing basic materials.

At the present time a considerable amount of materials research is being carried out on an ad hoc or emergency basis as a part of the development of specific weapons systems. The overall effectiveness of DOD research and development could be expected to improve if such materials were readily available.

The ARPA materials program will seek to augment our basic materials research capability by supporting interdisciplinary laboratories for basic research in materials at selected universities. Materials problems are now so complex that various combinations of the knowledge of several disciplines are required to solve them: principally, solid state physics, inorganic and high temperature chemistry, metallurgy, and ceramics. Pontus is viewed as a continuing program designed to build a measure of stability and strength into the basic research foundation which underlies our defense capabilities.

In addition to these primary assignments, you have already been informed that the Agency has retained management responsibility for certain space programs, pending their transfer to the appropriate military department. The communications satellite program, Notus, is an effort to assess the technical feasibility of reliable, efficient, and secure communications satellites for use in global command, control, and support of military forces.

As part of Project Transit, a navigation satellite was launched in September 1959. Orbit was not achieved, but useful systems data was acquired. Three further launches are contemplated for the balance of fiscal year 1960 and 1961. It is hoped that a satellite system can be developed to provide a more precise, worldwide, all-weather navigation capability of considerable value to ships and aircraft.

ARPA is also engaged in a three-phase satellite tracking and data acquisition program based on a need, shared by both the Department of Defense and NASA, to know precisely where satellites and space probes are at any given time.

One element of the program is known as Spasur, a continuation of the east-west satellite detection fence project discussed last year. It is naturally in our interest to develop means to detect, track, and identify unknown or silent satellites.

As a second feature of the program, a central catalog of all satellites is being set up so that new orbiting objects may be identified at once. This activity is called Spacetrack. It will involve the receipt, collation, and analysis of data from a variety of sources such as the detection fence, the NASA minitrack network, and the military missile ranges.

The third project is for installation of tracking and data collection devices overseas. In addition, studies of other approaches to the problems of satellite detection, tracking, and data collection are planned.

This tracking and data acquisition program will support both the military scientific and development program in space and the nonmilitary space program directed by the NASA. The worldwide character of this undertaking requires an extensive investment in stations and equipment, and the DOD and NASA have cooperated in the development of a mutually supporting system.

With this outline of ARPA's programs in mind, I believe the ARPA budget figure becomes more meaningful. A reduction in the specific hardware requirements of the Agency's programs—for example, expensive rocket boosters—has occasioned a reduction in the overall dollar expenditure request contained within our budget presentation. However, of the $215 million requested, a significantly greater portion can now be devoted to the kinds of advanced research leading hopefully to "breakthrough" technology for which the gency was created.

We look forward to a year of heavy activity and continued progress. The clarification of the Agency's role and mission which has been made possible by the recent decisions of the Secretary will, we are sure, permit us to devote increasing attention to our research and development task and less to the critical, but for ARPA unrelated, areas with which we have been previously concerned.

The Secretary noted in testimony before the Defense Appropriations Subcommittee of the House Appropriations Committee earlier this month that, considering the defense program as a whole, "the rate of adjustment to technological progress has been rapid and remarkable." It is ARPA's intent to contribute to and facilitate this continuing process of adjustment by reducing scientific unknowns to useful and manageable knowledge.

This completes my prepared statement. I shall be happy to answer any questions.

The CHAIRMAN. Thank you very much, General. We are interested in your statement which is different from the others that have been given to us.

Your work is, of course, in defense missiles and defense programs. You are satisfied with our present position with reference to defense developments in space, are you, General?

General BETTS. I am not in a position to comment on that, Mr. Brooks, in terms of the entire Department of Defense missile and space programs since ARPA is only concerned with certain segments of that program. I am certainly of the opinion that the ARPA budget is adequate to do the jobs we have to do in advanced research and in the tail end of the space efforts with which we are concerned.

The CHAIRMAN. You are with the Defense Department, the Office of Director of Defense Research and Engineering, aren't you?

General BETTS. Yes; I am a part of Dr. York's office; that is right.

The CHAIRMAN. So you work with Dr. York and what Dr. York says pretty well represents your views?

General BETTS. I haven't heard anything from Dr. York today with which I seriously disagree; that is right, sir.

The CHAIRMAN. You have one man who is in accord with you, Dr. York.

Mr. FULTON. Could we strike out the word "today."

General BETTS. Occasionally, we do disagree.

The CHAIRMAN. Mr. Fulton.

Mr. FULTON. I would like to thank the general.

May I have your comments on the deterrent and retaliatory capabilities of the United States?

At the present time when we have the Strategic Air Command and we have the Navy and Air Force jet bombers able to deliver nuclear weapons, of course, part of our posture of defense is the power to retaliate in great and massive size by means of IRBM's or ICBM's; is that not correct?

General BETTS. That is correct.

Mr. FULTON. What we are talking about in the development of the ICBM as a weaponry system and the IRBM as a weaponry system is something for the future. It is a matter of judgment on how soon the conventional methods will be superseded by these long-range missiles—unmanned missiles. Is that not right?

General BETTS. I think I would agree with that.

Mr. FULTON. So actually, at this particular point in our defense history, we are phasing out many of the conventional weapons and phasing in new ones that we have been making research upon?

General BETTS. This is true.

Mr. FULTON. And in that phasing you people are making sure that there is no scientific gap, or intelligence gap, or any capability gap. You are able to defend our United States security and our position, are you not?

General BETTS. We have been working not only on the development of the long-range missile, but also we have been working on the development of the reentry capabilities of such missiles.

Mr. FULTON. Aren't we either equal or ahead of Russia on the capability of reentry? No missile is good unless its payload has the capability to reenter the atmosphere undamaged.

For example, back in 1957 we saw the successful reentry of the nosecone of the Jupiter-C missile. That certainly established an outstanding lead over any of our other competitors on the ability to complete the trajectory of a missile where it can be effective, is that not the case?

General BETTS. I think I would say only this, Mr. Fulton: I don't have enough knowledge of the Russian's reentry development program to compare it with what I do know of the reentry development within the U.S. program.

I would say that we would be very remiss if at this stage in our situation with respect to the Russians we did not concede that they do have the ability to bring a warhead through the reentry onto target, and I think that is the U.S. position, but I don't have personal, independent knowledge of their capability in this area. This has not been part of my responsibility.

Mr. FULTON. Do you know if there is any gap or lag in our own defense capabilities with regard to the reentry of our missile warheads?

General BETTS. I think our reentry program has been very effective.

The CHAIRMAN. Would the gentleman yield?

Mr. FULTON. I would be glad to yield.

The CHAIRMAN. Would the recent effort of the Russians, in firing that missile across the Pacific and landing it within a limited area, indicate a reentry capability?

General BETTS. It certainly would if we accept the Russian announcement at its face value and I have no basis for either accepting or denying.

Mr. FULTON. I want to compliment you particularly on the second paragraph of your statement, General Betts, where you state, "The work begun last year on ballistic missile defense Project Pounder"—in which I understand you have 50 programs under study now—"has been continued in an attempt to discover adequate means to counter operational ballistic missiles in the future. About one-half of the ARPA budget is devoted to this activity."

General BETTS. This is correct, sir. For the coming fiscal year. This has not been true in the past.

Mr. FULTON. So you are emphasizing the antimissile defense?

General BETTS. We consider the ballistic missile defense one of the most critical problems of the Department of Defense.

Mr. FULTON. Then you state further, "Our thinking is geared beyond the more conventional Nike-Zeus concept which involves, as you know, destruction of a missile for the terminal phase of its flight."

Therefore you are thinking on a much broader basis of the whole trajectory of an ICBM or an IRBM missile.

General BETTS. This is one of the very marked advantages on this kind of a program in an organization like ARPA which does not have the specific problem of getting an operational system into the field in a specific time frame.

Having turned that kind of a program over to the Army, in the Nike-Zeus program, then ARPA is completely free to do the things which we feel must be done technologically to grow in capability in this whole area.

Mr. FULTON. You have study contracts out, 50 programs under Defender——

General BETTS. And we have hardware which may or may not contribute to the Zeus program. We don't know at this stage of the game.

Mr. FULTON. Are you then studying missile interception at the early, midcourse, and terminal phases of flight?

General BETTS. This is correct.

Mr. FULTON. When the statement is made, then, that Nike-Zeus is not put into operation, it does not mean that everything is being held up in the U.S. Department of Defense, or ARPA, on antimissile defense. We are making broad progress, are we not?

General BETTS. We are certainly doing everything we can technologically to get a good, sound solution to this problem.

Mr. FULTON. In your estimation, are the efforts and the money being provided for you adequate, both in this fiscal year and in the proposed fiscal year, beginning June 30, 1960?

General BETTS. Of the things which we see to be done in this area, I think we have adequate funds to carry them ahead at just as fast a pace as they can advance technically.

Mr. FULTON. Thank you. That is all.

The CHAIRMAN. May I suggest to the committee at this point, we have well exhausted this subject and we have some high-powered witnesses coming and a heavy day tomorrow too.

Now, Dr. York has some few matters that he wants to talk to us about in executive session, so if there is no objection, I would say this would be a very good time to go into executive session and close our session today.

Mr. FULTON. Could I just finish with one point on Nike-Zeus?

The CHAIRMAN. You are the only one who has asked any questions in the open session of the General.

Mr. FULTON. At this time, considering the present stage of research and development of the Nike-Zeus we have no defense against a complete smothering by that type equipment. For example, an enemy can drown out or can flood out any power of discrimination of incoming missiles we have at the present time, considering the level of our research and development in this field.

For example, we can't discriminate yet between duds and jamming techniques, as well as live weapons. So that is a real reason why we should not go into the Nike-Zeus production at the present time, is that not right?

General BETTS. Well, I think there is a great deal more to it than just that, Mr. Fulton. All I would say is, in reaching the judgment not to go into production I am sure that the Secretary took note of all of the things which have been done in the ARPA program with respect to discrimination techniques, as well as the progress that has been made within the Army Nike-Zeus program in this general area.

The CHAIRMAN. If the gentleman wants to continue, we will have to stay in open session. You are the only one who has asked any questions of the witness.

Mr. FULTON. That is all.

The CHAIRMAN. If there is no objection, we will go into executive session.

(Whereupon, at 3:25 p.m., the committee proceeded in executive session.)

[EXECUTIVE SESSION]

REVIEW OF THE SPACE PROGRAM

TUESDAY, JANUARY 26, 1960

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

The committee met in executive session at 3:25 p.m., Hon. Overton Brooks (chairman) presiding.

The CHAIRMAN. The committee will come to order.

Is everybody screened, Doctor, from the viewpoint of the Pentagon?

Mr. DUCANDER. These are liaison officers from the Department.

Colonel CARTER. It is OK back here, yes, sir.

STATEMENTS OF DR. HERBERT F. YORK, DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING; AND BRIG. GEN. AUSTIN W. BETTS, ADVANCED RESEARCH PROJECTS AGENCY—Resumed

The CHAIRMAN. Doctor, at this point I want to ask you one or two questions. I really appreciate the sincerity of your testimony and I believe as we all do, that we want to try to protect this country from devastation by ICBM's or by any other means that the Russians have at their disposal.

For the first time in my life I have been really concerned about the security of our people back home.

I want to ask you this: Do we have a program underway to simplify the missile systems?

Dr. YORK. A program to simplify missile development?

The CHAIRMAN. Yes, to simplify the equipment and procedures in the operation of the missile?

Dr. YORK. Yes. This is what we refer to as our improvement programs on Atlas and Titan.

The CHAIRMAN. It seems to me you could do more that way perhaps than almost any other way.

Dr. YORK. Yes, indeed. We feel very strongly about that, that these first generation missiles which are a result of a crash program are complicated in many ways unnecessarily but when you are in a big hurry what you do when you come to making a decision about whether we will try this approach or that one, you take the one which is most certain rather than the one which is perhaps simpler but nevertheless would take more time to check out.

I do not have the statistics but I know for example on just the number of valves which there are in an Atlas engine, this number has come down from something in the hundreds as of 2 or 3 years ago, to perhaps one-tenth of that now—perhaps 20 percent, I am not really quite sure—and we see all the signs of having it become simpler still.

So right in our programs as part of the Atlas and Titan program, we have simplification as being one of the main points of emphasis, with all the things that simplification means. It means easier maintenance, it means greater reliability and so forth.

The CHAIRMAN. It would mean a great savings, too, in cost.

Dr. YORK. Then there are certain operational simplifications that may not necessarily be equipment simplification, but nevertheless make it easier to actually fire one of these things in anger, on short notice.

For example, here we are developing what we refer to "as in-silo launch" for Titan. Without in-silo launch the missile is on a big elevator, the elevator brings it up, and then you fire it from the surface. That is some more equipment that you have to have that has to work in times of chaos and it is some more functions that have to be performed all in the proper sequence and at a time when presumably enemy bombs are bursting all around or might be.

In addition, separately from these big missile programs, the Air Force is right now trying to put together a set of programs proposed to them by their Ballistic Missile Division for still greater simplification of rocket engines, for example, and we are carrying on programs in developing storable fuels because it means again less operations that have to be performed at the time you want to fire the missile. Storable fuel is one that you can put in the missile and leave it already loaded.

I would be hard put to get a dollar value for this sort of work, but it is probably in the $100 million class, just for simplification and this kind of improvement alone.

The CHAIRMAN. And yet it is vital to our development.

Dr. YORK. We regard it as very important because these missiles are very complicated and they must be made simpler.

The CHAIRMAN. I have heard it said that one reason the Russians were as effective as they are in the handling of their missile program, the ICBM program especially, is because they have a much larger booster and the equipment inside and the engines inside of that booster are larger. As a result, they get more efficiency out of them. There is less failure on the part of the engines or the operation of the equipment inside.

What would you say about that?

Dr. YORK. Once you get them in big, I mean Atlas size or even Thor size and Jupiter size and bigger, I do not think this makes very much difference to the rocket itself. It does make a difference in some of the applications. For example, in the case of lunar probes it has been the entire difference. The fact that they have more weight to play with means that they do not have to be so careful or so precise about what they do. They have more technology to choose from because they do not have to go for the extremes in miniaturization and so on. It has been a big advantage there.

In connection with missiles, I think it has not made much difference. But what did and what is really similar is—in 1954—because of the recognition of the fact that the situation was certainly not at all good—I mean the relative situations of ourselves and the U.S.S.R. in big weapons—we chose to start first the one we were most sure of: Atlas, as opposed to Titan, which was a two-stage missile.

The reason we did that is that with the Atlas design you can start all of the engines on the ground. In 1954 we were not certain how much of a problem there would be with lighting one of these engines in space.

Now as it turned out it is perfectly all right. But we did not know that at the time so we took the conservative course because of our feel- of the urgency of the situation.

In order to make an ICBM-range missile, with the one-and-a-half-stage type of design, you have to have very thin tanks because the Atlas is virtually a stainless steel balloon and that means it is more delicate. You have to trim every possible bit of weight off.

Now with the Titan and also with some of the more improved version of the Atlas we are not quite in that position anymore. As of the last year or so, we no longer have to trim every possible element but even this has paid off to some extent because by what amounts to virtually overdesigning the Atlas with regard to all of these things, getting all the weights down and so on, we have gotten a better bird than we anticipated.

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The CHAIRMAN. Am I right on this one point: I have heard a lot about gaps in our programs, but if we do not develop a bigger booster, the time may come when we will have a satellite that we are prepared to put up requiring a large booster, and will there not actually be a gap then in our development? In other words, unless we forge ahead with the bigger booster and satellite development, we are not going to have a progressive program, is that not right?

Dr. YORK. That could happen and since the booster is in many cases the longest leadtime item, that is why we very strongly support the big booster programs of NASA. Actually in most cases we have found a way around it by and large. The Discoverer program was instigated because we wanted to check out engineering components but did not have the bigger booster in order to enable us to do it in the full scale Midas, and Samos system.

It is possible that in the communications program we may end up waiting for a booster. These are not large gaps in time and for the programs that we are firm about in defense, talking now not about space programs in general but just our particular programs, the net loss in time will be very small because there are other things you can be doing.

The CHAIRMAN. There are things in these other programs that you consider important to national defense and if it reached development quicker than we think, it would be all right. But we would actually have a gap until the booster was ready.

Dr. YORK. We would have a problem there but not in the case of any of the others.

Mr. FULTON. Until we proceed with these other programs, we must proceed on a broad front and not consider one approach as against another.

I agree with the chairman that we must move on a multilateral approach rather than emphasize one particular weapon and put our strategic defense on that particular method. Don't you agree with that?

Dr. YORK. Yes, and furthermore, I believe, if I understood you right, we can afford to do that. We do it in quite a number of cases. When we are finally certain we try to concentrate but we carry on alternative approaches in these matters.

Mr. FULTON. So, for example, with the Atlas program, while you did diminish maybe from 4 to 2 firings per month, you, nevertheless kept the Thor program going, to pick up other information.

My point is this: If we keep a broad-based approach, while we may not be successful on each of these programs as an end item, nevertheless, we keep the pyramid of our scientific knowledge growing on a broader base. Would you agree with that?

Dr. YORK. Yes.

Mr. FULTON. That is all, thank you.

Mr. ANFUSO. Dr. York, I asked you this question about the early warning systems. Do you have any information on that?

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The CHAIRMAN. Mr. Chenoweth?

Mr. CHENOWETH. Doctor, I am interested in knowing about the comparison on the number of operational missiles. Atlas is our only operational missile.

Dr. YORK. Atlas is our operational ICBM missile.

Mr. CHENOWETH. Are you in a position to tell us how many we have.

Dr. YORK. I do not believe that I should. The testimony on that has come from the Secretary, the Chiefs of Staff, and the CIA.

I have heard it but I would rather not——

Mr. CHENOWETH. How does it compare with what the Russians have? That is what I am interested in.

Dr. YORK. We both have very small numbers.

Mr. CHENOWETH. The Atlas has been in operation since September?

Dr. YORK. It was turned over to the operations in September.

Mr. CHENOWETH. We visited the Convair plant where they are producing it and I forget what they told us the production program was. It seemed to me they were moving along at a pretty good pace.

Dr. YORK. The bottleneck on operational Atlas is not the missile at the present time but all the ground equipment, and the whole base structure. The missile cost is aproximately 15 percent of the cost of a base. The missiles for a base cost about 15 percent of the cost of the base and that is a measure of the man-hours, complexity, and so on, involved in setting them up.

Mr. CHENOWETH. We have the base at Vandenberg.

Dr. YORK. Yes; we have "a" base at Vandenberg.

Mr. CHENOWETH. Don't we have more than one there? I thought we saw two.

Dr. YORK. You saw [* * *] missiles probably on launchers. There are also some other big ICBM installations there for test and evaluation of the missiles that could be used eventually.

General BETTS. Mr. Chenoweth, could I give you a number that would help you to appreciate the problem here?

Mr. CHENOWETH. Certainly.

General BETTS. After the construction is complete—and I mean the concrete for the hole in the ground and the things there.

Mr. CHENOWETH. You are talking about the silo operation?

General BETTS. Yes. The things that a constructor can come in and do, after that is complete, it takes * * * man-years, or more, of engineering effort, of engineers and technicians on site, to take the missiles and check out equipment and loxing, the fueling and the pumps and the valves and all of that, just to hook it up.

This is really the thing that makes it such a long-drawn-out problem to get to big numbers of intercontinental ballistic missiles, when we must be in the posture of surviving their attack.

In other words, if we did not have to worry about their attack, we could just crank out Atlas missiles, stand them in the open and this would be a completely different proposition, but since we are going into concrete and a hardened configuration, there is over * * * man-years of effort onsite, just to hook up the pieces and make them work.

Mr. CHENOWETH. After you get that built, you can use it over and over?

General BETTS. Oh, yes; there is no question about that.

Mr. CHENOWETH. Doctor, in connection with that, are we working on putting these launching sites underground? When we are ready to launch these missiles we will have different places, I understand, all over the country, where we expect to put these underground; is that correct?

Dr. YORK. Yes. The first few Atlas squadrons will not be that way but all the Titan squadrons and all of the Atlas squadrons except the first few will be in deep silos for launching.

Mr. ANFUSO. And an attack would not burst them or destroy them?

Dr. YORK. It depends on how close they hit.

Mr. ANFUSO. A direct hit?

Dr. YORK. A direct hit always takes one out.

Mr. CHENOWETH. When will the Titan be in operation?

Dr. YORK. It comes in in mid-1961. Now, that is assuming we get over the present difficulties in Titan.

Mr. CHENOWETH. Do you think it will be next year before Titan is operational?

Dr. YORK. Yes; mid-1961.

Mr. CHENOWETH. What is the basis of that prediction?

Dr. YORK. Well, that is the schedule when you put everything together that has to be done. When the contractor and the responsible people in the Air Force put together all of the judgment as to how these things will work out.

Mr. CHENOWETH. You are 3 years ahead on Atlas and it is reasonable to assume you might be a little ahead on Titan.

Dr. YORK. I really do not think so. First of all, these Titans are all starting out in the hardened configuration, which means that all the holes have to be dug, all the civil engineering has to be done, all the assembly work that General Betts spoke of has to be done.

I doubt that we would be ahead of that * * *.

* * * * * * *

Mr. CHENOWETH. How are you doing now? Are you picking up some?

Dr. YORK. It is hard to say. There is a Titan schedule this week and we will have to see how it goes.

Mr. CHENOWETH. That is all, Mr. Chairman.

The CHAIRMAN. Mr. Osmers.

Mr. OSMERS. Mr. Chairman, while we were in open session there was an exchange between Mr. Anfuso and Dr. York which I would like to go back to for a moment.

The statement was made, I believe, by Mr. Anfuso, that the Russians were believed to be spending * * * times as much as the United States on missile-satellite-space development.

Now, Mr. Chairman, I think I have been following this program pretty closely through this committe and also through the Armed Services Committee and this information does not jibe with other information which I have on this subject.

Now, I realize that there have to be guesses about what the potential enemy——

Mr. ANFUSO. Would the gentleman give us his information? I want correct information. I am just as much interested as you are.

Mr. OSMERS. I want to say, first—and of course I was very much upset about that uncorroborated statement being made with reporters in the room—in the first place, let me say that I have heard no one make a specific guess as to how many rubles are being spent on this program by the Russians.

The CHAIRMAN. Will the gentleman yield?

Mr. OSMERS. Yes.

The CHAIRMAN. The CIA gave us direct figures.

Mr. ANFUSO. * * *.

Mr. OSMERS. I would suggest, Mr. Chairman, if that is so, that those figures be rechecked as to accuracy because I have a feeling that those figures will not stand up.

I would like to have Dr. York's view on it. I know he is not in the intelligence branch of the Government and I am not trying to put him in it.

Dr. YORK. That is right, and really the proper source is the intelligence community.

Overall for defense, the figure that I have heard—I would like to say this is second hand—is that they are buying about the same amount of defense we are. Now, this is an attempt to take into account the fact that some things are more expensive, some are cheaper, and so on.

Mr. HECHLER. If the gentleman will yield, how is it with relation to gross national product?

Dr. YORK. With relation to gross national product, it is larger.

Mr. ANFUSO. I am just as anxious as you are to get the truth on this matter, and I would certainly like to hear the opposite, if it is so. I think it is important for us to find out whether they are spending * * * times as much.

I frankly state to you, Dr. York, and to the committee, that that is my impression.

Now, you have just admitted, at least to your knowledge, that they are spending as much. We are a much wealthier country——

Mr. OSMERS. Now, excuse me, Mr. Chairman. The witness did not say that. He said overall for defense, not for missiles and satellites.

The CHAIRMAN. What did you say, Doctor?

Dr. YORK. That the total amount of defense that they were buying was about the same as the total amount of defense that we were buying.

You may be referring to an article by Hansen Baldwin, perhaps, in which he said that relative to the G.N.P. they are spending three times as much, but absolutely about the same.

The CHAIRMAN. How can we ever catch up, though, with them if we are spending exactly the same amount that they are?

Dr. YORK. Now, the question is, how much are we spending in specific categories, such as missiles and space?

The CHAIRMAN. I would say research and development. The figure is about the same in research and development, is it not?

Dr. YORK. I don't know what they are spending on space. They haven't launched an earth satellite for almost 2 years. I don't know what you make of that. I don't know what to make of it, myself, but they haven't launched an earth satellite in 2 years.

Mr. RIEHLMAN. I think we have to go back to the testimony given by Mr. Dulles; he gave us some figures as to what they were spending. However, that takes into consideration all of the Government's activities where we would have to not alone take in what defense is doing, but what industry is doing in research and development programs. In Russia everything is handled by the Government and every ruble that is spent in industry in research and development, and every program in research and development goes into this category of expenditures. Therefore, it wouldn't be fair to just simply say that what we are putting in our defense program is comparable to what they are putting into their defense program, because they are not taking into consideration what we are putting in through industry, and that runs into the billions of dollars every year.

Mr. ANFUSO. I think that is a good point that you raised, but my impression was——

Mr. RIEHLMAN. I am sure Mr. Dulles emphasized that when he spoke here the other day.

Mr. ANFUSO. My impression was that in making a comparison, Mr. Dulles was taking into consideration what we were spending also through private industry in the space effort.

Mr. RIEHLMAN. No, I am sure not. He really specifically said that if we did that, we would have to take into consideration what we were spending.

Mr. ANFUSO. Then why is it so difficult to get that? I would want to know, and so would you want to know.

Mr. FULTON. May I make a suggestion? Let us have our staff look into that.

The CHAIRMAN. That is an excellent suggestion. Now, I have a figure. I don't think I should give it out even in this meeting here. I don't think I have any right to.

Mr. OSMERS. Mr. Chairman, there is one thing that I think we should point out to the staff, or to anyone who undertakes this task, and that is that you will get lost in this subject, if you take an article such as Hansen Baldwin had in the Times, in which he starts to talk about gross national product and the percentage of this, multiplied by that.

I think the facts that this committee and this Congress—and the administration and the Department of Defense and NASA—must have, are facts as to the size and quality of the programs. If we start to relate it to rubles and dollars and make comparisons of American industry and Communist organizations, and if they want to throw in the cost of running all their scientific schools, and if we want to, it would run it way up. I think that any of that information that we can get we want to get. But, basically, as a Member of Congress, and specifically of this committee, I want to know what the Soviet program is. Not the dollars, or how the figures got jazzed up, or comparing it to the gross national product.

So, in those terms, those are the facts I think we should get.

Mr. CHENOWETH. I would like to know just what we are spending overall now. In space, missile, and satellite programs.

Dr. YORK. Space missiles and satellite programs by the Government, and including procurement, about $6 billion.

Mr. CHENOWETH. I was thinking it was a little more than that.

The CHAIRMAN. No; that is it. That is what was given us today.

Mr. OSMERS. Now, Mr. Chairman, right in connection with that figure: Are there any programs being conducted in the country by others, or by industry or by universities or by others, that would materially add to that if you were going to deal in expenditures?

Dr. YORK. Not in terms of expenditures and not that fits the definition of missile and space programs.

In terms of people, some of them involve very good people, but in terms of dollars they don't make much of a dent.

Mr. OSMERS. The expenditures would be in the $6 or $7 billion area?

Mr. ANFUSO. Will the gentleman yield there?

Mr. OSMERS. Yes; I will.

Mr. ANFUSO. And also you have to take into consideration the value of the dollar and what we can get for the dollar and what they can get for the ruble and what they can do without the ruble, without any expenditures at all.

The CHAIRMAN. It definitely presents a difficulty.

Dr. YORK. I was only answering the question in respect to what we spend.

Mr. FULTON. Mr. Chairman.

The CHAIRMAN. Mr. Fulton.

Mr. FULTON. I move the chairman be empowered to assign a staff officer, or officers, to the question of the figures along the lines that have been discussed here, and let them report for the record. I had talked previously with several of these people who were here in uniform, saying this would be a question of deep import, and there is quite a bit of difference of opinion and a little misunderstanding. I would rather have it authoritatively done, and let's have it done by the staff.

The CHAIRMAN. Let's see what Dr. Sheldon has to say. He may have the figures in his head.

Dr. SHELDON. Mr. Chairman, I wish I did. I only wanted to say that I hope the members of the committee will not be disappointed. Before joining this group I put in a year working with a large team of people on just this problem, with the full assistance of Central Intelligence. I assure you there is no way on anybody's part to come up with a set of figures which will compare dollars and rubles in a meaningful way. I am afraid you must go back to looking at programs.

With the help of these people we could give you a classified figure, but I say most sincerely and earnestly, after a year of full-time work with many people, that you won't get anything from the figure.

Dr. YORK. I am afraid I must agree with Dr. Sheldon.

The CHAIRMAN. Is there any objection to the motion?

Mr. RIEHLMAN. Just a moment. In view of what Dr. Sheldon has told you, and he is a member of the staff, and because of the experience he has had, I am just wondering whether Mr. Fulton is really serious about having his time spent on a program which he admittedly says can never produce the answer we are looking for. I would rather have him work at something else besides this.

Mr. FULTON. Dr. Sheldon didn't quite make it completely negative, universally. He said you would have to go back to the programs and compare programs and not try to translate back to rubles, dollars, and things of that type, isn't that it, Doctor?

Dr. SHELDON. Yes, sir.

Mr. FULTON. I think it would be profitable to have the good doctor look into it, but I think it profits us not in the least to try to do it here today.

Mr. OSMERS. Mr. Chairman, I would certainly want to agree with that suggestion, and I understand well the point Mr. Riehlman makes. It has to be programs, not dollars, economics, or gross national product.

The CHAIRMAN. I think if anybody can do it, Dr. Sheldon can, but don't be upset if he doesn't come up with a dollars-and-cents answer; but rather, makes it in programs.

Mr. FULTON. After he puts 1,000 man-years of work in on it, I want to recheck it again and see what we are doing.

Mr. OSMERS. It will no longer be a problem.

(The information requested is classified.)

Mr. CHENOWETH. I would like to ask how the next fiscal year's budget compares with what is spent this year?

Dr. YORK. For missiles and space, they both go up.

Mr. CHENOWETH. Can you give us an estimate of the figures?

Dr. YORK. The total research, development, test, and evaluation in the procurement budget and the line item for missiles alone goes from about $2.15 billion up to about $2.4 billion. That is about 10 percent and that is in actual direct obligations, the spending goes up probably a little faster. In military space, the related programs that I defined this morning, it goes from $418 million up to $480 million, which is about 15 percent and that is in direct obligations the spending goes up a little faster.

Mr. CHENOWETH. What is the last figure?

Dr. YORK. $2.15 billion is the direct obligations on all missile programs. That is approximately half big missiles and half small missiles.

Mr. CHENOWETH. That is procurement?

Dr. YORK. No; that is research, development, test, and evaluation.

Mr. CHENOWETH. What is the second figure?

Dr. YORK. That is the separately identified military space programs.

Mr. CHENOWETH. We are spending $4.2 billion——

Dr. YORK. Let me say them again: In missiles, but not including space, it is about $2.15 billion in 1960, in new obligations. About $2.4 billion in 1961, in new obligations.

Mr. CHENOWETH. Now, what is your second figure?

Dr. YORK. In military-related space programs, the ones I discussed this morning, it is $420 million in 1960, $480 million in 1961.

The CHAIRMAN. $481 million?

Dr. YORK. From 418 to 481.

The CHAIRMAN. That is on page 4 of the statement.

Dr. YORK. That is the Midas program, the Samos program, the Navigations program, the Dynasoar program, and a small amount of miscellaneous component developments.

Mr. CHENOWETH. What items go into it?

Dr. YORK. In the 480, that is about it.

Mr. OSMERS. That is millions of dollars.

Mr. CHENOWETH. We are spending about $6 billion.

Dr. YORK. I have now accounted for, call it a half a billion and then $2.4 billion——

Mr. CHENOWETH. You are up to $3 billion now.

Dr. YORK. Now, I am up to $3 billion. I actually included that in the $6 billion, I put in procurement of missiles, as opposed to development test evaluation, procurement.

Mr. CHENOWETH. Actual purchase of the finished article?

Dr. YORK. Yes; that is about $3.5 billion.

Mr. CHENOWETH. You are up to $6½ billion now, roughly?

Dr. YORK. Yes, and then there is the NASA—no, I am sorry, it is not—we shouldn't be up to $6½ billion. We should only be up to about $5.8 billion at this time because certain moneys are actually for one purpose, but in another account.

Then you add in the NASA budget and that brings you to about $6.5 billion.

Mr. CHENOWETH. That is for fiscal year 1961.

Dr. YORK. That is for fiscal year 1961.

The CHAIRMAN. You give those figures to Judge Chenoweth, because I think the committee has all of that, Judge.

Mr. FULTON. I would like a full summary made by Dr. Sheldon to tie these things in on our program.

Dr. YORK. This includes small ones. It includes Bomarc, Nike-Hercules, as well as the big missiles.

Mr. FULTON. I know that in the Armed Services Committee there has been some research work done on this already. I inquired about it just before this session and it was not ready yet, but there will be some work already done by some of their staff.

The CHAIRMAN. I am having a little difficulty holding our members here.

Mr. ANFUSO. I move we adjourn, Mr. Chairman.

The CHAIRMAN. I have a lot of questions here that the staff has prepared. They are excellent questions. Could I submit them to you, Doctor, and ask you to answer these for the record?

Dr. YORK. Yes.

The CHAIRMAN. They are really excellent questions and should be asked you, but I recognize this, that if we do it, we will be here later than we should and we are going to have a heavy session tomorrow.

For that reason, I am anxious to take up one or two matters here in executive session.

NOTE.—The questions and answers appear below.

Mr. CHENOWETH. May I ask one more question?

The CHAIRMAN. Yes.

Mr. CHENOWETH. Suppose we doubled that appropriation, Doctor, where would we be?

Dr. YORK. We would run out of people to spend it if we doubled it.

Mr. CHENOWETH. Nothing would be gained by upping the appropriation?

Dr. YORK. If you up it a little bit, you will get a little bit more. Doubling it is pretty drastic medicine.

Mr. CHENOWETH. Some groups have been suggesting we ought to treble it. It isn't practical to do that?

Dr. YORK. Not overall.

Mr. CHENOWETH. Even if we had the money?

Dr. YORK. No. You can always argue whether this should be trebled at the expense of that.

The CHAIRMAN. Mr. Bass?

Mr. BASS. Dr. York, would you or General Betts tell me what the extreme range is for the Atlas missile?

Dr. YORK. It depends on the payload. * * *

Mr. BASS. Would that mean then that we could hit any target in Russia?

Dr. YORK. You don't need that to hit the targets in Russia. You will get well over 95 percent of them at 5,500 miles.

The CHAIRMAN. We certainly thank you, Doctor. I have a million other questions to ask you, but I am not going to do it this afternoon.

And you too, General. We appreciate very much your action in being here this afternoon.

Just a minute, Mr. Anfuso. We have one more thing to take up in executive session.

I want to thank you and all of your staff for being present. Now, we will go into a superexecutive session to take a matter up with the committee.

(Whereupon, at 4.15 p.m., the committee proceeded to other business.)

QUESTIONS SUBMITTED TO DR. YORK BY REPRESENTATIVE OVERTON BROOKS

1. Dr. York, were you consulted in drafting the proposed administration legislation for amending the Space Act?

Answer. Yes.

2. Who consulted you. The President? Dr. Glennan? Dr. Kistiakowsky?

Answer. Dr. Glennan and his associates.

3. Was the Secretary of Defense kept fully informed of your activities in this matter?

Answer. Yes.

4. Did you assist in drafting the bill?

Answer. Early drafts of the bill were discussed with me and others in DOD. In the course of these discussions suggestions for changes were made by us, some of which were incorporated in the final draft.

5. Were you assisted by the military services or did you consult them during the preparation of the draft?

Answer. Some persons from the military departments assisted in formulating DOD views on the various drafts. These include both military and civilian.

6. Do you support the bill?

Answer. Yes.

7. What in your opinion are the major features of the bill which tend to correct deficiencies in the Space Act?

Answer. The new bill places responsibility for U.S. progress in space exploration and space flight as an end in itself in NASA rather than in a council at a higher level. This is primarily of benefit to NASA, and therefore can be discussed better by them.

8. The administration bill does not draw the military and civilian programs together with respect to centralized management and control of the national effort, especially with the recommended abolishment of the NASC. Do you concur in this divided management concept between DOD and NASA?

Answer. Yes.

9. When you divide the military and civilian space program, under the administration proposal, what mechanism is provided for setting priorities between those space programs directed toward national security and those directed toward the peaceful exploitation of space?

Answer. The NASA programs have space exploration and space flight per se as end objectives, the DOD space related programs are designed to exploit the capability of space flight for solving specific military problems, such as early warning of missile launchings, communications, and so forth. These objectives are so disparate from a functional standpoint that it is, in my opinion, wrong to attempt to place them all in single priority system based on environmental considerations. For example, the Midas program (early warning) priority should be set in accordance with military value of early warning and in relation to how well Midas competes with ground-based methods of achieving early warning. The priority of Midas has no more to do with the priority of lunar probes than it has to do with the priority of the Interstate Highway System.

10. The proposed legislation appears to create a sharp line of demarcation between civilian and military space programs. Do you feel that this can be done at this time?

Answer. Most programs can be fairly clearly designated as either civilian or military. There is, of course, a considerable gray area where such a designation is not entirely obvious. The responsibility for items falling in this area has been assigned to one or the other agency by executive agreement.

11. Many knowledgeable people, military, civilian, and scientific, are on record with this committee saying that at this time such a division is not clear. Can you explain to the committee why you see this clear military-civilian program separation?

Answer. The division is not perfectly clear in all cases. It is, however, clear enough in the majority of cases so that it is easily feasible to handle the remaining cases by means of separately arrived at executive agreements between the two agencies.

12. Is it not possible under the administration bill that the NASA may find it necessary to create large facilities in support of this clearly defined civilian program?

Answer. If the NASA program grows beyond the point where it can be supported by available DOD facilities plus presently existing NASA facilities, then it will indeed need to create large facilities in support of its program.

13. It would appear to the committee that the split between military and civilian space programs as defined by you, Dr. York, has a great potential for duplication of manpower, money, and facilities. What do you think?

Answer. The presently planned programs of NASA and DOD do not duplicate each other.

14. If the Defense Department will continue to provide support to the NASA as you describe, is this not a marriage of military-civilian programs in an area which requires many millions of dollars and the effort of military forces in support of the civilian program? This clear line of demarcation which you described previously between civilian-military programs is not quite clear to the committee in the light of your support explanation; would you please restate it?

Answer. Use by NASA of DOD support facilities (i. e. ranges) does not, in my opinion, constitute "a marriage of the military-civilian programs." It is simply the fastest and most economical way to make progress.

15. What mechanism exists in DOD to insure the proper support of NASA programs?

Answer. A permanent mechanism for handling the support problem has not yet been established. However, satisfactory interim arrangements do exist; for example, NASA deals directly with the range commander for support of its launch requirements, and a special arrangement has been made in the case of Project Mercury, in which case General Yates, who is also commander of AMR, has been designated coordinator for all DOD support for Project Mercury.

16. Do you know of any formal mechanism within NASA to support the military space program?

Answer. At the present time, support by NASA of DOD programs consists of their carrying out certain booster developments which may be, eventually, of use in military as well as civilian programs (e.g., Saturn and Centaur). In each case there is a joint ad hoc committee whose purpose is to assure that potential DOD requirements will be met.

17. If the CMLC is abolished as proposed how do you visualize that proper liaison and assessment of program potential will be obtained? Has DOD reorganized to accommodate for this?

Answer. The CMLC would be replaced by a series of boards or committees dealing with the various matters of mutual interest such as space vehicle development, auxiliary power supplies, and so forth. In fact, such committees already exist and are even now the principal liaison mechanism between the two agencies.

18. The committee has knowledge of the fact that former Secretary of Defense Neil H. McElroy asked Mr. Walker L. Cisler, president of Detroit Edison Co. to make a study of the operation and management of the support program of the missile and space efforts of DOD. It is also understood that NASA participated since it appeared difficult to separate their support requirements from those of the DOD. Can you tell the committee what Mr. Cisler's findings and recommendations were?

Answer. In brief, Mr. Cisler recommended that an office be set up which would establish launch schedules at the various ranges and, using these, determine what new facilities, if any, were needed to support the programs using the ranges and space tracking facilities. The DOD recognizes the need for a mechanism for firm overall coordination of range and space tracking support facilities and is considering Mr. Cisler's recommendations as one of various possible means for accomplishing this objective.

19. Have you taken any steps to implement these findings and recommendations? If so, what?

Answer. We have concluded that some mechanism is needed to provide firmer central control over the ground support facilities for missile and space operations. We are studying Mr. Cisler's proposal along with other possible arrangements. We have not yet implemented any of these.

20. As Director of Defense Research and Engineering you are in a position to review and approve research, development, test, and evaluation programs proposed by the three military departments. Is this not so?

Answer. Yes.

21. Are you also in a position to review and approve the weapon system proposals of the three military departments which they submit as necessary in carrying out their roles and missions?

Answer. Yes, insofar as their technical aspects and feasibility are concerned. However, determination as to their military value, assuming they are technically sound, is made by the military authorities.

22. Are you also influential in determining the quantity of weapons to be procured as well as the quality?

Answer. By virtue of my authority as Director of Defense Research and Engineering, no. However, as a member of the Defense Secretariat and the Armed Forces Policy Council, I do from time to time participate in discussions involving quantity of weapons.

23. Would you not say, then, Dr. York, that you in effect control what the roles and missions of the Army, Navy, and Air Force really play in national security?

Answer. No.

24. The title Director of Defense Research and Engineering does not appear to adequately describe your sphere of authority Dr. York. Can you explain to the committee how all this authority gravitated into your office?

Answer. I think my title does adequately describe my sphere of authority. What authority I have did not gravitate to my office but was clearly spelled out in the Reorganization Act of 1958.

REVIEW OF THE SPACE PROGRAM

WEDNESDAY, JANUARY 27, 1960

House of Representatives,
Committee on Science and Astronautics,
Washington, D.C.

Hon. Overton Brooks, chairman, presiding.

The Chairman. Dr. Glennan, go ahead with your statement.

(Dr. T. Keith Glennan, Administrator, National Aeronautics and Space Administration, after being sworn in, took the witness stand.)

STATEMENT OF DR. T. KEITH GLENNAN, ADMINISTRATOR, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Dr. Glennan. Mr. Chairman and members of the committee, I appreciate this opportunity to discuss NASA's program and its $802 million budget appropriations request for fiscal year 1961.

The continuing interest in our program shown by the individual members of this committee has been stimulating and gratifying. I have had the personal privilege of accompanying several members on visits to our research centers and to test launchings at Cape Canaveral. And all who have made these visits have expressed sincere gratification at the quality and dedication of the men who are carrying forward the Nation's space exploration program.

Before entering upon a discussion of our budget request and program, I want also to express publicly my appreciation for the effective support given to our operations by the several military services and by the Office of the Secretary of Defense. Cordial and effective working relationships have been developed during the past year and I am confident that the means now exist, or are in the process of creation, that will further minimize duplication and encourage even more effective mutual support in this difficult but exciting business.

As you know, the President recently directed me to study the possible need for additional funds to accelerate the high-thrust launch vehicle program. As soon as this study has been completed, we will be requesting substantial additional funds.

The fiscal year 1960 budget apropriation was $500,575,000. If the pending $23 million supplemental request is granted by the Congress, the fiscal year 1960 total will be $523,575,000.

Several members of our administrative and technical staffs will follow me with a detailed, program-by-program review of the $802 million fiscal year 1961 budget request in the following three principal categories:

Salaries and expenses	$167, 560, 000
Research and development	545, 153, 000
Construction and equipment	89, 287, 000

I would like to discuss with you some of the pertinent facts about the Nation's program in space exploration as I see them today. In doing this, I will start with an evaluation of our position with respect to that of our competitor in this business, the Soviet Union. Then I would like to point out the major events in NASA's operations over the past year and outline the course we must follow if we are to gain for the United States the advantages that accrue to a nation demonstrating leadership in the science and technology which must undergird a program in space exploration.

It is clear that the Soviet Union continues to hold a substantial space lead in the eyes of the world. It is equally clear that this lead is based principally upon the possession by the Soviets of one or more reliable launch vehicle systems having perhaps twice the thrust of our own first stage booster rockets.

This imbalance will continue until we have achieved a launch vehicle system that fully exploits the thrust of the Atlas through the construction and use of properly proportioned new upper stages, or until we have achieved a launch vehicle system which is based on a much more powerful first stage rocket—or both.

In no other aspect of the space business do we appear to lag the Soviet Union. In all other aspects, it is my opinion that we have an equal capability and that we have published more significant scientific results, more fully and more promptly than they.

This is a simple, straightforward statement. Like most such comparisons in the international scene, it is not subject to rigorous proof but my statement coincides, I believe, with the informed opinion of the scientific community at home and abroad. But this statement does not tell the whole story. The more powerful Soviet launching vehicles make possible their undertaking of some missions that are completely denied to us today. They are able, I should think, to move more quickly from the inception of an idea to the design and construction of payloads because weight restrictions are less stringent than ours.

Thus, they can avoid the time-consuming tasks of miniaturization, optimum packaging and other weight-saving practices.

It is probable, also, that the availability of high-thrust launch vehicles operates to increase the reliability of their flights, since they can undertake significant and spectacular missions with adequate weight-carrying capacity permitting substantial margins for their operations.

You may properly say: All right, that was the situation a year ago. What have you done about it? Gentlemen, we have done a great deal. As my associates describe in detail our activities in the vehicle development field, you will see the effort that has been expended, the progress made, and the plans and promises for the future.

I am sure you are concerned, as I am, about the very long periods of time required for most of these significant development programs. It would be easy to promise earlier dates. Many people do. But I call your attention to the history of the Atlas ICBM. Almost 5 years of intense, top priority effort—an urgent program in every sense of the word—had to be expended to bring that rocket to an operationally ready state. And the launch vehicle systems we are developing are more complex and versatile than the Atlas.

I think it is time that all of us recognize that on the basis of the present scoring system, one based almost wholly on weight-propelling capability, we cannot expect to outscore the Soviets for a considerable period of time. We should be able to match their present weight-lifting capabilities within the next 12 to 18 months, based on present expectations for the Atlas-Agena B and the Atlas-Centaur systems.

If by that time, as may well be possible, the Russians have made optimum use of what we believe to be their present thrust levels, or have developed an even higher thrust booster, our expectations of superiority will not be satisfied for about 4 to 5 years, when the Saturn should be ready.

But we have used, to maximum advantage, the cards we have held in this game. Without desiring to play down our very real deficiency in thrust, I would like to cite an example. I think it is clear that we have made excellent use of launch vehicles utilizing rocket engines which were originally designed and developed for the armed services' missile program, and not for space missions.

Out of 10 attempts to place spacecraft into orbit or on deep space trajectories in calendar year 1959, we achieved five successes. These, together with earlier Explorers, Pioneers, and Vanguards, have given us—and we in turn have given the world—a vast amount of data from which significant scientific information has thus far been derived.

As I have said earlier, in the extent and quality of our scientific findings we probably have an edge, in the judgment of the international scientific community.

But the fact remains that novel and spectacular space experiments involving heavy and complicated payloads on difficult missions are the big chips in this poker game at the present time. As one newspaperman has said:

> It is not good enough to say that we have counted more free electrons in the ionsphere than the Russians have, that we know more about cosmic rays. We must achieve the obvious and spectacular, as well as the erudite and obscure.

There is only one way to regain the ground we have lost—ground lost several years ago. It will be accomplished by the establishment of hardheaded, long-term goals—this we have done—the identifying of the technical tasks necessary to be undertaken in order to press forward toward those goals—this we have done for the shorter term future—the development of the organization and management to accomplish these tasks—this we are doing—the utilization of the genius and capabilities of industry, education, and other branches of government—this we are doing—and the funding, at an adequate level, of the work to be undertaken—this we seek in the authorization request now before this committee for study and action. All of these elements must be pursued diligently, urgently, and relentlessly.

At the end of the present fiscal year, the National Aeronautics and Space Administration, with the support of the Congress, will have organized under one governmental agency what I believe to be the greatest collection of scientific and technical personnel ever assembled, to carry out vigorously this Nation's space exploration program.

With the help and genius of American industry, the proven talents of Dryden, Horner, Pickering, Silverstein, Abbott, Von Braun, Newell, Hagen, Stewart, and hundreds of others, will meet with confidence any competitive challenge in space that this Nation faces today or that may arise to face us in the future.

As responsible officials, each of us can recognize that space is but one of the areas of intense rivalry between our way of life—freedom—and the Communist dictatorship. As individuals, we do have a responsibility to recognize that while space is the most glamorous, the most visible area of competition—and very fruitful also for propaganda purposes—we are engaged in an across-the-board contest. I remind you of this because these other areas of competition also make large demands on the Public Treasury.

Now what are our plans for the future? We seek $802 million in new obligational authority. Before many days have passed this amount will be increased as we turn on more steam in our superbooster program involving Saturn, its component rocket developments, and the F–1, 1,500,000-pound single chamber engine. Our intent here is to advance, as fast and as surely as the technological problems will permit, the time period in which the two- and three-stage Saturn vehicles will be available for initial tests and the time period in which we will have a reasonably reliable launch vehicle system in the multiton payload range.

This program will be described for you by Dr. Wernher von Braun later in this series of presentations. The speedup we hope to effectuate promises to be as much as 1 year for the complete first phase of the Saturn vehicle. The test dates referred to for the two- and three-stage developmental Saturn units will be advanced by 3 to 9 months by the actions we expect to take.

Despite many expected problems, Project Mercury continues to move forward in an atmosphere of confidence apparent to all concerned. Morale is high, hours are long for the top staff, the Astronauts are busy and fit. In the third quarter of calendar year 1960 we expect to embark on the man-carrying, Redstone-boosted ballistic training flights. The first manned, Atlas-boosted orbital flight should take place in calendar year 1961.

The Atlas-Able flight to the vicinity of the moon, which was attempted on Thanksgiving Day last, will be repeated during the second quarter of calendar year 1960. A backup booster has been scheduled for this flight, but a word of caution is needed here. Pad availability and checkout time required make it highly unlikely that a repeat mission can be scheduled within 4 weeks of first launching should such a backup flight be necessary.

Our experiments in space science and applications are scheduled at the rate of almost one per month for calendar year 1960. The Tiros meteorological payload; Project Echo, the passive communications satellite; and the several flights intended for the study of radiation and other phenomena of outer space, will keep our launch teams and scientists very busy. It is of interest to note the participation of one of the Nation's largest communications companies in the Project Echo experiment, with an investment totaling several millions of dollars of its own funds.

Consistent with our determination to hold to a minimum the number of different types of launch vehicle systems, we recently canceled the Vega project in favor of the Atlas-boosted Agena B vehicle. We canceled Vega for a number of reasons.

First, the Defense Department's demonstration of significant reliability in the Thor-boosted Agena A system; second, the decision of the DOD to uprate the Agena A stage to a point where it approached the capability in most missions of the Vega; third, the high rate of firing of the Agena systems using both the Thor and the Atlas as first stage boosters, thus promising greater reliability; and fourth, the fact that the Atlas-Agena B availability approximates that of the Vega. All of these considerations entered into our decision.

The decision to cancel Vega was made with probable cost expenditures, including termination costs, running in the neighborhood of $17 million. Some portion of the expenditure is recoverable in the Centaur program. Schedules will not be delayed by this change in vehicle systems.

Organizationally, we have made good progress. The President's decision to give NASA full responsibility for all superboosters made it desirable for NASA to acquire the Development Operations Division—the Von Braun team—from the Army Ballistic Missile Agency at Huntsville, Ala. The President's report and supporting papers dealing with this transfer now lie before the Congress. Negotiations to effect this transfer have been carried out in a highly cooperative atmosphere of good will, and I am confident that the needs of the Army for support of specific military tasks will be met.

The acquisition of the von Braun group has made possible the beginning of centralization at Huntsville of major responsibility for the bulk of our launch vehicle systems development and operations. A new division of the NASA headquarters organization, the Office of Launch Vehicle Programs, has been established evidencing the importance we attach to this activity in which our budget estimates show more than $250 million to be obligated during fiscal year 1961. Subsequent speakers will discuss our organizational arrangements in more detail.

Construction of Goddard Space Flight Center, named for America's rocket pioneer, is proceeding on schedule at Greenbelt, Md. Initial occupancy is planned for mid-1960, thus beginning the consolidation of our Washington area staff engaged in space flight development and field operations.

In the field of international cooperation, we have made very great progress. Here our policy of frankness and our adherence to the traditional and well-understood policy of prompt disclosure of scientific results is building good will throughout the world.

Agreements with several nations have been negotiated covering the installation, manning, and use of tracking and data acquisition equipment. Others currently are under negotiation. Cooperative satellite launching programs are being undertaken with Canada and England and initial discussions have been held with several other nations. We have participated actively in the deliberations of the U.N. Ad Hoc Committee on the Peaceful Uses of Outer Space, and of COSPAR, the Committee on Space Research of the International Council of Scientific Unions. In all of these activities, we have worked closely with, and have had the counsel and support of, the State Department.

I have not attempted in this statement to go into detail on any of these program and operating matters. As I pointed out earlier, my associates will present those I have mentioned, and several others, in sufficient detail to give you a good picture of the Nation's program and plans for space exploration.

In this regard, the Associate Administrator will present a plan for research and development activities extending several years into the future. He will point out, of course, that any research and development plan is subject to continuing review and can be considered valid only to the extent that it is funded. Nevertheless, we believe we have developed a plan that will guide our programing toward significant and ambitious milestones and end objectives.

Now, if I may, I want to turn again to budgetary matters. There is pending before the Congress our request for supplemental funds for fiscal year 1960 in the amount of $23 million.

You will remember that your committee authorized expenditures of $530 million last spring, but the Congress appropriated $500,575,000. It is hoped that the Appropriations Committee will act promptly on this request, the majority of the funds being required for our top priority project—Mercury.

New obligational authority in the amount of $802 million is requested for fiscal year 1961. I believe this sum, together with the additional amount we will request for acceleration of the superbooster program, will enable us to carry forward vigorously the program we will present to you.

I should note, however, that ours is almost wholly a research and development operation, with all of the uncertainties and unforeseen problems that accompany any such activity. We are dealing with an enormously complicated technology.

The most significant of our space experiments must operate in environments and under conditions not easily reproduced for component testing in ground-based facilities. A few conditions cannot be reproduced at all. Furthermore, almost all significant tests and experiments result in the destruction of the rocket and payload. Reuse is impossible, or nearly so.

All of this adds up to an expensive business. And this budget is a tight budget.

It provides for a determined and vigorous program to develop reliable launch vehicle systems with the thrust necessary to propel the spacecraft on the missions we want to undertake. It provides for the urgent prosecution of Project Mercury. It is intended to make possible difficult experiments in both the communications and meteorological fields.

It provides for a significant number of flights for the purpose of probing more deeply into the secrets of outer space as we build up our knowledge of the conditions to be met by future human voyagers to the moon and beyond. It provides support for the basic and applied research and advanced component development which is necessary to undergird any program of this kind.

In short, this budget is intended to provide for the urgent prosecution of the Nation's program in space exploration in all its phases, with particular emphasis on the superbooster developments. If approved, I am as certain as anyone can be in the research and development game, that we will accomplish our goals for the coming fiscal year and will have taken significent steps forward toward the attainment of the long-term objectives we have set for ourselves.

Respectfully, I urge you, Mr. Chairman, and I urge the members of your committee, to approve this budget request as soon as you have satisfied yourselves on the validity of our requirements. Delays in both authorization and appropritaions actions will severely limit our abilities to plan for, and proceed with, our difficult tasks.

And now, I would call your attention to the schedule of presentations to be made by my colleagues and associates. Each of us will be happy to explain, as fully as we can, any aspect of our program and to answer your questions to the best of our ability. Thank you again for this opportunity to appear before the committee.

The CHAIRMAN. Thank you very much, Doctor.

Doctor, I want to assure you that this committee is going to give your bill its most prompt attention.

I have consulted with our counsel and with the members of the committee as to whether we should try to meet at 9:30 in the morning.

Of course, this thing should be followed with all possible speed, commensurate with thorough consideration of your bill, as I know it is urgent.

We were prepared to start January 2, but for a directive from the executive department. We found that we could not interrogate witnesses on any matters relating to funds until after the budget message of the President was made public on the 18th of this month. That is the reason for our present delay. But we are going to push it with all possible speed.

With that in mind, Doctor, please be back in the morning.

I think that the committee ought to go ahead with our GAO witnesses. We should finish with them. Then we will take up the NASA budget again with Dr. Glennan and question him the first thing tomorrow morning.

Mr. ANFUSO. Mr. Chairman, could I be permitted to ask him a few questions?

The CHAIRMAN. If we start doing that, then we will open——

Mr. ANFUSO. I understand it is agreeable to Mr. Fulton.

Mr. FULTON. I will be very glad to consent.

Mr. ANFUSO. If it is agreeable to the members, I would appreciate it.

The CHAIRMAN. All right, there is no objection to it.

Mr. ANFUSO. Dr. Glennan, first of all, I want to congratulate you on your very frank statement. I see that you and your agency are very much on the job.

In the last few days, Dr. Glennan, this committee has tried to alert the American people to the dangers we face from ICBM's attack. There is on record, for example, a statement by Gen. Thomas E. Power, commander of our Strategic Air Forces, that 300 ICBM's or less can be very devastating to our population and defense.

We are not going to be sleeping. I know that your agency won't permit this Government to be caught sleeping.

I ask you this for the purpose of inquiring. Doesn't the real hope of mankind depend to a great extent on the work which your agency is doing in developing outer space for peaceful uses, work which holds such great promise of creating a world of abundance, alleviating tensions, perhaps making war unnecessary, and promoting prosperity and a decent living for all peoples on earth?

Dr. GLENNAN. Mr. Anfuso, I think the work we are undertaking will make very, very substantial contributions to the well-being of all peoples; yes. This is really kind of an all-persuasive business we are in. Space is out there for everyone.

There are untold bits of knowledge which we expect confidently to acquire. It is a knowledge which ultimately will help us understand better what we are doing here on earth, and in the process of developing the devices which will carry us to our destination there, we are undoubtedly going to add materially to the sum total of the knowledge of techniques and processes, materials, systems, which are in use daily in this country.

I couldn't agree with you more that this is a quest for new knowledge, which is unique, and which I think will contribute very greatly ultimately to the peace and welfare of all nations.

The CHAIRMAN. Thank you, Doctor.

Mr. ANFUSO. Wait a minute.

The CHAIRMAN. We want to get on to the GAO witnesses.

Dr. GLENNAN. Mr. Chairman.

Mr. ANFUSO. Let me finish with just this question.

I am glad that you are negotiating agreements with other nations, because you realize that this country can't do this job alone. I hope that you will make agreements with other nations, such as, for example, to cooperate on space medicine and biology and other ventures such as better rocketry and guidance and instrumentation. May I close by saying that I, for one, and, I am sure, every Member of this Congress, feels that we want to give you more cards—I mentioned the word "cards"—we would like to give you more cards. In order to double this effort, in order that we can reassure the American people, do you think that at some time in the near future you can come back to us with a report stating how, if you had double the amount that you have requested, you could use that amount, and whether that would help us in catching up with the Russians. If you can come up with that statement, I am sure that we can get the Congress this year to appropriate it.

The CHAIRMAN. Thank you very much, Doctor.

Dr. GLENNAN. Mr. Chairman.

The CHAIRMAN. Let's go ahead with the GAO.

Mr. FULTON. Doctor Glennan wants to say something.

The CHAIRMAN. Do you want to answer that statement?

Dr. GLENNAN. No, sir; I wanted to ask a question of you. Our General Counsel is here, who is thoroughly familiar with all of these matters which have been under discussion by the GAO. He will stay here and attempt, if possible, to answer some of the questions that may be raised. I will be glad to come back, myself, tomorrow.

The CHAIRMAN. We will be glad to have your General Counsel remain with us.

(Whereupon, the committee proceeded to further business.)

REVIEW OF THE SPACE PROGRAM

THURSDAY, JANUARY 28, 1960

House of Representatives,
Committee on Science and Astronautics,
Washington, D.C.

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

The Chairman. The committee will come to order.

We are meeting this morning in the Old House caucus room because the charts used by NASA are too extensive for our own hearing room. The committee will want to see and inspect them carefully.

Dr. Glennan called me from Detroit. He went there to make a speech last night and no planes have taken off from Detroit. He probably won't be in until tomorrow morning. He will be the first witness in the morning.

In the meantime with his consent, we are going to call Dr. Hugh L. Dryden, Deputy Administrator, National Aeronautics and Space Administration.

(Dr. Dryden was sworn previously.)

STATEMENT OF DR. HUGH L. DRYDEN, DEPUTY ADMINISTRATOR, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Dr. Dryden. Mr. Chairman, I wish to talk to you today about the national space exploration program. I appreciate the opportunity of describing to you the philosophy and structure of the national space exploration program for accomplishing the general objectives of the National Aeronautics and Space Act of 1958. Dr. Glennan in his opening statement gave you an evaluation of our position with respect to that of our competitor and outlined the course which must be followed.

We must establish the long-term goals, we must determine the technical tasks necessary to press forward toward those goals, and we must develop the organization and management to accomplish these tasks.

As he indicated, some of these things have been done and most of them are well along.

Specifically, in the 16 months since NASA was formally established on October 1, 1958, great progress has been made in the formulation and initiation of a comprehensive integrated program of action.

The most visible and spectacular aspect of the space activities under way is the succession of launching of space vehicles at Cape Canaveral, some successful and some unsuccessful.

These launch vehicles are intended to boost a spacecraft across the frontier into outer space to perform those missions needed to reach our national objectives. As the launch hour approaches, as you know, the labors and hopes of hundreds of scientists, engineers, technicians, the work of months and years, come into general public view for the first time. We begin to understand that much of the space program in progress at a given time, for example, today, is aimed toward missions to be flown later. Our integrated space program is like an iceberg. The parts in view, above the water, so to speak, are the smaller part of the total effort required to perform successful missions in space. Most of the iceberg is under water, hidden from view.

The general pattern of activities necessary to a specific flight mission is represented schematically on the accompanying chart, Missions. Each mission requires a suitable launch vehicle system to launch the spacecraft into orbit or to great distances from the Earth to the Moon or planets.

If I might divert to the large exhibit on the left, this is intended to exhibit to you in general terms the nature of some of the missions about which I am talking (fig. 9).

Some refer to the flying of rockets and probes essentially vertically which return to the Earth. Some of the missions, as at the bottom, are Earth orbital missions. Some, as just above, are missions to the Moon, and finally, missions to the neighborhood of the planets.

When I use the words "flight mission," I am talking about one of these types of activities and the remarks which I make apply in general to all of them.

Each mission requires a spacecraft equipped for the specific purpose and provided with the instrumentation, telemetry, and other apparatus to accomplish the desired mission. We often call this apparatus the payload.

We are trying to get this word "spacecraft" in general use to mean the vehicle which goes into orbit with everything it contains. The launch vehicle is the rest of the space vehicle which puts the spacecraft into orbit. The payload is that part of the spacecraft such as instrumentation, telemetry, and so forth.

Each mission requires the operation of suitable ground facilities to receive and record telemetry, to track the spacecraft for determining its position continuously, to photograph its track, send command signals, or whatever else may be required by the mission.

Developments in these three areas and the missions to be carried out must be planned together in proper time phase; the possible missions are in fact determined by developments in launch vehicle systems, spacecraft components, and available tracking and telemetry systems.

This leadtime aspect is a most characteristic feature of space activities. It is found in many other areas of our life today, even in legislative activities. The history of a given space flight is analogous to the history of a bill in the Congress. Some bills are passed and signed, and hence are successful. A bill under active debate on the floor has its roots extending well into the past, perhaps to previous sessions of the Congress.

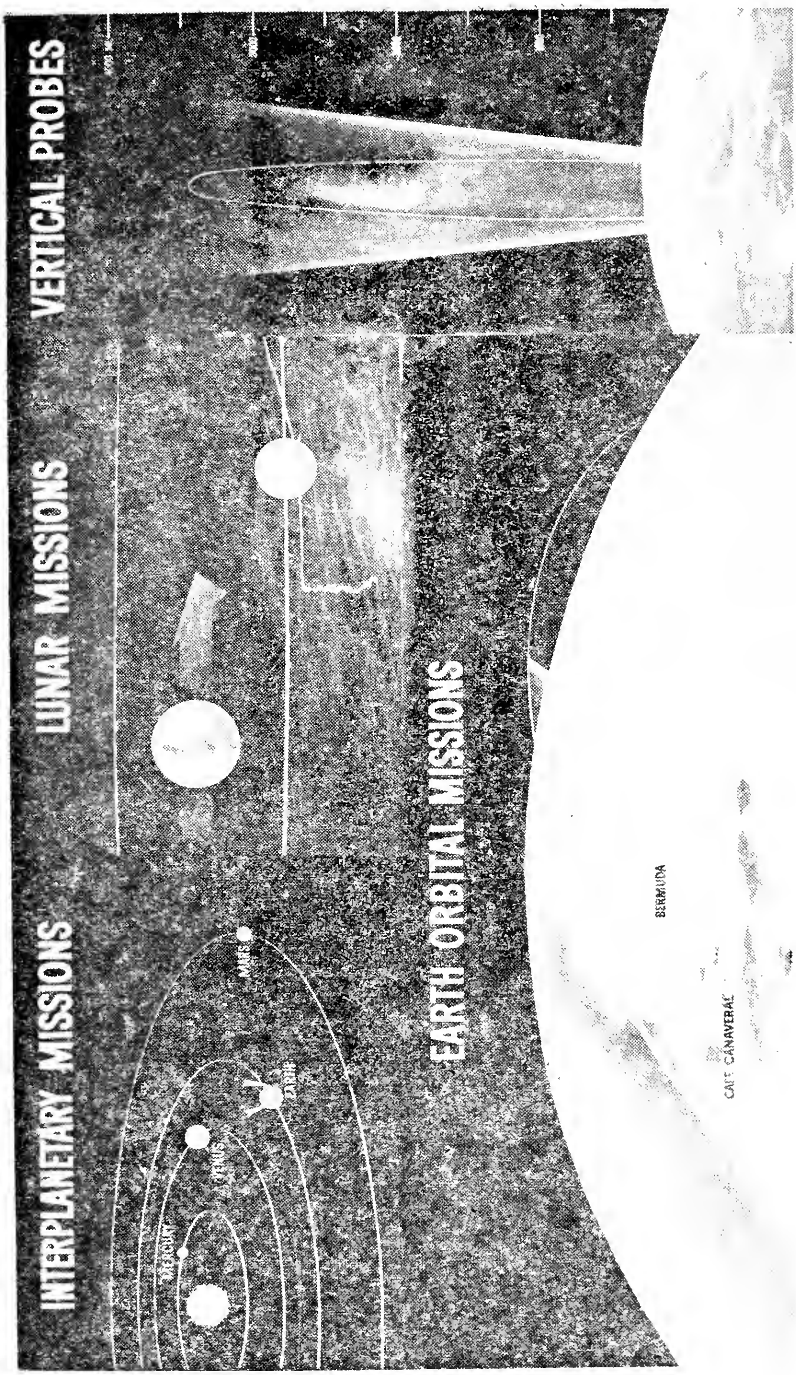
INTERPLANETARY MISSIONS
LUNAR MISSIONS
VERTICAL PROBES
EARTH ORBITAL MISSIONS
MARS
EARTH
VENUS
MERCURY
BERMUDA

FIGURE 9

Space missions we hope to execute in the new few months correspond to bills in committee hearings. Our advanced research and technology corresponds to committee hearings and staff investigations on general topics. Research not only supports specific space missions, but also generates new missions.

To undertake a specific space flight mission a year or more from now, many decisions must be made now and many tasks must be begun now relating to activities at the lower levels of our iceberg-like chart. These must be pursued vigorously in the intervening months.

For example, the budget before you for fiscal year 1961 supports the design and procurement of vehicles and payloads and related research and development which does not appear as a flight mission until fiscal year 1962 or later.

The things which you will see in the next few months are those which you financed last year and for which preparations have been actively in progress.

The leadtime required may vary from a few weeks or months for a simple sounding rocket with more or less standard instruments, to years for a completely new superbooster. It is an exceptional and usually rather minor space project which can proceed from concept to flight in a few months. The Atlas booster just becoming available to us was initiated with highest priority 5 years ago.

Thus, our overall program presents to the spectator a kaleidoscopic mixture of matured developments, actively developing hardware, short-range applied research and component development, and longer range advanced research which determines our position a few years in the future.

Our current missions are being performed with launch vehicle systems based on the intermediate range ballistic missile boosters, Thor and Jupiter. Multistage launch vehicle systems based on the intercontinental ballistic missile booster Atlas as the first stage are well along in development and are scheduled for missions in 1961 and beyond.

A DX priority (the highest national priority) has been assigned to the Saturn launch vehicle system based on a new rocket system being developed specifically for space vehicles. The Saturn system is required to give us the capability of advanced space missions, both manned and unmanned. It is the key to our possible accomplishments in the period beyond the next few years.

Last year we presented to you the concept of the national booster vehicle program, which we now prefer to call national launch vehicle program. The Nation cannot afford to design a specialized and optimized vehicle for each of the dozens of missions.

NASA and the Department of Defense seek to develop the smallest number of vehicles that will encompass the entire range of presently envisioned missions.

There is another reason for such a course in addition to the necessity of avoiding unnecessary duplication and expense. This is the hard fact of experience that a new launch vehicle cannot be designed on the drawing board, manufactured, and launched with an expectation of a high probability of success on the first mission.

The first 5 or 10 flights must be regarded as development tests of the launch vehicle to gain reliability. By using the same vehicle for many missions, a high degree of reliability will be reached earlier, our dollars will go further, and our relative competitive position will be enhanced. In initiating our space program 16 months ago, we had to order interim vehicles which could be obtained within 1 year in order to gain flight experience now. We are, however, moving as quickly as possible to five vehicles as will be described by a later speaker.

The ground tracking and telemetry networks are the means by which the results of space exploration are received on the ground. The optical and Minitrack network established during the International Geophysical Year has, with some extension to cover polar orbits and with the normal improvements, proved adequate for unmanned earth satellites.

Project Mercury requires special provisions because of the presence of the astronaut; it uses existing military stations and some new portable stations along the intended trajectory. The needs of the deep space probes are met by three stations using large antennas, one of which exists at Goldstone, Calif.; one is under construction at Woomera, Australia; and the third is scheduled for construction in Africa.

Our philosophy in this area is to integrate our stations with those of the Department of Defense, utilizing existing stations wherever possible and installing temporary movable stations to accommodate temporary needs. A later speaker will give you a complete picture of these ground support facilities without which the whole activity would be useless.

Many spacecraft are peculiar to the intended mission. Some require attitude stabilization, retrorockets, or other special components. Auxiliary power, telemetry, and sometimes other communication or command transmitters are needed. The instrumentation is that required by the mission.

In addition to these three underlying areas of development which directly support and are closely integrated with specific missions, a broad foundation of advanced research and technology carried out in laboratory facilities on the ground is prerequisite to leadership in space exploration. The technological problems are most rapidly and economically solved in ground facilities which simulate the launch and space environment, as fully as possible; i.e., as regards vacuum, temperature, noise, vibration, acceleration, loads, and so forth—the one feature we cannot reproduce on the ground is weightlessness.

Research explores the new areas, new knowledge of the fundamentals of propulsion, of effects of meteorites on structures, of new phenomena in solid state physics, or in plasma physics, and provides new ideas for study and exploitation.

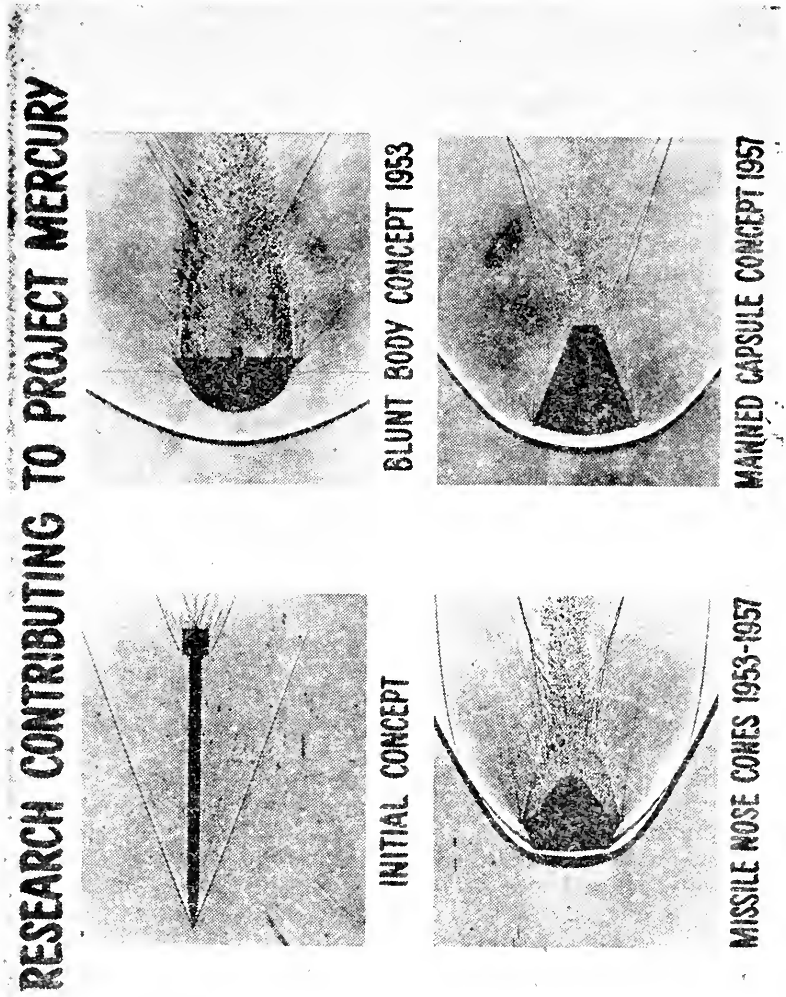

FIGURE 10

The leadtime aspect of research activity may be illustrated by an historical example, research on the reentry heating problem which gave the foundation for the concept used in Project Mercury. About 10 years ago the scientific community and industry were all following the idea of using slender sharp-nosed bodies for ballistic missile warheads (fig. 10).

The very first concept of the ICBM then under development at a very slow rate was with a sharp-nosed body.

NASA research showed that such sharp-nosed bodies—illustrated at the left of the chart—absorb about 30 percent of the aerodynamic heat which is generated during atmospheric reentry. During atmospheric entry, the heating of the body would be so great that no known high-temperature materials and structures could stand the temperatures which would be experienced.

In 1953, Mr. H. J. Allen of the Ames Research Center, showed that a blunt reentry shape generating a large bow shock wave, would generate most of the heat within the atmosphere itself, and that less than one-half of 1 percent of the heat would be absorbed by the body.

As you see at this figure at the top on my right, he went to the extreme in his early research of a flat-pieced body and his first experiments were of that type.

A little bit later the basic research went to the blunt body concept at the lower figure used by all present ballistic missile nose cones, with some variations, of course, as developments have proceeded.

In subsequent years, concentrated research effort on these problems has led us to a better understanding of basic flow and heat transfer phenomena at speeds approaching orbital velocities.

I might remark that the developments in the ICBM have led to the possibility of somewhat less blunt shapes than the one which you see there. However, the reentry satellite velocity is a tougher job and we must use blunter shapes than on the ICBM; and, as you know, the IRBM can use a less blunt shape still, because the demands are not so great.

By the time the Soviet Union had launched Sputnik I into an earth orbit on October 3, 1957, researchers at our Langley and Ames Research Centers were studying problems of manned satellite capsules. However, the key to the problem of allowing a manned capsule to withstand high reentry temperatures had been developed from our basic research in 1953 on general problems of high-speed flight and later studies relating to the reentry into the atmosphere of ballistic missile nose cones. It is apparent the nature of research is such that the application of the results is often not foreseen at the time the studies are initiated.

There is a constant interaction between the various elements of this integrated space exploration program. Not only does the foundation of advanced research and technology give results leading to new vehicles, new telemetry and tracking devices, and new instrumentation and thus, to new missions made possible, but the desired goals and missions suggest vehicle, telemetry, and intrumentation developments which should be carried out and these, in turn, lead to the need for research in certain areas.

Thus, a great deal of our current research is suggested by the problems of landing a man on the moon, of operating a manned station in space, or of operating an unmanned astronomical observatory. The results obtained are, however, basic in character and applicable to many other specific missions as well.

Having examined the structure of the program underlying a specific mission, let us look at the space flight missions of the national space exploration program. They fall into three categories: Those directly concerned with the travel of man, himself, into space, in the foreseeable future throughout the solar system; the application of earth satellites to human benefit; and the scientific study of the space environment.

Together, these categories form a single integrated program of space exploration and no category can be neglected without detriment to the others. Thus, it is obvious that the results of the scientific study of the space environment, for example, quantitative detailed information on the Van Allen radiation belt and on the impact of meteorites, are essential to the design of reliable space vehicles to be used either for applications to civil and military purposes, or for habitation by man.

Similarly, the accomplishment of various steps in manned flight contributes to the scientific knowledge of space and provides a technology for making more difficult scientific measurements by human observers or by every heavy apparatus such as a large telescope. In either category, unforeseen new knowledge may well revolutionize accomplishments in the other category.

A DX priority—the highest national priority—is assigned to Project Mercury, the first step in the travel of man in space at satellite speeds and beyond. This program includes as a preparatory mission the travel of man in a ballistic trajectory, during this calendar year, if everything goes well. Soon thereafter, we will begin to gain direct experience in the orbital flight of man. A progress report on Project Mercury will be given by a later speaker.

Our program looks forward to a continually increasing capability and accumulation of experience. Much of our advanced research and technology is planned to attack the problems to be encountered in the travel of man to the Moon and his safe return to Earth. As we advance toward this goal, we must achieve such intermediate goals as a manned space station in orbit about the Earth and the flight of man to orbit the Moon and return safely to Earth. We must develop spacecraft capable of reentering the Earth's atmosphere not only from Earth satellite speeds without excessive heating or deceleration, but also from the much higher speeds involved in return from the Moon. We know already that there is a difficult guidance problem connected with the safe return through the atmosphere.

The program includes missions leading to the applications of Earth satellites for peaceful purposes to promote human welfare. These applications have been of great interest to men of all nations. The development of meteorological satellites is one of the important goals of the national program. Still in the earliest research and development stage as regards the instrumentation, the results already obtained open new vistas to the forecaster and research scientist alike. A second application of special benefit to the Western World is that to the task of long-distance communication.

The third category of missions includes those used for the unmanned exploration of space. Satellites and space probes can carry out measuring instruments far into space, in time to the far reaches of the solar system. They do precede man and explore the way for him, but more important they extend the body of scientific knowledge about the Earth, its atmosphere, ionsphere, and other aspects of nearby space, about the Moon and planets, and about our entire universe.

Although we speak of this program as a space science program, it, in fact, includes a multiplicity of programs in gavitational, electrical, and magnetic fields, cosmic rays, electrified particles, radiations of all wave lengths, in fact, all branches of physics and chemistry extended into outer space.

The results promise to benefit our activities on earth as much as our activities in space, and in a sense, this category of missions also represents the application of satellites and space probes for peaceful purposes to promote human welfare.

The accomplishments of the national space exploration program to date have been substantial. Experience in its conduct has made us more acutely aware of the unknown factors in the conduct of research and development on the previously unexplored frontiers of space. The course ahead for several years is well established and we have made plans for a decade ahead in the light of our present knowledge. We expect to revise these plans from time to time in the light of the experience gained.

Mr. Horner will describe the long-range plan and discuss the organization and facilities which have been assembled to carry out the national program of space exploration.

If you wish, Mr. Chairman, we may proceed with that presentation and have some questions then or have questions now, as you prefer.

The CHAIRMAN. It might be best to let him proceed, now.

Mr. DRYDEN. I think it would be a little more coherent to get before you the general plan for the future.

The CHAIRMAN. If there is no objection, we will proceed with Mr. Horner. Following that, we will question both witnesses.

Our next witness is Richard E. Horner, Associate Administrator, National Aeronautics and Space Administration.

Will you please give the official reporter something on your background?

(Mr. Horner was sworn previously.)

STATEMENT OF RICHARD E. HORNER, ASSOCIATE ADMINISTRATOR, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Mr. HORNER. I am Richard E. Horner, Associate Administrator, National Aeronautics and Space Administration. I obtained a bachelor of science degree in aeronautical engineering from the University of Minnesota, master of science in aerodynamics at Princeton University, 9 years' commissioned service with the Air Force, 10 years' service in the Research and Development Management of the Air Force, the last three of which I served as Assistant Secretary of the Air Force for Research and Development.

I have been with the National Aeronautics and Space Administration since June 1, 1959.

The CHAIRMAN. Thank you, sir.

Mr. Fulton wants to ask you a question on your background.

Mr. FULTON. Where do you get the title Associate Director?

Mr. HORNER. Mr. Fulton, I think you probably need to ask my boss about that. The position of Associate Administrator was established when I arrived in the Administration.

Dr. DRYDEN. May I say Mr. Horner has somewhat the responsibilities of the Chief of Staff for Operations. The operating divisions of the agency report to him.

Mr. FULTON. My inquiry is whether you need statutory authority to establish the position with an administrative power to act within your agency. That is really the point I am making because I understand it has just been set up.

Dr. DRYDEN. You will recall, sir, the act provided for 10 excepted positions, which the Administrator could establish for the administration of this act, carrying salaries between $19,000 and $21,000. Mr. Horner holds one of those positions. He has no independent legal authority apart from that delegated in the usual course under the law.

Mr. FULTON. Not to bring it up now, but I would like some sort of a short memorandum on that, on possibly establishing this position as pretty much a superintendent of operations.

Dr. DRYDEN. We will be glad to prepare something for the record.

(The information requested is as follows:)

The functions and authority of the Associate Administrator of NASA are stated in general management instruction No. 2–1–1, a copy of which is attached.

The authority for establishment of the position of Associate Administrator and appointment of the incumbent is found in subsection 202(a) and 203(b) (1) and (2) of the National Aeronautics and Space Act, which provide, in relevant part, as follows:

"* * * Under the supervision and direction of the President, the Administrator shall be responsible for the exercise of all powers and the discharge of all duties of the Administration, and shall have authority and control over all personnel and activities thereof."

* * * * * * *

"In the performance of its functions the Administration is authorized—

> "to make, promulgate, issue, rescind, and amend rules and regulations governing the manner of its operations and the exercise of the powers vested in it by law;
>
> "to appoint and fix the compensation of such officers and employees as may be necessary to carry out such functions. Such officers and employees shall be appointed in accordance with the civil service laws and their compensation fixed in accordance with the Classification Act of 1949, except that (A) to the extent the Administrator deems such action necessary to the discharge of his responsibilities, he may appoint and fix the compensation (up to a limit of $19,000 a year, or up to a limit of $21,000 a year for a maximum of 10 positions) of not more than 260 of the scientific, engineering, and administrative personnel of the Administration without regard to such laws, * * *."

We need no need to provide specifically by statute for the position of Associate Administrator. The only additional authority which could be vested in the Associate Administrator by statute would be the authority to exercise certain nondelegable statutory functions which presently can be performed by the Administrator and the Deputy Administrator. These functions are relatively few in number and are not so burdensome as to make it necessary for them to be performed by the Associate Administrator.

PART I. NASA MANAGEMENT MANUAL—GENERAL MANAGEMENT INSTRUCTIONS

No. 2-1-1

Effective date: December 23, 1959.

Subject: Functions and authority, Associate Administrator.

1. Purpose

The instruction establishes the functions and authority assigned to the Associate Administrator.

2. Functions

The Associate Administrator is responsible for assisting the Administrator and the Deputy Administrator in the overall management of NASA operations. Specifically, he is assigned the following functions:

(*a*) Insuring that actions, policies, or programs necessary to carry out NASA's mission are developed in a timely manner by the appropriate staff. Reviewing, evaluating, and approving proposed actions and staff papers prepared for approval by the Administrator to assure that (1) such papers or actions are soundly and fully developed, and (2) such papers or actions are properly coordinated and problems resolved to the greatest extent feasible prior to submission to the Administrator and Deputy Administrator.

(*b*) Reviewing advance planning done by the various elements of NASA (including those developed in the Office of Program Planning and Evaluation, a staff office reporting directly to the Administrator) to assure proper coordination among plans developed and to assure that the planning undertaken by various organizational elements is based on the same or consistent program assumptions; securing such modifications in plans as are required to achieve necessary consistency.

(*c*) Reviewing basic budget assumptions and preliminary budgets to assure adherence to budgetary policies and guidance established by the Administrator and Deputy Administrator, and direct action to modify and adjust assumptions and preliminary budgets to bring them into consistent alinement for review by the Administrator.

(*d*) Coordinating and directing the activities of the Office of Launch Vehicle Programs, Office of Space Flight Programs, Office of Advanced Research Programs, and Office of Business Administration.

(*e*) Directing and supervising the operations of the Western Operations Office.

(*f*) Conducting a continuous review of program progress and actions taken by the NASA staff to assure that (1) decisions made by the Administrator and/or Deputy are promptly carried out, and (2) the Administrator and Deputy are kept informed of delays and necessary adjustments.

(*g*) Reviewing problems and conflicts of staff judgment arising among different areas of agency operations for the purpose of resolving such problems or recommending resolutions to the Administrator and/or Deputy.

(*h*) Assuring the proposed actions, policies, and programs are coordinated with activities of other interested agencies, particularly the Department of Defense.

(*i*) Representing NASA in meetings, conferences, and other appearances before or with other agencies of the Federal Government including the Bureau of the Budget and congressional committees.

(*j*) Keeping continually informed of the plans and activities of those offices reporting directly to the Administrator (i.e., General Counsel, Office of Program Planning and Evaluation, Office of International Programs, Office of Public Information, and the Assistants to the Administrator and Deputy Administrator) that he may continually insure effective coordination throughout NASA.

(*k*) Exercising as Acting Administrator, in the absence of the Administrator and the Deputy Administrator from NASA headquarters, all of the functions, powers, and duties of the Administrator, except those nondelegable functions, powers, and duties vested in the Administrator specifically by law.

3. Responsibility and authority

The Associate Administrator is responsible to the Administrator and Deputy Administrator for the effective performance of the total NASA operation, and is authorized and directed to take such action as is necessary to carry out the responsibilities assigned to him within the limitations of this and other official NASA assuances and communications.

4. Relationships with other officials

In performing the functions assigned to him, the Associate Administrator is responsible for keeping the Administrator and Deputy Administrator informed of major problems or developments which may be of interest to them; he is responsible for assuring that actions he takes are consistent with overall NASA policy as expressed by the Administrator.

5. Effective date

The provisions of this Instruction are effective December 23, 1959.

HUGH L. DRYDEN,
Deputy Administrator.

The CHAIRMAN. Would you wish to call him chief of staff, instead?

Dr. DRYDEN. Well titles are always a very difficult problem, as you know.

Mr. FULTON. He is just 1 of 10, now. If he is doing this outstanding work, I think possibly it should be recognized with statutory authority.

The CHAIRMAN. We should call you Dr. Horner, shouldn't we?

Mr. HORNER. No, sir.

The CHAIRMAN. Just Mr.?

Mr. HORNER. That is right.

The CHAIRMAN. Will you proceed with your statement?

Mr. HORNER. Yes, sir, Mr. Chairman.

Mr. Chairman, and members of the committee, it is my purpose to extend the remarks of the Administrator and Dr. Dryden by discussing with you the 10-year plan of program activity in space experiments that we have developed, and relate to it the financial resources that we are currently using and those we are requesting authorization for at this time. I will also set forth our other resources in terms of the organization, personnel, and facilities that are essential to the implementation of the space effort.

You realize, of course, that during the last 16 months all of our planning has proceeded simultaneously with our efforts to create a functioning organization and the initiation of major scientific and developmental programs.

It will appear obvious to you, I am sure, that whereas our plans reflect the lessons of our intensive recent experience, their extrapolation into the future becomes more tenuous as the years become more distant. And, of course, any planning which must be supported by fiscal budgets beyond the one currently under request for authorization must, of necessity, be recognized as dependent upon the many and various influences of Government operations in the future.

In addition, and completely aside from the relative brevity of our experience and the uncertainty of financial resources that might be available in the future, there must also be taken into consideration the well-recognized fact that the nature and depth of future research and development efforts in any complex technical field are heavily dependent upon the character of prior accomplishments. Stated simply, our successes or miscues of this year will have a commanding influence on the integrity of our plan for next year.

Having explained the uncertainties of a long-term plan, I will now turn to the reasons for having one. Virtually all of our key programs presume a scheduled progress in launch vehicle and spacecraft development. These major developmental tasks frequently require time periods of 5 to 6 years for completion and can be substantially longer under given circumstances of technological progress and resource availability.

Thus, although the usefulness of highly tentative plans might be questioned, long-term objectives, on the order of 10 years in advance of today's program, are essential to keep our development activities properly focused.

The actions we initiate this year and next in the vehicle development program will have a determining influence on our capabilities for meeting national objectives in the last half of this decade and even beyond. Accordingly, we have developed a 10-year plan, one which we expect to modify from year to year on the basis of realized experience, development progress, and resource availability. It is formulated around the requirement that its implementation must so utilize the resources of the United States that our national role as a leader in the aeronautical and space sciences and their technologies is preserved and steadily enhanced. We have also assumed that a steady growth in the scale and intensity of our efforts, especially for the next 5 years, is an essential basis for consistent and fruitful efforts in meeting this requirement.

The initial step in constructing the plan was a projection of attainable growth in our capability to launch into the space environment spacecraft of increasing size, versatility, and technical sophistication.

The first chart shows the anticipated growth in spacecraft weight from year to year during this 10-year period. Here I need to define spacecraft as that portion of the vehicle, including the propulsion, attitude controls and guidance units for maneuvering, which is designed to be placed into orbit about the Earth or onto a departure trajectory from the Earth (fig. 11).

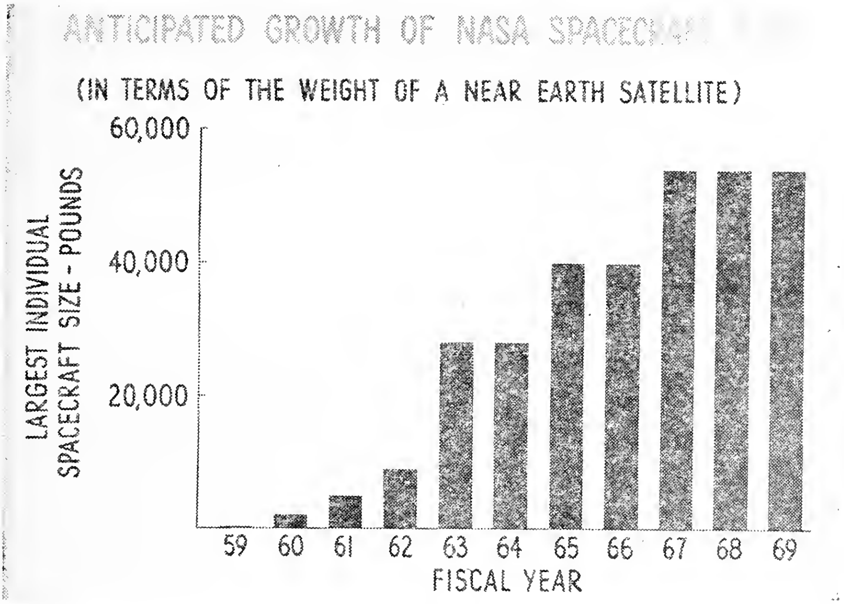

FIGURE 11

For the purposes of comparison, on this chart the capabilities of launch vehicles are measured in terms of the weight that can be projected into a low altitude earth orbit of about 300 miles. You will note that the increasing capabilities in the early years come through the successive utilization of the Thor-Agena B, the Atlas-Agena B, and the Atlas-Centaur.

In the 1963–67 time period, our increasing capability will be primarily attributable to the use of the Saturn first stage and successively improved upper stages based on employment of liquid hydrogen and liquid oxygen. You will note that by 1967 we will have gained the capability of placing payload weights in low earth orbits of about 25 times the magnitude of those available today.

I hasten to emphasize that the requirement for payloads of these weights in such orbits is limited, but remind you that I am using this figure as a convenient method of comparison and the increasing performance represented will be necessary to project needed payloads on more difficult missions to the planets and to high earth orbits.

The rate of growth indicated here is consistent with our foreseen potential for technological progress and is attainable provided adequate resources are applied. It is clearly necessary if the vigorous program which will attain national objectives is to be implemented.

To further define the framework of this plan, I would like to consider now our projected launching schedule which is illustrated here in the general terms of the numbers of each vehicle launching which occurs in the next six quarters, and for each fiscal year thereafter during the decade (fig. 12).

TABLE II

ANTICIPATED MAJOR VEHICLE LAUNCHING SCHEDULE BY VEHICLE

FISCAL YEAR	1960*				1961				'62	'63	'64	'65	'66	'67	68	69
Redstone				1	2	3	2									
Atlas				1	2	1	2	1	6	1						
Juno II			1		1	3										
Thor - Able			2													
Atlas - Able				1	1											
Scout				4	2		2		6	6	6	6	6	6	6	6
Thor - Delta			1	1	1	2	1	1	5							
Thor - Agena B									1	6	6	6	6	6	6	6
Atlas - Agena B							1		3	4	5	6	3	12	12	12
Atlas - Centaur								1	5	4	5	6	9			
Saturn									2	2	3	4	4	4	4	4
Nova Type															1	2
TOTAL	12				29				28	23	25	28	28	28	29	30

*LAST TWO QUARTERS ONLY

FIGURE 12

You will note that in fiscal year 1962 and beyond, the present variety of first stage launch vehicle types will be reduced to one solid propellent rocket, the Scout, and three liquid propellent rockets, the Thor, the Atlas, and the Saturn.

This number might very well be reduced further by eliminating Thor vehicles earlier than is indicated in this chart. The Agena B and the Centaur will become our utility second stages until larger high-energy upper stages come into use on the Saturn in the time period fiscal year 1965 and beyond.

This restriction of the number of vehicle types is planned in the interest of increasing reliability through more intensive experience with each of a limited number of systems. Beyond the capability of the Saturn series of vehicles, we have provided for the introduction of a vehicle, the Nova, with four to six times the first stage thrust based upon the 1½-million-pound F–1 engine currently under development. We foresee the beginning of development testing on such a vehicle in 1968. Our total launching and space flight capabilities are being developed to the point where it is anticipated that a program of more than two launches per month will be conducted for major application and exploration missions in space.

The spacecraft capacity and the planned launching schedule are both a prerequisite for and a product of the intended missions to be accomplished. The interplay between such schedules is obvious in this next table of mission target dates. In some respects this listing might be considered a key indication of the proposed rate and scale of our space experimentation effort (fig. 13).

NASA MISSION TARGET DATES

Calendar Year	
1960	First launching of a Meteorological Satellite.
	First launching of a Passive Reflector Communications Satellite
	First launching of a Scout vehicle.
	First launching of a Thor-Delta vehicle
	First launching of an Atlas-Agena-B vehicle (by the Department of Defense)
	First suborbital flight of an astronaut.
1961	First launching of a lunar impact vehicle.
	First launching of an Atlas-Centaur vehicle.
	Attainment of manned space flight, Project Mercury.
1962	First launching to the vicinity of Venus and/or Mars.
1963	First launching of two stage Saturn vehicle.
1963-1964	First launching of unmanned vehicle for controlled landing on the moon.
	First launching Orbiting Astronomical and Radio Astronomy Observatory.
1964	First launching of unmanned lunar circumnavigation and return to earth vehicle.
	First reconnaissance of Mars and/or Venus by an unmanned vehicle.
1965-1967	First launching in a program leading to manned circumlunar flight and to permanent near-earth space station.
Beyond 1970	Manned flight to the moon.

FIGURE 13

Again, it is apparent that the year which is immediately ahead of us is subject to more definitive planning than the suceeding years, and the activities of the latter part of the decade can only be characterized by the most outstanding of planned objectives. Needless to say, there are many space experiments of real significance which do not appear on this listing and the "first launching" terminology generally indicates in each instance a beginning of a series of space vehicle operations.

In the current year is reflected the beginning of tests of several vehicle development programs as well as the first orbital experiments in both meteorology and communications.

You will also note the scheduled first suborbital flight of an astronaut, boosted more than 100 miles into space with a Redstone vehicle. In the calendar year 1961 we are working toward the launching of a sophisticated lunar impact vehicle and a further step forward in our vehicle development program with the initiation of flight tests on the Centaur.

Assuming continued success in the complex schedule of tests for Project Mercury, the first orbital flight of a manned space vehicle will also occur in calendar year 1961.

I might point out here, Mr. Chairman, and gentlemen, in this chart I have used calendar years, whereas in all of the other charts I refer to fiscal years because they relate to the fiscal operations.

From 1962 we go through the 10-year period with a comprehensive program of exploration of the Moon and the near planets and developing the Saturn launch vehicle to provide necessary information and capability for the beginning of manned circumlunar flight in the latter part of the decade.

It appears to be clear, from a careful analysis of launch vehicle requirements as we now understand them, and recognizing the need for information yet to be developed, that a manned landing on the moon will fall in the time period beyond 1970. These are the major milestones in our long-range plan for space exploration and the application of space vehicles.

Let us look now at the resources which our studies to date indicate to be essential for meeting these objectives. Before I turn to a specific consideration of our current budget authorization request, I would like to make a few generalized comments about future year financial requirements.

The many uncertainties related to a complex technological program such as the one with which we are dealing—unanticipated scientific advances, developmental difficulties, as well as the even more obscure influences of national financial policies and economic trends as a whole—make specific predictions as to total requirements for fiscal year 1962 and beyond speculative to the point of being worthless.

However, it can be said that in view of the half billion dollar obligation rate during the current year and the proposed $802 million program for fiscal year 1961, and its further augmentation as explained by Dr. Glennan yesterday, it is certainly likely that a natural growth of the developments now underway will lead to a budget request of more than $1 billion in the following year with a growth to more than $1½ billion a few years later.

Now, if I may, I would like to turn to our authorization request for new obligating authority in fiscal year 1961. As I have already mentioned, the total request amounts to $802 million. It is divided into three major functional areas of our activities as shown on this chart. For salaries and expenses their is allocated $167,560,000. These are the total charges for travel, communications, and utilities as well as salaries and other miscellaneous personnel expenses (fig. 14).

For research and development the figure is $545,153,000. From this account all project activity is supported, including purchase of materials and parts, as well as disbursements for development contracting. Of course, our investment for research grants and con-

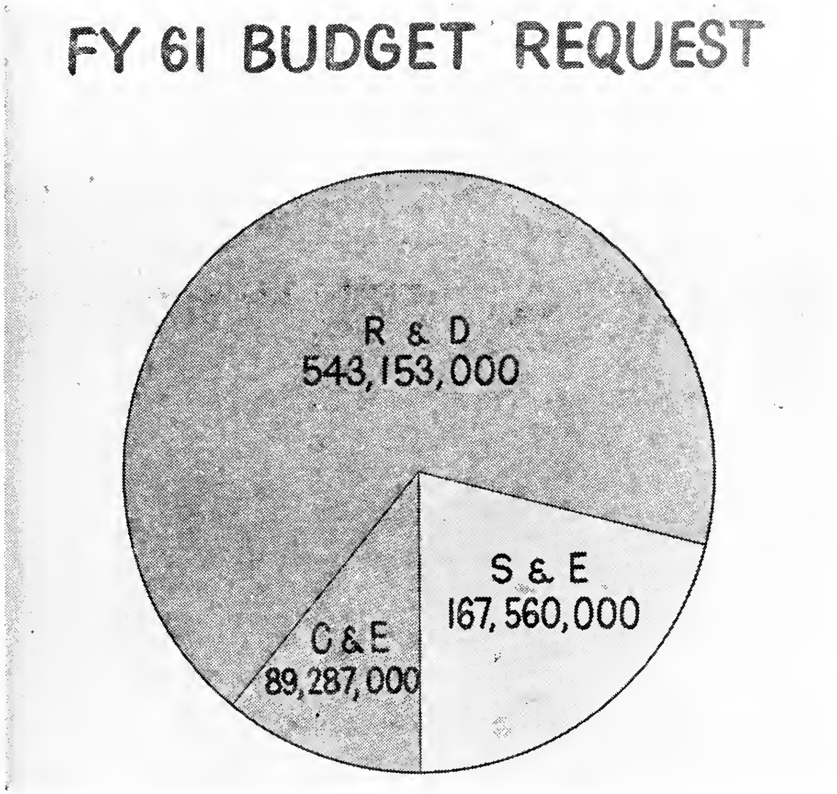

FIGURE 14

tracts is also provided for in this figure. You will note this category of funds constitutes substantially more than two-thirds of our total budget request. The members of the NASA staff who follow me will discuss in detail the individual development programs which are supported with funds from this area.

The third kind of budget authority we seek is that for construction and equipment in the amount of $89,287,000. This money is used to create new facilities for the accommodation of the changing research and development requirements. It is the minimum essential investment to provide the pressing needs for our essential inhouse project activity as well as laboratory and test facilities for the supporting research so essential as the foundation for our entire program.

Although the National Aeronautics and Space Administration inherited a substantial complex of excellent facilities at the existing NACA laboratories, the space exploration program demands a continuing investment to modernize and convert existing facilities as the requirements evolve, and construct entirely new facilities where new technical disciplines in research or testing must be covered.

Of the current request, 25 percent is for provision of facilities at our research centers to make possible the continuing supporting research program described to you by Dr. Dryden. The balance of the facilities requested are directly in support of space experimentation, most of it at the three space flight centers and the Cape Canaveral launch site.

You may find it desirable to develop additional information concerning individual facilities. We will be happy to respond to your questions as you see fit.

To properly consider the budget request of the current year, it is interesting to compare it with the resources provided in past years. This chart provides an easy comparison of the magnitude of the

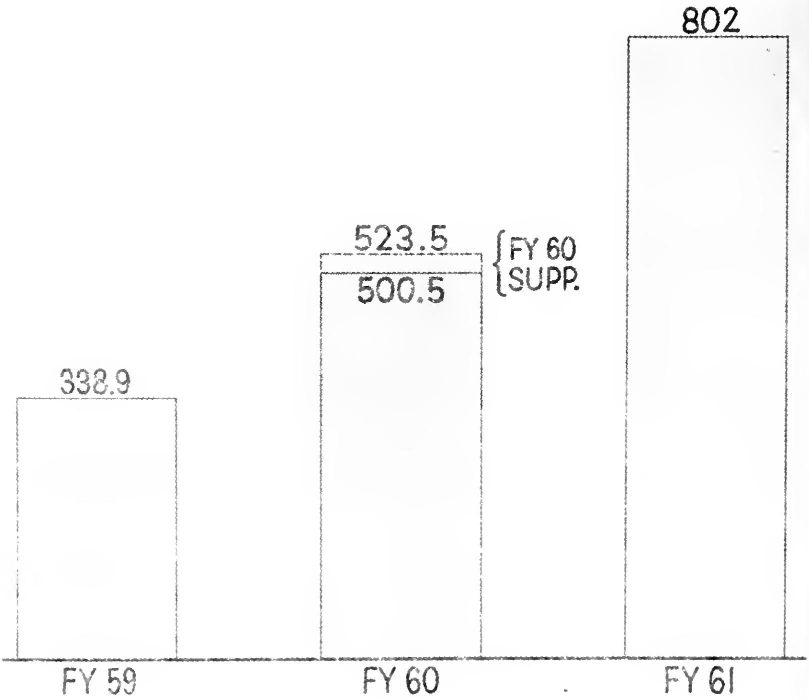

FIGURE 15

NASA programs in fiscal years 1959, 1960, and 1961. As indicated, the fiscal year 1960 number will be increased by $23 million if the Congress sees fit to grant our current request for supplemental appropriations (fig. 15).

I might say, Mr. Chairman, we are at this time scheduled to appear before the Appropriations Subcommittee on Monday in support of this supplemental request.

As I have indicated previously, the budget figures indicate a rapidly expanding program. The rate of expansion, however, is not a natural growth of the needs of the development program, since, in each of the last 2 years, substantial new responsibilities have been assigned to NASA as our national space effort has been identified and organized.

For example, during the past year, the assignment of development responsibility for superboosters has resulted in a major addition to our fund requirements.

This rapid rate of growth has extended our management capability to the limit of its capacity. Extra hours and added assignments have become the rule of conduct for our staffs both at the Washington headquarters and at the field centers. We have, however, been able to substantially maintain the work schedules and, if occasional development failures bring severe disappointment, they also bring added determination on the part of all, to bring success to the highly diversified and broadly cast program we have initiated.

In the area of financial management you will be interested to know that substantially all of the money appropriated for program support in fiscal year 1959 has been obligated to project activity. The program implementation performance has been equally satisfactory during the current fiscal year with funds being committed at the scheduled rate.

I would like to assure you that this is not just a process of committing funds as the schedule dictates, but each contract and procurement action is the result of a carefully considered analysis usually based on extensive scientific study and program correlation.

I would like to turn now to a consideration of other categories of resources which are essential to our program implementation. These include organization, facilities, and manpower. As you know, the overall complex of our organizational structure has been created largely by the integration of existing organizations and parts of organizations into the present National Aeronautics and Space Administration (fig. 16, p. 194).

The nucleus was provided by the 8,040 staff members of the laboratories and the headquarters of the NACA. To this were added 400 members from the Vanguard team, transferred from the Naval Research Laboratory. Seven hundred new positions were provided in the first fiscal year, and an additional 700 in the current fiscal year to round out the staff and provide technical and scientific skills that were not present in the older laboratories but are required for this new business of space exploration.

The proposed budget program reflects an additional increase to a total strength of 16,373 in the Administration, but here again almost 90 percent of the increase results from the assimilation of a single group, that of the Huntsville, Ala., agency, under the leadership of Dr. von Braun.

The remaining fraction of the growth is needed to balance the skills of the organization and to properly effect the integration. In this process of rapidly assembling existing groups into a coherent and effective organization, while concurrently developing a complex program of unusually high scientific and technical content, and at the same time carefully interlacing and coordinating our efforts with other governmental, scientific, and industrial organizations, it has been understandably necessary to increase our Washington staff.

We recognize that at least part of the work burden at the headquarters is interim in nature and we, therefore, strongly resist expanding beyond what we foresee as the longer term needs of a more stable organization and program growth.

The net result, as I mentioned earlier, has been long hours in concerted effort by most of our staff. We scarcely see how we could have accomplished our objectives, without the staff growth that has been realized nor can we anticipate proper performance with less than the stated requirements in the budget authorization under consideration.

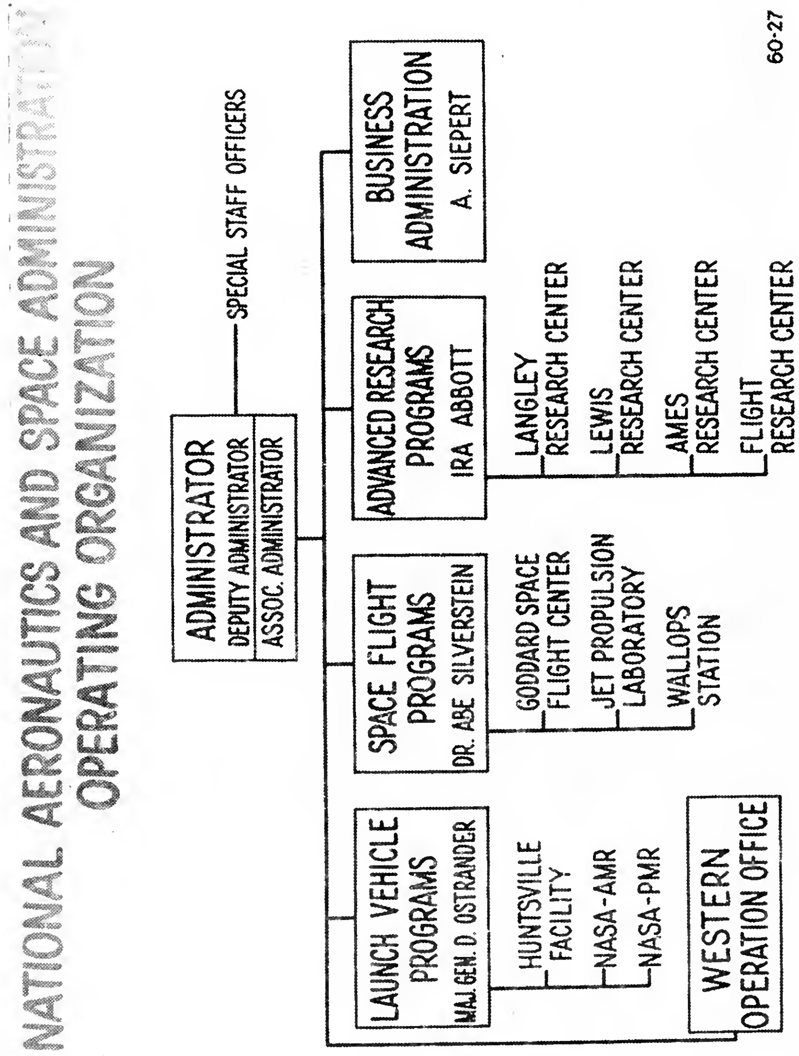
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
OPERATING ORGANIZATION
ADMINISTRATOR
DEPUTY ADMINISTRATOR
ASSOC. ADMINISTRATOR
SPECIAL STAFF OFFICERS
LAUNCH VEHICLE PROGRAMS
MAJ. GEN. D. OSTRANDER
HUNTSVILLE FACILITY
NASA-AMR
NASA-PMR
WESTERN OPERATION OFFICE
SPACE FLIGHT PROGRAMS
DR. ABE SILVERSTEIN
GODDARD SPACE FLIGHT CENTER
JET PROPULSION LABORATORY
WALLOPS STATION
ADVANCED RESEARCH PROGRAMS
IRA ABBOTT
LANGLEY RESEARCH CENTER
LEWIS RESEARCH CENTER
AMES RESEARCH CENTER
FLIGHT RESEARCH CENTER
BUSINESS ADMINISTRATION
A. SIEPERT
60-27

FIGURE 16

With the added workload of the recent assignment of responsibility for development of superboosters, a further addition to the headquarters staff is required. Recognizing the absolute essentiality of attaining the best possible launch vehicle performance in terms of timely availability of load-lifting capacity, and paying respect to the resulting need for reducing the number of types of launch vehicles in order to optimize reliability, the staff function of directing launch vehicle development and operations has been separated from the balance of the space flight programs.

This has resulted in the functional staff organization at headquarters that we see on this chart. Aside from the Office of the Administrator and the special staff officers he requires, the four functional staff elements now include the new Office of Launch Vehicle Programs, the Office of Space Flight Programs, the Office of Advanced Research Programs, and the Office of Business Administration.

The total staff strength intended is 16,373 people. It is the policy of the Administration to delegate all responsibility for program implementation and detailed program initiation to the field centers. Functional areas of responsibility have been assigned to each of the centers, and I believe it is worthwhile to discuss each of them briefly.

You may note their geographic location on the large map at my left and their channel of communication and responsibility to the headquarters staff is indicated on this chart (fig. 17, p. 196).

The Langley, Lewis, Ames, and Flight Research Centers are the laboratory centers which constituted the research capability of the National Advisory Committee for Aeronautics. Organizationally and for program integration purposes they report to the Office of Advanced Research programs in the headquarters. Although their individual staff levels have been stabilized for the past few years and the proposed staff strengths for fiscal year 1961 exactly coincide with the fiscal year 1960 staff numbers, the program of work at each of these centers has undergone a major change in the past 1½ years.

Whereas, by far the bulk of the work of 2 years ago was oriented toward the current and advanced needs of aeronautical developments, the combination of significantly reduced numbers of aircraft development projects in the United States and the needs for research in support of the space flight program have rapidly shifted the emphasis of research efforts at the centers to the astronautics end of the spectrum.

This change has resulted in substantial problems for our research center staffs in reorganizing and retraining for the new tasks, hiring in new technical disciplines as the effort in areas of waning interest is decreased, and the modification of old facilities and the creation of new to accommodate the new research regimes. This reorientation is progressing at a very satisfactory rate.

Having explained some of the problems of reorienting the in-house research program, I would now like to emphasize that although the total effort in aeronautics has markedly decreased, there is still very important work being conducted in this research area. The very low speed regime of flight is being extensively investigated in wind tunnels and by actual flight tests to explore the possibilities of vertical takeoff and landing craft as well as those which have very short takeoff and landing characteristics.

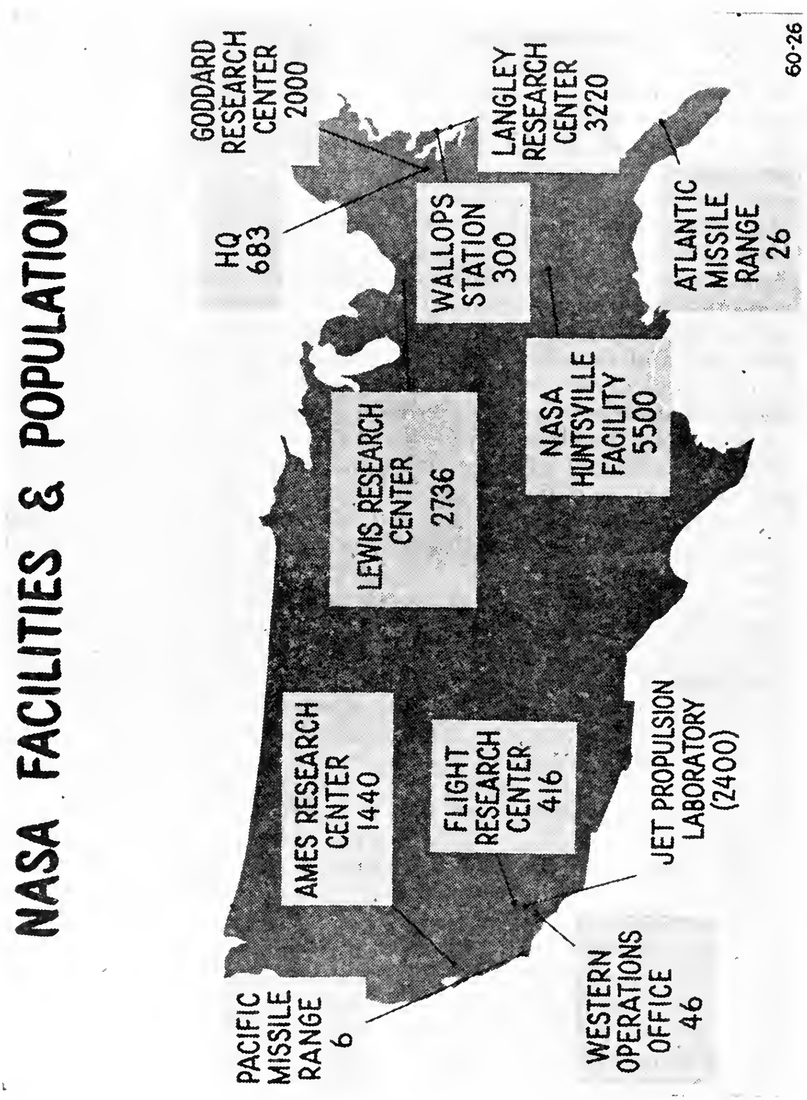
NASA FACILITIES & POPULATION
GODDARD RESEARCH CENTER 2000
HQ 683
LANGLEY RESEARCH CENTER 3220
WALLOPS STATION 300
LEWIS RESEARCH CENTER 2736
NASA HUNTSVILLE FACILITY 5500
ATLANTIC MISSILE RANGE 26
AMES RESEARCH CENTER 1440
FLIGHT RESEARCH CENTER 416
JET PROPULSION LABORATORY (2400)
PACIFIC MISSILE RANGE 6
WESTERN OPERATIONS OFFICE 46
60-26

FIGURE 17

As long as there is a continuing interest in the Department of Defense and the possibility of industrial application, there are likely to be continuing research requirements in this area.

At the other end of the spectrum of flight within the atmosphere, there are still challenging research problems to be solved in connection with supersonic and hypersonic flight. Of course, many of the hypersonic flight problems are equally applicable to space vehicles, for the departure and reentry phases of flight from and to the earth.

The work in high speed aerodynamics, materials and aircraft operating problems are, however, some areas in which there is continuing interest for development of high-speed military aircraft and missiles, and possible application to supersonic commercial transports.

Further, the NASA facilities stand ready to support specific applied research should additional developments of high-speed aircraft indicate the requirement.

Now, let us look briefly at the individual centers. At the Langley Research Center a staff of 3,220 will conduct the research program in fiscal year 1961 at a total program cost of approximately $50 million. This includes the salaries for the total staff, the research and development expenses, and the cost of a major facility addition which will be able to simulate the gas temperatures and velocities which will be encountered by a space vehicle returning to the Earth's atmosphere, a facility which is essential in the solution of key problems in our ongoing program (fig. 18, p. 198).

Major areas of work at the Langley Research Center include research in structures and materials, the aerodynamics of reentry vehicles, continuing work in aircraft aerodynamics and fundamental research in plasma physics. This center, which you will see from the map, is located near Hampton, Va., and is the oldest and the largest of the research establishments. A major portion of the research facilities, which constitute a total real investment of $154 million, are shown in this photograph.

The Lewis Research Center, located at Cleveland, Ohio, represents a facility investment of $148 million, and employs a staff of 2,736 people. An aerial view of the facilities of the center are shown in this photograph. Its primary research mission is investigation related to propulsion. Research programs are now active on chemical rockets with emphasis on high energy propellants, on nuclear rockets, and on electrical propulsion devices (fig. 19, p. 199).

Electrical power generation in support of this latter area of propulsion research also requires major attention from the center.

At the Ames Research Center, in the Santa Clara Valley of California, on the Moffett Naval Air Station, a staff of 1,440 conducts a comprehensive research program in facilities with an original construction value of $107 million. An aerial view of these facilities is shown in this photograph. The principal areas of work are space environmental physics, including simulation techniques, gas dynamics research at extreme speeds, and automatic stabilization, guidance, and control of space vehicles. There are also under experimental evaluation at this center several full-scale models of vertical takeoff and landing craft (fig. 20, p. 200).

The Flight Research Center at Edwards, Calif., is a relatively small but unique and highly specialized facility, shown in this photograph.

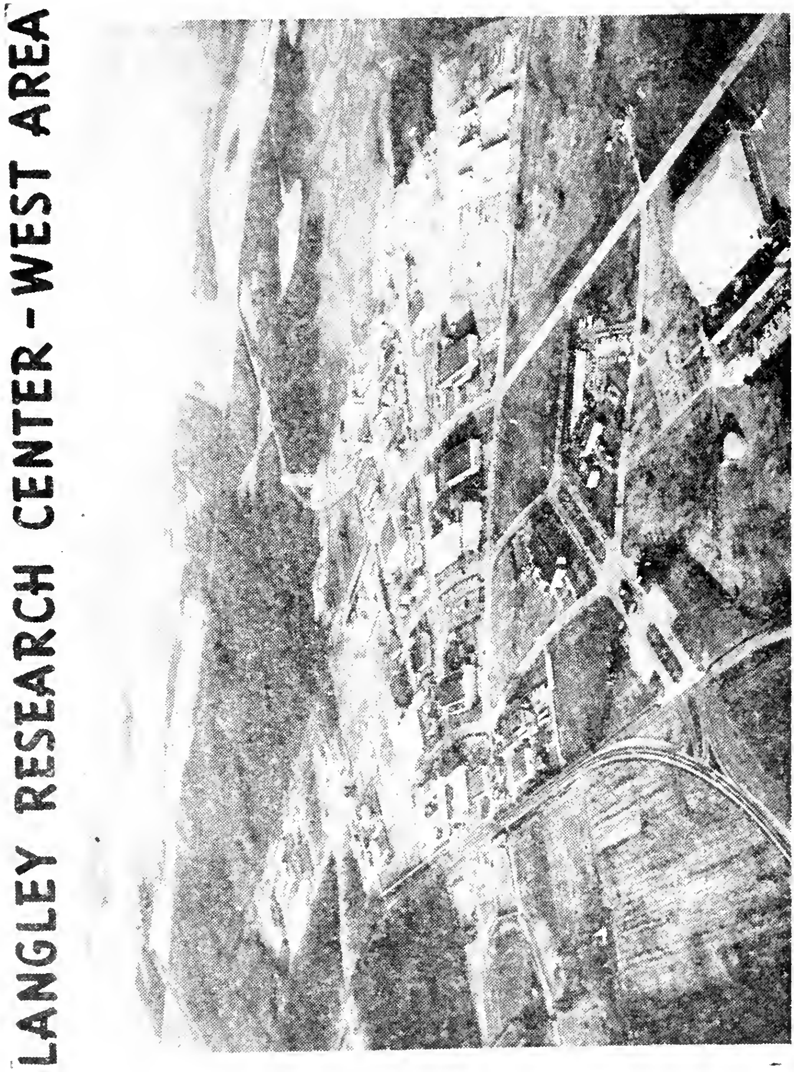

FIGURE 18

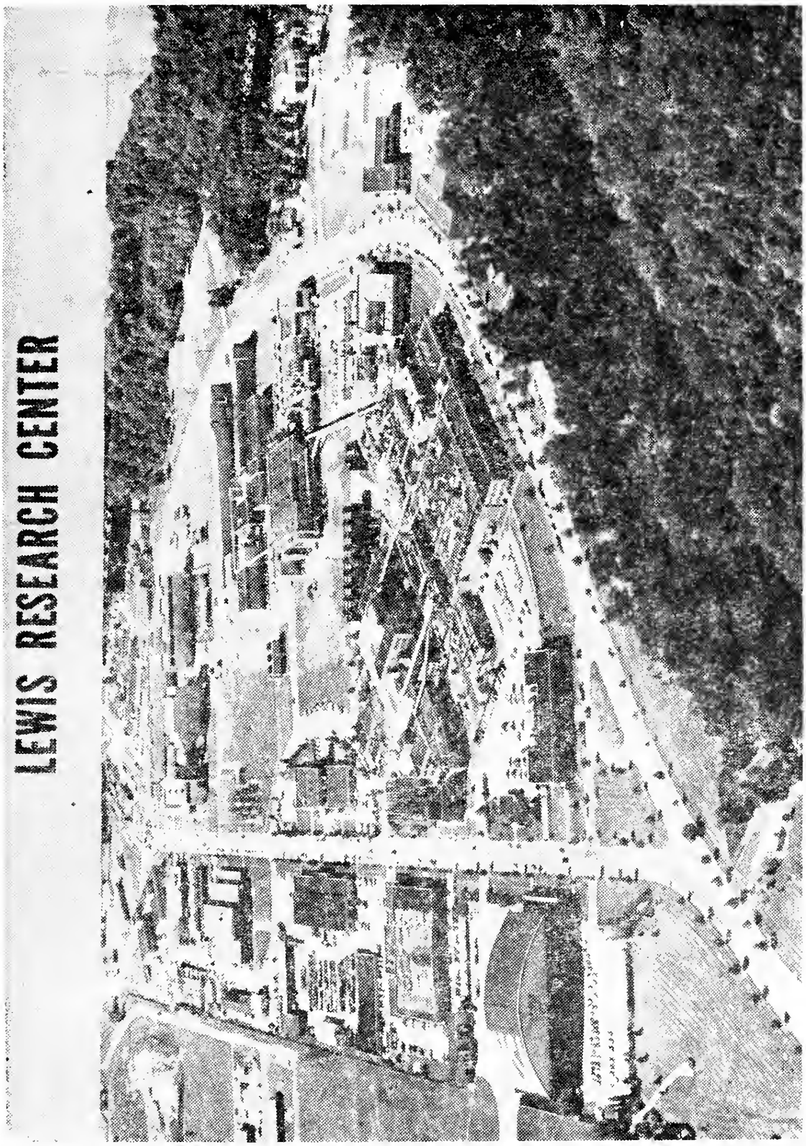

FIGURE 19

AMES RESEARCH CENTER

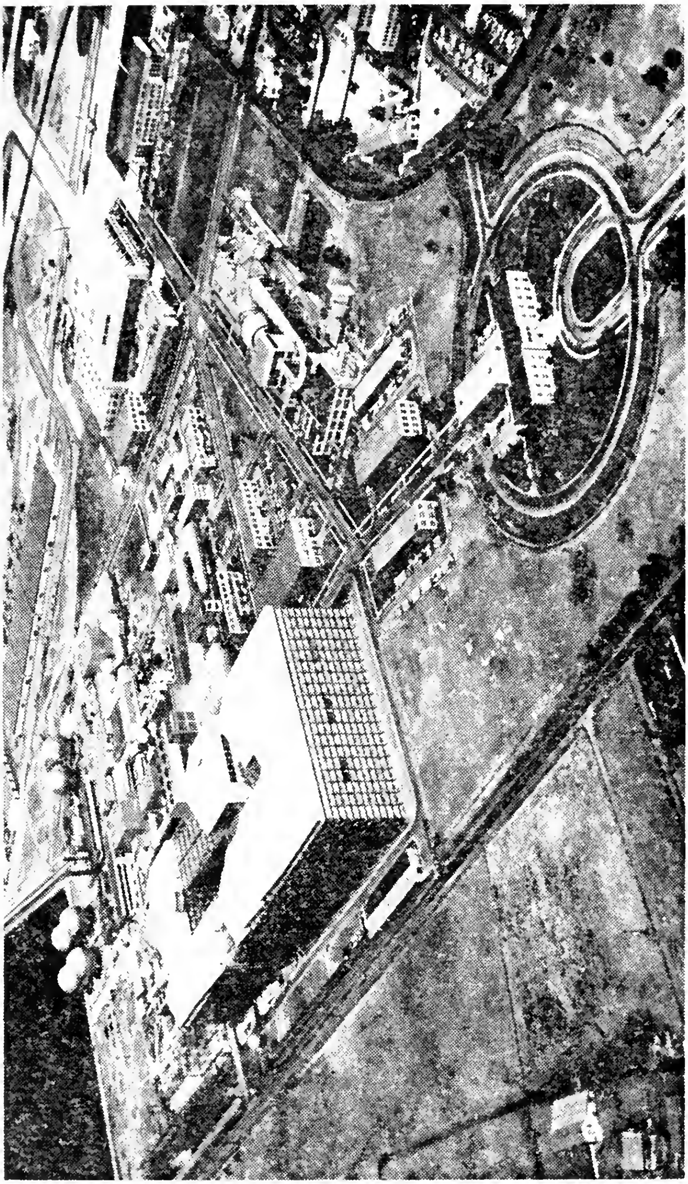

FIGURE 20

On the edge of Rogers Dry Lake, it takes advantage of this 75-square-mile flat surface as an ideal testing ground of research aircraft. Four hundred sixteen staff members are currently concentrating most of their efforts on the flight evaluation of the X–15 (fig. 21, p. 202).

A limited number of flights have already been conducted by the contractor's flight crew. One as recently as this last weekend. It is anticipated that center personnel will shortly begin the flight research program wherein the pilot will be propelled substantially above the earth's atmosphere and experience the characteristics of space flight for durations of a few minutes.

Next week we will accept delivery on the first airplane from the contractor and begin the planned research efforts.

The coming year should be of high interest in this project if the program goes as expected.

In the space flight side of the program there are three major research and development centers at work and three locations in which we have varying levels of investment for purposes of launching space vehicles. In research and development activities, we have divided the work into two categories—launch vehicle development and operations on the one hand, and spacecraft development and operations on the other.

Two centers are primarily engaged in spacecraft development and, again, a functional division in the work has provided to the Goddard Space Flight Center the primary responsibility for those projects concerned with earth orbiting craft both in their development and operation, as well as supporting research and test as necessary for the mission.

It is at this center that the Vanguard team served as a nucleus for a staff which is projected to grow until it numbers 2,000 with the proposed fiscal year 1961 budget authorization. The staff is currently housed in several different locations in the Washington area and at the Langley Research Center.

However, the badly needed space research facilities for this center are under construction at Greenbelt, Md., and the first of these will become available for beneficial occupancy by the middle of this summer. The satellite and sounding rocket program, the manned space flight program, and the application of space vehicles, including passive communications and meteorology, are the major program elements of this center. Following witnesses will discuss these programs in detail, and point out accomplishments to date.

The responsibility for the other major area of spacecraft development is assigned to the Jet Propulsion Laboratory at Pasadena, Calif. It is the exploration of deep space, including the lunar and interplanetary flights. This laboratory is employed in our program through the medium of a contract with the California Institute of Technology. The staff at the present time totals approximately 2,700 people, including several hundred currently engaged in the systems engineering of an Army weapon, the Sergeant ballistic missile (fig. 22, p. 203).

As the activity on this weapon system is phased out, we expect some decrease in the total staff size, but our present plans indicate that a stable requirement will persist for about 2,400 people. An

FLIGHT RESEARCH CENTER

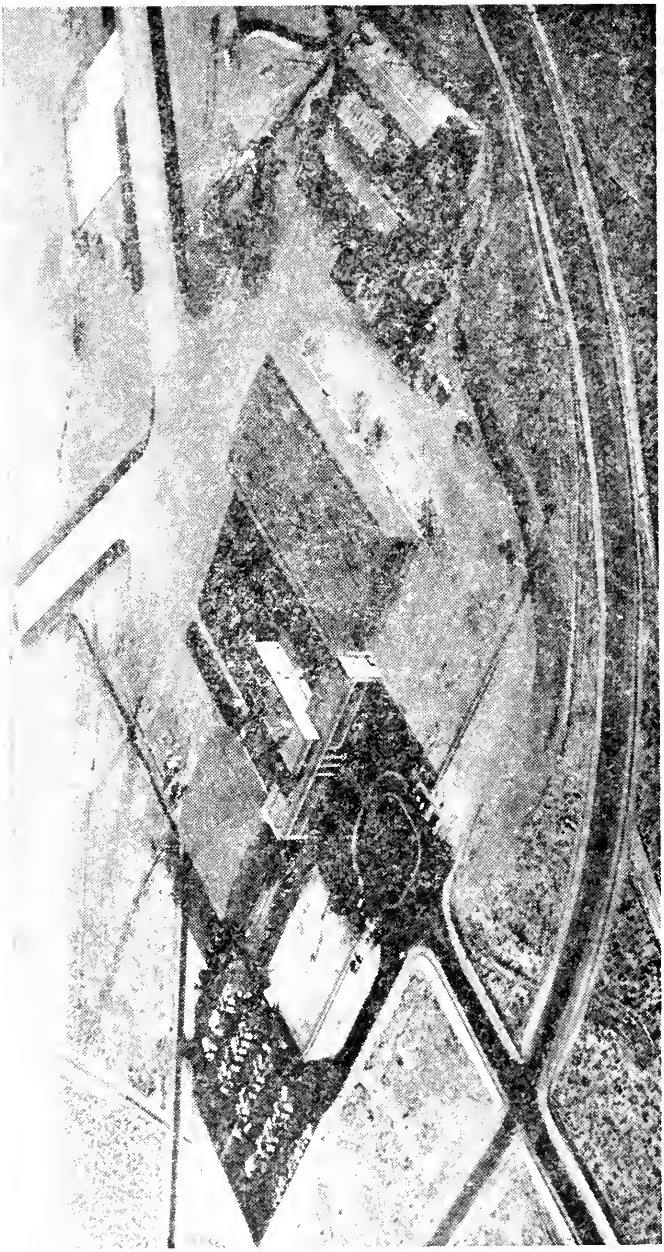

FIGURE 21

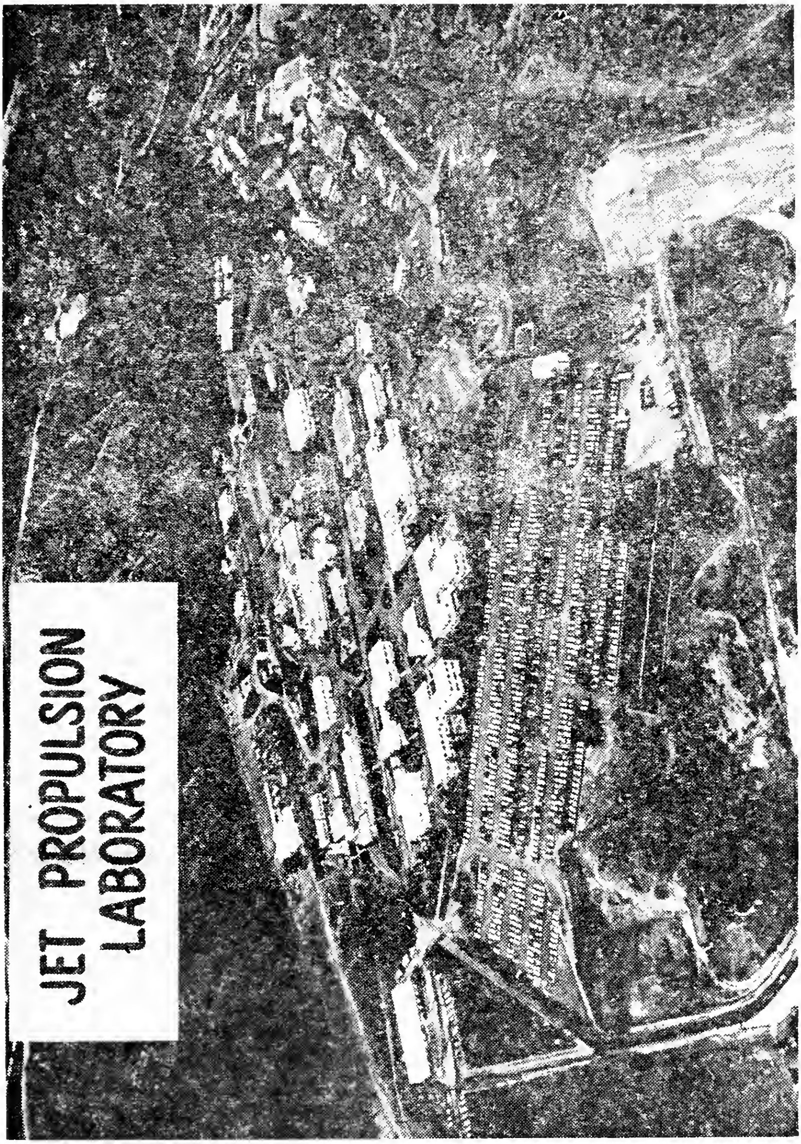

FIGURE 22

aerial view of the facilities which the laboratory occupies in the foothills of the Sierra Madre is shown.

It is in the area of work of this organization that one becomes most impressed with the extreme complexity of the spacecraft which must be created to carry out the interesting missions in lunar and interplanetary exploration. As I have indicated earlier, our program anticipates a major flight experience of this kind at approximately 3-month intervals in the time period affected by our proposed budget. A vast amount of creative engineering is a prerequisite to each flight, and the data analysis of the quantities of information recorded also represents a tremendous task. It is clear that this work will require a major fraction of our resources in the years to come.

I might say here, in most of our past experiments, the bulk of the investment for each flight has been to the vehicle, itself—to the propulsion system. We can clearly see this is not going to be the case in the future, that even with the added costs of the larger vehicles, the costs of the payloads to carry out the tasks that can be done and must be done are going to be even higher than those for the launch vehicles.

It is appropriate to divert here a moment and explain a principle of our program formulation in this area. The question of backup vehicles for specific experiments has arisen frequently. This has indeed been a cogent question during the early days of our program when improvisation has been common and individual space flights have been somewhat loosely related in the fabric of our entire effort.

It is our objective, however, to plan our experiments in each of the major program areas as a coherent and integrated effort. Each major experiment will be carefully related to the overall program objectives, based upon the results of previous flights, and generally increasing in sophistication and in difficulty as time progresses.

Many of the spacecraft will, in themselves, be related through the use of common structural frames, power supplies, and instrumentation. There will also be many which, though differing in their performance objectives, use launch vehicles of the same type.

In such a program the best utilization of our resources is not realized by providing backup boosters for each payload. Rather, it should be considered that a launch is scheduled periodically, in this case each 3 months—that is in the case of the deep-space exploration program—and if a catastrophic failure is experienced with any one launch, then a determination can be made at that time as to whether a similar spacecraft should be flown on the next scheduled vehicle.

The need for extensive ground testing of all spacecraft requires that spare devices be produced in each case. It is, therefore, possible to assemble an additional spacecraft to replace a failure on reasonably short notice. This, I would emphasize, is a principle used in the formulation of our program. Like all such principles, it is occasionally desirable to consciously violate it where unique program requirements prevail. Thus, our program is under constant surveillance to identify specific flights where a backup vehicle would be advisable and in these cases one is provided.

The launch vehicle development and operation task is assigned to the NASA Huntsville facility. I know you are all aware that the decision to transfer this facility to NASA was taken recently, and the plan to carry out this decision is currently before the Congress.

It provides for a transfer of 5,500 people under the leadership of Dr. von Braun. The development facilities, which will also be transferred, had an original investment cost of approximately $100 million.

The major project activity of the group at the present time is, and for some time will be, the development of the Saturn booster and the integration of the upper stages. Dr. von Braun will provide the committee with a detailed briefing on this project.

There are also numerous other activities at this center, including work on several Army missile systems, which will be carried on in accordance with the agreements we have made with the Department of Defense.

As I previously indicated, the responsibility for launch vehicle operation as well as development comes under the von Braun group. For this purpose, a missile firing laboratory is maintained at the Atlantic Missile Range at Cape Canaveral, Fla., which will supervise all NASA vehicle launchings from that site and will actually carry out the launching of vehicles developed at Huntsville.

In the time period pertinent to this budget authorization request, we will also have some space flight operations from the Pacific Missile Range. We plan to launch from this location all spacecraft which require polar orbits. Although the launch operations will be carried out largely by contract, a small group of NASA technical and administrative liaison people will be located at the site.

At Wallops Island, off the Virginia coast, we have a small launching service organization which conducts the numerous launchings of our sounding-rocket program and the solid propellant orbital vehicle which we will bring into service during the current calendar year. A staff of 300 people operates a facility valued at $18 million which is shown in this aerial photograph. The work is largely in response to the needs of the sounding-rocket and satellite program (fig. 23, p. 206).

To round out the organizational picture, as shown in the lower left-hand corner of the chart, is the Western Operations Office. This office is established in Santa Monica, Calif., with a staff of about 40 people. Its function is to perform liaison with the many development contractors engaged in our program and to carry out contract administration as required. The existence of this office greatly reduces the requirement for travel to this area by personnel of the headquarters and various other centers.

Mr. Chairman, I would like to turn for just a brief period to another subject which has been of extreme importance to us and has occupied a great deal of our attention. This is the matter of our program coordination with the space efforts of the Department of Defense.

I want to emphasize, first, that we have an excellent relationship with the military departments and the Office of the Secretary of Defense. Program correlation and project coordination are thorough and compatible with our needs, as I believe they are with the needs of the Department of Defense. There has been a great deal of discussion about a single national space program with, I am afraid, all too little understanding of what is precisely involved in this term.

WALLOPS STATION

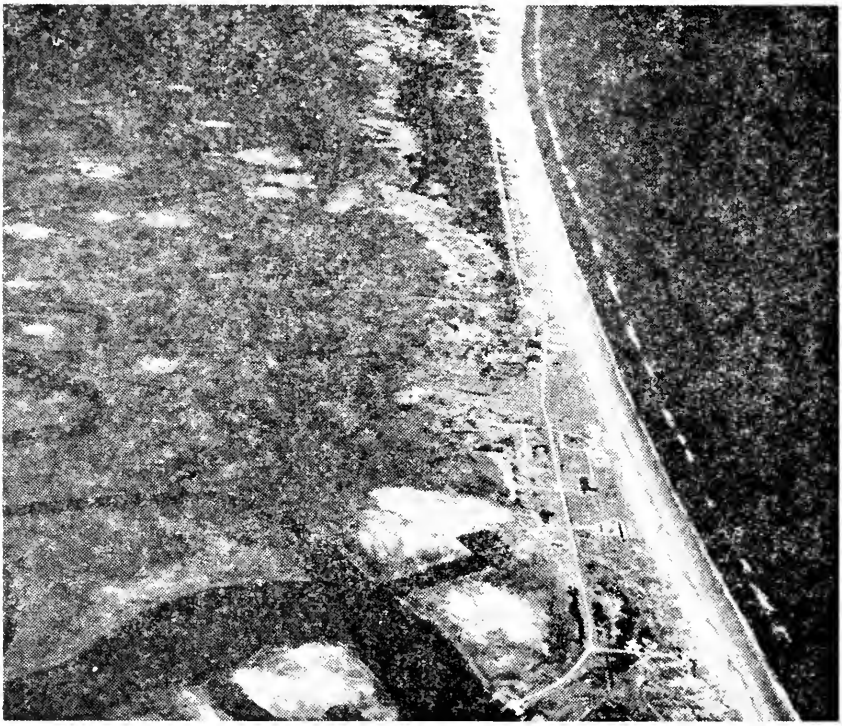

FIGURE 23

The Nation's space efforts can be discreetly considered in two major categories. One is space exploration, the measurement of scientific phenomena in space and on distant bodies, whether it be by the use of instrument or the human senses.

The other is the application of spacecraft. Now, to insist that there should be a single national space program might very well be to insist upon relating such diverse endeavors as meteorology, international communications, navigation, military reconnaissance, and space exploration. They are neither easily relatable nor sensibly compatible. It is, however, clearly possible to formulate a national space exploration program, and it is our belief that it was the intent of the Congress, as shown by the legislative history of the National Aeronautics and Space Act of 1958, that the NASA should indeed formulate such a program and proceed with its implementation. This we have done.

I make this point because its recognition is prerequisite to a workable relationship between the NASA and the Department of Defense. We have this recognition.

I have had a chart prepared which I think illustrates the coordination as it currently exists. A few facts stand out. Space exploration is the responsibility of NASA. Military applications are the

FIGURE 24

responsibility of the Department of Defense. Civil applications are the responsibility of NASA. There are some applications which are of interest to both military and civil needs. The underlying research and technical development is largely useful in both programs and common use can be made of launch vehicles (fig. 24).

Therefore, in the areas of certain applications—launch vehicle development, and background research and development—careful coordination is required to assure that full value accrues in joint utilization of either agency's products. The chart shows examples of these coordinating devices.

You will see at the top a category which we would call program correlation. They are program management coordination instruments. They exist in some cases under the executive jurisdiction of the Defense Department and in other cases, under the executive jurisdiction of NASA.

All of these boards and committees have membership from both the Department of Defense and the NASA.

The Defense Science Board, the Scientific Advisory Board of the Air Force, the Naval Research Advisory Committee, all have NASA membership and all treat with the program elements I have mentioned here as of joint interest.

The Research Advisory Committees of the NASA are 13 in number and they each cover a different technical discipline. They each have membership from the Department of Defense.

There is also a NASA–DOD Space-Science Committee which considers the whole area of space experimentation.

In the other category, the category of project coordination, these are individual committees concerned with individual projects. The Research Airplane Committee is a general committee considering the subject of research airplanes. There are also specific committees in the case of the X–15, and the Dynasoar.

There are also committees on the Centaur, the Agena–B, the Saturn, the F–1 engine, the Scout and many others.

We also have a very busy and effective committee covering space flight ground facilities which coordinates the uses of launching sites and tracking installations.

Again, I repeat, they are working well. When undesirable duplication is identified, it is eliminated and there is tremendous payoff in the programs of each for the benefit of the other.

Mr. Chairman and gentlemen, I appreciate this opportunity to appear before your committee to discuss these several facets of our program with you. Many of them I have covered sparsely. As Dr. Dryden indicated, we will be happy to answer any questions you have, to the best of our ability.

The CHAIRMAN. Thank you very much, Mr. Horner. Your statement was certainly comprehensive and was of great interest to all of us.

Now, Dr. Dryden and Mr. Horner, we would like to ask you a few questions.

I would like to ask you first this question: Yesterday, Dr. Glennan referred to the need for additional funds in the handling of this program. Mr. Horner makes reference to that in his statement.

Can you give us more detailed information on that? How much will you need and for what purpose will you need additional aid?

Dr. DRYDEN. We are talking about the funds required for the acceleration of superboosters.

The CHAIRMAN. It is especially important to the committee, I am sure.

Dr. DRYDEN. As you know, we follow the procedures of submitting this through the executive side of the Government and we hope to get to you, certainly within the next week, a transmittal by the President of an amendment to the 1961 budget to cover this subject.

The CHAIRMAN. Now, Dr. Glennan made reference to the urgency of this legislation and we want to give it top priority. You call it DX priority and we want to give it that top priority, but we can't do it if you are not prepared to come and tell us about it.

Can you tell us in a general way what you propose to do?

Dr. DRYDEN. I think the statement has been made that it is of the order of $100 million additional. I cannot tell you what the specific amount will be because it is not yet through all of the review procedures, but this is the order of magnitude.

The CHAIRMAN. The committee shouldn't be surprised to note a request for $100 million at that time. That will be for the superbooster.

Dr. DRYDEN. The superbooster program, including the Saturn, the F–1 engine, and the upper stages of Saturn.

The CHAIRMAN. That gives these programs, then, the top priority, the DX priority?

Dr. DRYDEN. Yes, sir.

The CHAIRMAN. Do you have any programs of space that don't have the DX priority?

Dr. DRYDEN. Yes, sir; there are only two programs that have this priority, and I might remind you this is the same priority as various elements of the ballistic missiles program. These two are Mercury and Saturn.

The CHAIRMAN. Those are the only two in your agency that have DX priority?

Dr. DRYDEN. That is correct.

The CHAIRMAN. Your communications project, which I consider very important, doesn't have that?

Dr. DRYDEN. May I make one explanation of the priority system. A DX priority is a device which enables you to get material delivered that you need at the time you need it. In other words, if you need a particular piece of electronic equipment, you don't have to go to the bottom of the list of those who have placed orders. The DX priority gives you the opportunity for early delivery. It, in itself, does not carry with it any more money.

The CHAIRMAN. It does not carry additional funds. That is what I was going to ask you.

Dr. DRYDEN. This is correct.

The CHAIRMAN. What priority would you have to have in support of the project to give you the needed funds that you have for that project?

Dr. DRYDEN. The point I am trying to make is that the DX priority system is entirely apart from the allocation and appropriation of funds.

The CHAIRMAN. The DX is your priority, is it not?

Dr. DRYDEN. It is actually a Commerce Department priority on American industry.

The CHAIRMAN. Is it under control of Commerce?

Dr. DRYDEN. Commerce is the agent that carries it out. The determinations are, in certain categories, by the Department of Defense. In this particular category, DX, it must go higher in the executive branch.

The CHAIRMAN. Now, we are in a race. The Defense Department says it is a race, and we all know it is a race, with Russia, and our projects have less than a DX priority.

Dr. DRYDEN. The practical situation in every priority system, Mr. Chairman, is that if you put every project in the top priority you return to where you were before.

In other words, you can give this top priority only to a relatively small number of projects in the country. Otherwise the whole system becomes useless. You are competing then with a hundred other projects.

The CHAIRMAN. How many projects have DX priority in this country?

Dr. DRYDEN. It is of the order of 8 or 10.

The CHAIRMAN. And how many does space have?

Dr. DRYDEN. Two in NASA.

The CHAIRMAN. What are the others?

Dr. DRYDEN. Ballistic missiles. Polaris, Atlas, Titan——

Mr. HORNER. There are two for space projects in the Department of Defense and the others are primarily in the ballistic missiles field.

The CHAIRMAN. Items of education and things of that kind do not have DX priority, do they?

Dr. DRYDEN. No.

The CHAIRMAN. What priority would you need to get the requested funds from the Bureau of the Budget for these projects?

Dr. DRYDEN. Priority assignment in itself has no direct effect on the assignment of funds.

The CHAIRMAN. Well, there is some priority in the distribution of funds by the Bureau of the Budget because when there is more demand than there is money, there is bound to be a priority in handling them.

Dr. DRYDEN. This is handled by an examination of each individual case, as I understand it.

If we want funds for a certain purpose, we have to argue for the funds for that purpose.

The CHAIRMAN. Let me put it this way then: Did you make a request for funds in reference to these projects that you have referred to and which we consider important in space development and fail to receive the amount of money requested?

Dr. DRYDEN. I cannot recall the details on individual projects. We did ask for a substantially greater amount than was allowed.

The CHAIRMAN. For what projects did you ask for more than was allowed?

Dr. DRYDEN. I can't tell you by specific numbers at the moment.

Mr. HORNER. I can give you some examples. I couldn't be sure it is a comprehensive listing.

One of the projects we asked for more funds on than is in the $802 million request is the F-1 engine and it is now a part of the overall study on augmentation of the superbooster program. We are confident that this study will result in augmentation of that program.

The CHAIRMAN. And will you now get the funds you need on that project?

Mr. HORNER. Yes, sir.

As a practical matter, I would anticipate that the difference between the dollars we had originally requested and the total dollars of our budget after this augmentation you have discussed with Dr. Dryden is going to be quite small.

The CHAIRMAN. It would be substantially the same now, under the new setup?

Mr. HORNER. Yes, sir.

The CHAIRMAN. Now, what projects, Mr. Horner—because you are familiar with the details—on what projects did you make requests for funds and didn't receive the amounts requested?

Mr. HORNER. We reduced the amount of construction. This reflects in a reduction in our proposal for new facilities, and substantially in a delay of some of the new facilities that had been requested until later years.

There was some reduction in our advanced technology and supporting research program. This is literally hundreds of individual smaller projects across the board.

We had anticipated some staff expansion which we have now withheld. I don't think of anything else at the moment, Mr. Chairman.

The CHAIRMAN. Did you get all of the funds you requested for your navigational project?

Mr. HORNER. We have no navigational project.

The CHAIRMAN. That is under the Navy?

Mr. HORNER. That is right.

The CHAIRMAN. Do you have communications?

Mr. HORNER. We have a passive communications project and we received substantially the moneys that we asked for.

I point out, Mr. Chairman, that the final balancing of the program between projects is done almost entirely on our own authority. The money that is provided to each individual project is, of course, sometimes questioned in the budget negotiating process and in this questioning and reexamination sometimes the funds on individual projects are reduced, but in the final analysis, NASA exercises its own prerogatives in adjusting the balance between projects.

The CHAIRMAN. Of course, we are behind in the space race and we want to catch up and, as Mr. McCormack says, get ahead.

If NASA says it has all the money it has requested and all it needs, then the responsibility falls on NASA. It is just a practical situation.

If you requested funds and didn't get them, and they are important to you, the committee would like to know it and the country would, too.

Now, you say you have gotten the funds that you need on the other projects?

Mr. HORNER. Mr. Chairman, I pointed out my list would not be a comprehensive one because I couldn't depend on my memory. If the committee would desire, we can provide a listing.

The CHAIRMAN. I think the committee would be very much interested in knowing what you say you need and what you were allowed.

Now, we have only two projects in the DX category, but I would like to know on a nationwide scale what importance is attached to these projects that are assigned to you and have a dual importance—both military and peacetime importance. You can't give us that——

Dr. DRYDEN. We will supply for the record a comparison between the requests we submitted and the amounts allowed.

The CHAIRMAN. Can you do it this afternoon. Doctor?

Dr. DRYDEN. I think so.

(The information appears at p. 228 of the record.)

The CHAIRMAN. What sense of urgency, Doctor, do you assign to this question of getting ahead in space, overtaking and getting ahead of the Russians in space?

Dr. DRYDEN. I think we assign the greatest possible urgency to it.

The CHAIRMAN. How can you do that without adding the greatest possible priority to your request?

Dr. DRYDEN. The amounts, of course, allocated to space are matters of allocations in relation to other projects as well as ours. There are some questions that go to higher levels of authority. We submitted requests for the amounts of funds we felt necessary to move the program as rapidly as we could move it and we will furnish this information to you, sir.

The CHAIRMAN. And you will show us what you failed to get, this afternoon?

Dr. DRYDEN. Yes.

The CHAIRMAN. Mr. McCormack.

Mr. McCORMACK. I have no questions, but you have stated, and so has Dr. Glennan, that we are in competition with another country.

Dr. DRYDEN. Very much so.

Mr. McCORMACK. So the American people might just as well realize that fact. This idea that we are not in competition creates apathy and complacency rather than the healthy progress that should be made in the field of outer space. Is that right?

Dr. DRYDEN. We consider that we are in a broad competition with the Russians, that it is incumbent upon us to produce a program which will move us forward just as rapidly as possible and we think we have formulated such a program.

We do not believe—let me state it positively: I think I testified last year we believe that this is an overall competition like an Olympics tournament. There are numbers of events and there are many areas that are of great benefit to our country which perhaps are not as attractive to the competition.

We believe that in time, just as quickly as we can, we will overcome the present handicap that results from the small size of boosters which are available to us.

So far as we know, this is the only specific way in which we are behind. The Saturn project is the one which will remedy this, we feel. It is true that with the Atlas-Agena we will attain the position that our competition is in now, but by that time they will have moved ahead.

We believe that the completion of the Saturn vehicle at the earliest possible date is the one step that we can take that will relieve that particular handicap.

Mr. McCORMACK. Well, that is really the heart of it, isn't it?

Dr. DRYDEN. This is really the heart of the difficulty, if you like.

Mr. McCORMACK. So we can talk about everything else, but the concentration should be on that—propulsion power.

Dr. DRYDEN. On that and the things necessary to exploit it when we have it. You will recall there are things other than the booster which we must have ready at the time we have the booster.

Mr. McCORMACK. If you solve the source of the difficulty, the others are easy.

Dr. DRYDEN. If we solve the source, the others will follow.

Mr. McCORMACK. How far do you say we are behind the source of this competition?

Dr. DRYDEN. As Dr. Glennan said, something on the order of 5 years will be required to catch up.

Mr. McCORMACK. If we are behind in 5 years, what do you think our competitor will be doing in the meantime?

Dr. DRYDEN. This estimate of 5 years includes some estimate of what he will be doing in the meantime.

Mr. McCORMACK. There is no question but what we have the facilities and capacity in America to do so.

Dr. DRYDEN. The only thing we do not have is time. We didn't start soon enough.

Mr. McCORMACK. That goes to leadership, too; doesn't it?

Dr. DRYDEN. We have to start at the starting line with the other competitors. If someone is halfway down the track, there is no sense entering that particular event.

Mr. McCormack. The question of management and leadership is vitally important also.

Dr. Dryden. These are important to remedy the condition as early as possible. They will not overcome to the fullest extent this matter of time.

Mr. McCormack. With regard to the $23 million supplemental budget for the remainder of this fiscal year, of course, you always knew you could come back with a request for more funds——

Dr. Dryden. That is correct.

Mr. McCormack. And that $23 million is really necessary to carry out the work for the remainder of the fiscal year?

Dr. Dryden. This covers items that are authorized. Therefore, it does not come before your committee for authorization.

Mr. McCormack. For appropriation only?

Dr. Dryden. The need of it is primarily to make sure that our Mercury tracking network matches the availability of the flights. In other words, we cannot fly until our ground stations are completed. We need to expend money this fiscal year in order to make these two elements in the program meet at the right time.

Mr. McCormack. Now, with that $23 million and the $802 million for which you are seeking authorization and appropriation in the next fiscal year, will that amount be all you could wisely, efficiently, and effectively expend during the next fiscal year?

Dr. Dryden. Well, there is no question that if you have more money you can do more. I think the question is, does the additional money contribute to your objective? Can you advance the time scale?

Now, when Dr. von Braun presents his review of Saturn, he will show you what the amount requested buys in the way of time. This detail is being completed and we will give it to you next week.

Mr. McCormack. If you had more money, could you reasonably in the next fiscal year make further progress?

Dr. Dryden. It would not affect the time scale of anything that will happen in the next year or two. It could perhaps give more insurance in the next year or two. It could affect things further down the road.

Let us take these long-range objectives of circumlunar navigation. There is no question that the date at which you reach that is at least in part determined by the amount of money. It, however, is determined mainly by the speed at which you develop the technology and overcome problems whose solutions you don't see right now.

I am trying to make clear that it is not like building a piece of machinery that we know how to build and just having to figure how long it takes to build it.

There are some unknowns in this business.

Mr. McCormack. You asked for more money than the budget message included. You must have had ideas in your agency that you needed that money.

Dr. Dryden. Somewhat more. We asked for what we thought was the optimum rate to get ahead just as quickly as possible.

Mr. McCormack. I notice Mr. Horner used the word "minimum."

Mr. Horner. Yes, sir.

Mr. McCormack. So the figure represents the minimum amount?

Mr. Horner. We feel it is the minimum essential to carry out the program I showed you.

Mr. McCORMACK. Now, your agency was consulted in connection with the administration bill amending the Space Act?

Dr. DRYDEN. Yes, sir.

Mr. McCORMACK. Was the Defense Department consulted?

Dr. DRYDEN. Yes, sir.

Mr. McCORMACK. Was the Department of Army consulted before the bill was drafted, and the Department of the Navy?

Mr. HORNER. We in NASA carried on all of our communications concerning the proposed legislation with the authorities in the Office of the Secretary of Defense. The Secretary of Defense disseminated the information through the Department of Defense——

Mr. McCORMACK. What happened over there you don't know?

Mr. HORNER. We can't answer specifically.

Mr. McCORMACK. In other words, NASA sought the opinion of the Defense Department at the Defense Department level rather than the opinions of component branches of the Defense Department?

Mr. HORNER. There is one addition I might make to that: There are some elements of the bill that are uniquely of interest to the Department of the Air Force in its role as—I will use the term "space transportation agency," which has been assigned by the Secretary of Defense to the Department of the Air Force and at the request of the Secretary of Defense we did talk with the top officials in the Department of the Air Force.

Mr. McCORMACK. That didn't happen in the case of the Army or the Navy?

Mr. HORNER. We were not asked to do so in the other two cases.

Mr. McCORMACK. You did it at the request of the Secretary of Defense?

Mr. HORNER. I would amend that by one further statement: We did also talk to the Assistant Secretary for Research and Development in the Department of the Navy and the Director of Research and Development in the Department of the Army.

Mr. McCORMACK. You talked with both of them about the bill?

Mr. HORNER. Yes, sir.

Mr. McCORMACK. Did they express any opinions about the bill as recommended and filed?

Mr. HORNER. To the best of my knowledge they are in agreement with the bill.

Mr. McCORMACK. Now, let's come to section 309 of the bill:

> Nothing in this Act shall preclude the Department of Defense from undertaking such activities involving the utilization of space.

That doesn't mean research, does it?

Will you tell me just what section 309 means now? What is intended and what section 309, as enacted into law, will mean?

Dr. DRYDEN. As I understand the position, this says that at any time the Department of Defense finds a military job which it can do in space better than they can do it some other way, or that they can't do at all any other way, the Department of Defense is not excluded from proceeding with such developments, including the research—there is a phrase at the end that I cannot quite exactly quote.

Mr. McCORMACK. I will read it.

> Nothing in this act shall preclude the Department of Defense from undertaking such activities involving the utilization of space as may be necessary for

the defense of the United States, including development of weapons systems utilizing space vehicles and the conduct of supporting research connected therewith.

Dr. DRYDEN. This is the point which Mr. Horner covered in his statement: The responsibility for space application in the military field is that of the military, the Department of Defense. Exploration of space; applications to civil purposes are assigned to NASA.

Mr. McCORMACK. I understand that, but I want to know about the meaning of this provision. Would this mean all research in connection with the military would be vested in NASA or that the Defense Department would have to secure permission to go into basic research in connection with what they consider to be the development of military weapons?

Mr. HORNER. Mr. McCormack, would it clear this up if I pointed out that in our understanding, and in the understanding of the Department of Defense, supporting research covers both basic and applied research?

Mr. McCORMACK. In other words, you are not taking away from the military——

Mr. HORNER. Nothing.

Dr. DRYDEN. We make it perfectly clear this act takes nothing away from the military.

Mr. McCORMACK. We thought we made it clear in the original act, but we found we didn't in the interpretation of the word "except" in the Space Act.

Mr. HORNER. This wording was suggested by the authorities in the Department of Defense.

Dr. DRYDEN. This drafting is their drafting.

Mr. McCORMACK. I don't want to go into it too much now, but if in further consideration of this bill and that provision we want to make that more definite, accurate, and certain, there is no objection to that?

Dr. DRYDEN. No, sir.

Mr. McCORMACK. In other words, you realize that in the world of today the question of preservation rests essentially with our military?

Dr. DRYDEN. That is right.

Mr. McCORMACK. I am very strong for your agency, as you know, but I have never failed to recognize the serious position in which the world is today. It is pretty difficult to have basic research in a civilian agency in connection with a military application. Is that right?

Dr. DRYDEN. That is right.

This language was drafted by the Department of Defense to make perfectly clear that no attempt is being made in this bill to restrict the military use of space.

Mr. McCORMACK. That certainly clarifies my mind because I was somewhat disturbed about the language. Of course, we put the "free information" provision in last year and we have run into difficulties now. There were some questions I was going to ask on that phase, but I would rather wait until Dr. Glennan is here because I would like to ask questions in connection with why certain contracts were made. I am not impugning the motives.

I think as close a relationship between this committee and your agency should exist as is humanly possible.

You will remember that when the space bill was up for consideration in 1958, this committee kept in close contact with you; we told you everything.

Dr. DRYDEN. Yes, sir.

Mr. McCORMACK. That included the White House and Dr. Killian, then the President's science adviser. We even had executive department representatives sitting with us in executive session, which is very rarely done, so there would be that close cooperation. You remember that, don't you?

Dr. DRYDEN. Yes, sir.

In a letter to the committee Dr. Glennan expressed willingness to discuss any and all aspects of his contract decisions.

Mr. McCORMACK. That means in open session.

Dr. DRYDEN. I think so.

Mr. McCORMACK. I have no further questions now.

The CHAIRMAN. Mr. Fulton.

Mr. FULTON. We are glad to have you both here.

In respect to Mr. Horner's status, I would like a recommendation from the Agency to have a position that is an overall operation of responsibility so we can center the responsibility in one person.

I believe as associate administrator he has been given that, but in order to have a statutory responsibility for what is happening currently on programs and operations, I would like to have some sort of a recommendation on that.

Dr. DRYDEN. We can give you a statement, sir. I think this differs only in a degree from the heads of the other organizations. There are other staff positions which do not fall within Mr. Horner's jurisdiction.

Mr. FULTON. I am talking about upgrading the position into one of overall responsibility. I am always interested when we talk about our language. For example, you want to call it our national launch vehicle program. You don't want to call it the national booster vehicle program any more.

Dr. DRYDEN. This came from the confusion as to what a booster was. Is it a rocket engine? Is it a rocket engine plus the fuel tanks? Is it one stage, two stages, three stages?

We wanted a word whose meaning would not be confused. The "launching vehicle" could cover the whole thing, whether it is one, two, three or four stages.

Mr. FULTON. I notice you wanted to do it, but you both referred to "booster" and "super booster" and never went back to the word again.

Dr. DRYDEN. It shows we haven't succeeded in erasing the old word from our mind.

Mr. FULTON. You refer to spacecraft.

I don't think that would be very popular when you are already using casually the word "sputnik" with the same definition.

Where do you get the word "Agena"? Some of us have a knowledge of Greek mythology, but sometimes it gets a little beyond some of us.

Dr. DRYDEN. This is a name developed in the Defense Department for one of the stages which they developed in connection with the Discoverer project.

Mr. FULTON. Was it pulled out of a hat or out of Greek mythology?

Dr. DRYDEN. I just don't know where it came from.

Mr. FULTON. I would suggest a new set of names in the Department. It has no connotation and has no scientific aspect. I wondered about that name.

Next there is the question of the highest DX national priority on various projects. The one project is the Saturn booster. That has a DX priority for the Saturn launch system, doesn't it?

Dr. DRYDEN. Yes.

Mr. FULTON. Secondly, the Atlas booster system has had a highest national priority for almost 5 years?

Dr. DRYDEN. As a missile; yes, sir.

Mr. FULTON. Then, in addition to that, the Project Mercury has been assigned a highest DX national priority.

Dr. DRYDEN. Yes.

You have to state the language very carefully. The "highest priority" could only be one. I said these projects have a DX priority and DX is the highest national priority.

Mr. FULTON. I agree that it is a class rather than one particular program.

The question then recurs on the Mercury project, and I would like to ask both of you this question. The Mercury project is the man-in-space program, and it seems to be a basic essential step of our U.S. space program, is it not?

Dr. DRYDEN. It is, sir.

Mr. FULTON. And both of you say that?

Mr. HORNER. Yes, sir.

Mr. FULTON. Therefore, it is a necessary step in the progress of our U.S. program in space.

Dr. DRYDEN. Very much so.

Mr. FULTON. And that we follow it up promptly or we will be further behind Russia. Is that not the case?

Dr. DRYDEN. That is correct.

Mr. FULTON. Now, there is a 17-member advisory committee on science and technology that met Sunday, January 24, and issued some statements. They likened the Mercury program to the Vanguard project. They said that the Mercury program should be put in its logical place and suggested the target date on the Mercury man-in-space program be delayed 3 to 5 years.

Now, would you please comment on what that would do to our U.S. space program, particularly to our defense program and secondly in our position with Russia?

Dr. DRYDEN. Mr. Fulton, I think this would be extremely unfortunate. To the best of my knowledge, none of the persons on this committee has ever visited the Mercury project or had any contact with it. So far as I know, all they know is what they read in the papers and I believe——

Mr. FULTON. I would like your direct comment, that it would be a tragic blow to the U.S. space program and to our U.S. security to have such a postponement.

Dr. DRYDEN. Very much so.

Mr. FULTON. What do you say, Mr. Horner?

Mr. HORNER. I think it would create a great deal of chaos in our program.

Mr. FULTON. Would it put us further behind Russia in the space race?

Mr. HORNER. I don't think there is any question about that.

Mr. FULTON. How about you, Doctor?

Dr. DRYDEN. I think so. I think, although all of us realize that our competition has had the booster capacity to do this, there still is some hope that we can be there first.

Mr. FULTON. Now, then, the same group said that they favored a number of proposals. They wanted the high priority development of weapons that can knock hostile military satellites out of the skies.

Of course, that brings up the project Defender that is for the purpose of discovering a means to counteract ballistic missiles in the future. That project is allocated for over a half of the budget of ARPA, the Advanced Research Projects Agency of the Department of Defense.

Do you think that is being given adequate attention by the Department of Defense and ARPA in that particular field of defense—the so-called antimissile defense field?

Dr. DRYDEN. I believe from what I know that the antimissile defense is not quite the same thing as the antisatellite problem. The anti-ballistic-missile defense is being given an extremely high priority running down every possible suggestion for means of dealing with ballistic missiles.

Mr. FULTON. So it includes not only Nike-Zeus, but many other aspects and projects of flight phenomena in all the fields. Is that not right?

Dr. DRYDEN. That is right.

Mr. FULTON. What do you say, Mr. Horner?

Mr. HORNER. I don't find any disagreement with what Dr. Dryden has said. I am not very well qualified to comment on the efforts of the Department of Defense in this area at this time.

Mr. FULTON. Now, the comment has been made that your agency does not yet understand the depth of the Russian challenge. You certainly respect that challenge, don't you, and are doing everything you can to counteract it?

Mr. HORNER. That is right.

Dr. DRYDEN. I don't know what the reason for such statement is. I think we fully understand what is involved.

Mr FULTON. What do you say, Mr. Horner?

Mr. HORNER. Well, if the statement was made as an allusion to our desire to have more information about what the Russian program amounts to, it is certainly true, we would like to have more information than is available.

We don't have any question in our minds that there is a very significant Russian challenge, but we don't know just exactly what it is.

Mr. FULTON. But you have your eyes open to the challenge, and you are trying to meet it; are you not?

Mr. HORNER. Yes, sir.

Mr. FULTON. The other comment has been with respect to the adequacy of the National Aeronautics and Space Administration's top management, that it must be reexamined.

Do you find in your agency any evidence, or have there been any complaints of faulty management, or lack of coverage of the various fields by the administrative personnel?

Dr. DRYDEN. I know of none.

Mr. FULTON. Have you had any complaints, Mr. Horner?

Mr. HORNER. I find it a little difficult to respond to that question without being self-serving and subjective.

I think we have made excellent progress in the last 16 months.

Mr. FULTON. Now, Mr. Horner has a chart on the military, civilian, and NASA–DOD coordination efforts. There have been comments that there is a now nonexistent method for resolving military-civilian priority conflicts which must be devised.

Would you please have that chart—with the chairman's permission—put in the record at this point, together with Mr. Horner's testimony to show just what the setup is now so we can advise these 17 bright scientists that it is already in existence, although they don't know about it?

With the chairman's permission, may we put that chart in the record?

The CHAIRMAN. If there is no objection to it, it may be included.

(See fig. 24, p. 207).

Mr. HORNER. These are merely examples. There are more than appear on this chart.

Mr. FULTON. With regard to ARPA, you are on a day-to-day basis. For instance, with Mr. Godel you are on a day-to-day basis.

Dr. DRYDEN. This shows only the formal contacts and not the telephone conversations, luncheons, and so forth.

Mr. FULTON. If we look at the overall U.S. scientific program, taking into consideration the installations we have, the personnel we now have, as well as the projects we have under study, and in research and development, would you not say that in depth, on science, we are proceeding on a much greater and broader base of scientific approach, both in aeronautics and space, than anybody else in the world is at the present, including Russia? Would you answer that, Doctor?

Dr. DRYDEN. Insofar as aeronautics and space are concerned, I think there is no doubt. Dr. Waterman could answer the broader question better than I.

Mr. FULTON. Mr. Horner, what do you think about it?

Mr. HORNER. That is my impression.

Mr. FULTON. When we are talking about who is ahead or who is behind in space, we must realize that had several of our own lunar shots gone well rather than run into technical difficulties, we would have been even with Russia, even on the lunar shots, would we not, because it had been planned for certain lunar shots?

Mr. HORNER. I think it is generally accepted, and it is certainly true in our estimation, that the last lunar experiment that we attempted was technically more difficult than anything that the Russians have accomplished, if that will partially answer your question.

Mr. FULTON. That is the point I am making, that we are trying for certain high standards of scientific research that we have not been able to attain on lunar shots, but they are much above the standard that Russia has been trying to project on her lunar shots to date. Is that right?

Dr. DRYDEN. Somewhat above. "Much" may be too strong.

Mr. FULTON. What is the reason that Russia has not put into orbit any satellites within almost 2 years? Why has her program suddenly gone zero, blank, and failed on orbital vehicles?

Dr. DRYDEN. I, of course, do not know. I may say that at the meeting in Nice, France, a couple of weeks ago, the Russians said they were going to put up more earth satellites. They didn't say when.

Mr. FULTON. As a matter of fact, they haven't.

Dr. DRYDEN. They have not as yet.

Mr. FULTON. Would you please comment on how many we have had up in the last 2 years compared to Russia's failures? Even attempts?

Dr. DRYDEN. Including NASA and DOD, it is on the order of 18 or 20, I believe.

Mr. FULTON. Thank you. That is all.

The CHAIRMAN. Mr. Sisk.

Mr. SISK. Dr. Dryden, I think both you and Mr. Horner made excellent statements here this morning.

I wanted to ask you a few questions with reference to the Huntsville facility which is technically in the process of transfer. Now, actually, what is the status of that transfer at the present time? Mr. Horner, if you want to comment, or Dr. Dryden?

Mr. HORNER. If my memory serves me correctly the President announced the assignment of the superbooster development responsibility to the NASA in the latter part of October and at the same time announced his intention to have the elements of the development operations division of the Army Ballistic Missiles Agency at Huntsville transferred to NASA.

This is the Von Braun team. We started immediately to make a comprehensive study of all of the administrative, management, and logistic actions that must be taken to effect the transfer without delaying the development operations that are in process, and are accelerating in the case of Saturn, and to properly safeguard the interests of the Army that were being undertaken at that time by the technical people. This was a very complex study, indeed.

We have completed that study and formed a plan for this transfer. The plan, I believe, was delivered to the Congress on the 14th of January—I might want to correct that date in a day or two.

Mr. SISK. That date is correct. The 14th is correct.

Mr. HORNER. The law, as you will recall, provides that the plan be before the Congress for a period of 60 days while the Congress is in session and with the expiration of that time the plan will be carried out.

In the meantime we are going ahead—well, we have, with the Department of Defense, agreed upon controls over program correlation, management controls over project Saturn, and we have begun the formulation of the business and supporting side of what will be a new NASA center at Huntsville with Dr. Wernher von Braun as its director.

Now, there have been concurrently, of course, many activities necessary in support of the ongoing Saturn development program. We have as recently as last month, in cooperation with, and with the assistance of Dr. von Braun's staff and his personal attention, identified the upper stages for Saturn. Only yesterday and the day before there was a briefing of industry at Huntsville, preparatory to submitting proposals which will be due the latter part of next month for industry participation in the Saturn upper stage program.

We have also, as you know, been conducting a thorough study, again with Dr. von Braun and his staff, as to what the real financial needs for the support of that program during the coming fiscal year will be.

This study is just coming to its conclusion and as we have mentioned several times previously, we hope to present to this committee an amendment to our authorization request for 1961 very shortly, as to what the meaningful support requirements for project Saturn are, to indeed place it on a "highest national priority" basis.

Mr. SISK. Now, I understand, Mr. Horner, that this transfer of the Von Braun team is to be handled en masse, so to speak. That is the entire team of approximately 5,500 people is to be included in the transfer. Is that correct?

Mr. HORNER. The technical people, the scientific team under Dr. von Braun, that is true.

Now, you have to recognize that as an element of the Army Ballistic Missile Agency and as an element of the Army, the logistics, administrative, and management support for that team stems from other elements of the Army.

Certainly one of the difficult areas of discussion—difficult in the amount of detail that was necessary—was identifying sufficient support personnel and facilities for this technical team. The staff of 5,500 represents both the scientific and technical team and the supporting side of the new center.

I believe the numbers are about 4,300 scientific and technical—direct technical—workers, and 1,200 on the management, administrative, and logistics support side of the center.

Mr. SISK. The thing that I wanted to be absolutely clear on, because this was the information that we had been given indirectly heretofore, was that there was to be no breakup or splitup of the so-called Von Braun team.

Dr. DRYDEN. There are a few individuals who go back and forth, but this is by joint agreement between Dr. von Braun and the Army.

Mr. SISK. I certainly understand the idea of cooperation as we are carrying it on, of course, in other facilities.

With reference to the actual physical facilities at Huntsville which are being transferred, and which you indicate will amount in value to some $100 million, is just a portion of the physical facilities of Huntsville isn't it?

Mr. HORNER. That is a portion of what was the facility for the Army Ballistics Missile Agency.

Fortunately, almost all of the development facilities that were in use by the Von Braun team were in one area and we have been able to identify a discreet area of real estate about which if we wanted to we could put a fence and this becomes a new NASA center, very much in the same manner as our Langley Center which is on, as you know, Langley Air Force Base, and our Ames Center at Moffet Naval Air Station. It will be a very similar situation.

Mr. SISK. You anticipate no problems which would cause any delay in work due to the problems of transfer of facilities, or to the transfer of the team?

Mr. HORNER. We have been assured by Dr. von Braun and his staff that there will be no such problems.

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Mr. Sisk. I have introduced a resolution, and I don't know whether you are familiar with it, known as House Joint Resolution 567, to effect the immediate transfer of this facility rather than waiting until March 14, which under law would be required.

I would like to have you comment on that, if you are at all familiar with the resolution. It simply indicates that in view of certain precedents we have had in the past where this has been done, that it is the sense of Congress, in order to expedite the space program, that we permit the immediate transfer rather than waiting 60 days.

Dr. Dryden. I think it would be a desirable action to remove any slight uncertainty about the outcome. It would have a tremendous psychological value. I will say, of course, Mr. Sisk, as you know, that the various details of this transfer have to be faced at the proper time so there is no interruption.

Mr. Sisk. I understand that and I also understand, of course, that on the Saturn program they have been working with what I understand to be perfect cooperation—at least I hope it is near perfect; I guess nothing is ever quite perfect. It was my hope, of course, that this resolution will have good psychological effect. It would indicate the complete support of the Congress with the proposed transfer and our urgent desire to see that the situation proceeds expeditiously. I felt this would therefore be an advisable resolution.

Dr. Dryden. It would be very helpful from that point of view.

Mr. Horner. I think it would also facilitate the mechanics of transfer of personnel. There are some of the elements of transfer that cannot, as a practical matter, be completed until the end of the fiscal year, but prior to that time we must identify large numbers of support people, exactly where they are going, what facility they are going to sit in, who they are going to work for. The sooner we can have final confirmation that the transfer will take effect, the sooner we can get started on these kinds of activities.

Mr. Sisk. I appreciate that statement in support of my resolution very much, I might say to you gentlemen.

With reference to the time schedule which you have outlined here, I want to compliment you. This is the first time, I think, that we have had it drawn quite as specific as you have indicated here this morning. I am 100 percent in support of the position taken by my colleague, Mr. Fulton of Pennsylvania, with reference to this Mercury program.

I would be most unhappy to see any delay at all in pushing forward with it because this seems to me to represent one of the real possibilities of moving ahead with a program which could be extraordinary and impressive, not only for the real good that we could achieve with it, but also in this whole worldwide field of propaganda which we have to recognize today with reference to our prestige.

I would hope that if it were possible, without endangering anyone, certainly, that if you saw the opportunity of moving it forward faster, that you would do so, rather than to delay it.

Dr. Dryden. We think that the schedule we have is consistent with the greatest degree of safety that we know how to build into the project. We are not proposing in this to unduly take risks, but we will do this when we are convinced that the flight is reasonably safe. We have given our estimates of the time schedule, if our tests continue to be successful as they have been to date.

Mr. SISK. I appreciate your statement because I think we all agree certainly that we do not want to take the step until every possible bit of safety precaution has been taken.

Let me conclude if I might, Mr. Chairman, with this statement. As I say, these statements were excellent. They were fairly general in nature and I would hope that as other people appear here we may be able to have a little more specific data on actual progress in the next year.

Dr. DRYDEN. There are another 10 speakers or so.

Mr. SISK. We would like to have detailed some of the specific things that have been discovered or things that would be worthwhile in the program.

Dr. DRYDEN. We would like to take up each element, tell you what has happened in the past year, what our plans are for the future, when we have had failures and our best information as to the cause, and so on.

The CHAIRMAN. Doctor Dryden and Mr. Sisk, I think there are some other questions to be asked and then we have other witnesses too from NASA. We are anxious to get ahead with this program.

I think Mr. Fulton has an observation to make and following that we will adjourn until 2:30 unless there is objection.

Mr. BASS. Mr. Chairman, may I say something?

There are two or three members of the committee who have asked questions for 25 minutes. I suggest that we stick to the 5-minute rule to allow some of us junior members to get in a question or two.

The CHAIRMAN. I think the 5-minute rule is the best protection the junior members have.

Mr. BASS. We have not been observing it.

Mr. SISK. May I apologize to my colleague for infringing on his time? I am sorry. I had no intention of doing it.

Dr. DRYDEN. We will come back and be available at any time.

Mr. FULTON. I want to make this observation. I want the record to show that I join with Mr. Sisk in his House Joint Resolution 567 to effect immediately the transfer of the Development Operations Division of the Army Ballistic Missiles Agency to the National Aeronautics and Space Administration.

Could I say something to Dr. Dryden? I have been sitting here thinking and I was wondering about your nomenclature. Isn't it possible that the people of the Vandenberg Air Force Base, on their polar orbits, have named this thing Agena because there is a star near the Southern Cross? If they are going to put things into polar orbit, they are probably going to be aiming it at Agena.

Dr. DRYDEN. That may be.

The CHAIRMAN. I don't know. They didn't get the name from the comic strips this time although the spaceship did come from it.

We will adjourn until 2:30 and we will give the junior members latitude in asking questions this afternoon.

(Whereupon, at 12:20 p.m., the committee adjourned, to reconvene at 2:30 p.m., the same day.)

AFTERNOON SESSION

The CHAIRMAN. The committee will come to order.

At the time we recessed, we had just finished with the questioning by Mr. Sisk.

Mr. Bass, we will recognize you now.

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

Dr. Dryden, I believe you testified this morning that the reason why we were behind the Russians today in this space race was because we have not developed a booster as powerful as they have; is that correct?

Dr. Dryden. We are behind in this one element, yes, which has a profound effect upon our whole competitive position.

Mr. Bass. Am I wrong in assuming this is the principal reason?

Dr. Dryden. This is the principal reason. Not the only one, but the principal one.

Mr. Bass. If we had a booster as powerful as they have today, we would not be behind, would we?

Dr. Dryden. We would have to have the things which go with it, but we could do things which we cannot now do and we certainly could put weights in orbit which are comparable to the ones that the Russians have put into orbit.

Mr. Bass. In what other ways are we behind the Russians?

Dr. Dryden. We do not think that there is any other area in which we are particularly behind the Russians. All I meant to say was that you need more than the booster. You need the payload that goes with it and the means of exploiting the booster. It also takes time to get those things built.

Now, we have ample time to do that while the booster is under development.

Mr. Bass. Well, is it not fair to say that if we had a big booster, one as big as that of the Russians, that we would be at least equal to them in this space race?

Dr. Dryden. We think so.

Mr. Bass. Now, in your request for funds for this Saturn project, which is the big booster project, were you cut down at all in your request on this project?

Dr. Dryden. This is a little complicated situation because Saturn was a Department of Defense project. We did not ask for any money for the Saturn project. It was carried in the Department of Defense budget, an item of $140 million for this year.

Mr. Bass. Do you know how that request was handled in the Department of Defense?

Dr. Dryden. I do not know the details. Now, when the budget was submitted by the President to the Congress, an adjustment was made by which that $140 million was added on to the amount which we had requested: in other words, at the stage just before the big budget book came to Congress, an adjustment was made in the Bureau of the Budget between the budgets of the Defense Department and NASA to transfer this $140 million which had been in the Defense budget to the NASA budget, in anticipation of the transfer.

Mr. Bass. Do you know whether the original request was cut down by the Bureau of the Budget or any other agency?

Dr. Dryden. I do not know of my own knowledge.

Mr. Horner. It is my understanding that the $140 million was the amount the Department asked for the Saturn program, within the context of their overall budget, of course.

Mr. Bass. So both you and Mr. Horner, to your best knowledge, understand that this original request was not cut down?

Dr. DRYDEN. The original request of the Defense Department, so far as I know, was not cut.

Mr. BASS. Now, another very high priority project is the Mercury project; is it not?

Dr. DRYDEN. That is correct.

Mr. BASS. If we should be the first to put a man in space, orbiting around the earth, we would largely gain in this race with the Russians; would we not?

Dr. DRYDEN. We regard this as one of the space missions that has a spectacular aspect and popular appeal; yes.

Mr. BASS. Now, Dr. Dryden, how was your original request for funds for this project handled?

Dr. DRYDEN. We originally asked for $103,966,000 and we wound up by allocating $107,750,000 to Mercury.

Mr. BASS. Then you were given $5 million more than you originally requested?

Dr. DRYDEN. You see, the budget is not handled in that way. An overall amount is fixed and we come back with the proposal as to how this would be divided. The analysis of the Mercury program and needs led to the necessity, as we saw it, of putting a few more million dollars in the allocation for the project Mercury.

Mr. BASS. In other words, is it fair to say nobody cut the project?

Dr. DRYDEN. Nobody cut Project Mercury, that is correct.

Mr. BASS. In your opinion, if the Congress approves your fund estimates, would that enable you to go forward in the fastest way possible under the circumstances?

Dr. DRYDEN. That is correct. I think we testified before, we are depending on this $23 million 1960 supplemental in addition to this amount.

Mr. BASS. One other question, Doctor.

I believe you said earlier that the principal reason why we were behind the Russians in this space race was because they started earlier.

Dr. DRYDEN. That is correct.

Mr. BASS. How early did the Russians start?

Dr. DRYDEN. The Russians started—I am afraid I would have to look up the exact date—quite a while before we did. I think about 4 or 5 years, by setting up a commission on what they called the commission on interplantary communication.

They use the word "communication" in the very broad sense.

Mr. BASS. Roughly when was that?

Dr. DRYDEN. It was roughly 1954—I don't recall without looking up the date, and will correct it in the record.

Mr. BASS. Would it be 1954?

Dr. DRYDEN. My recollection is 1954. Mr. Horner's is 1952. My recollection is 4 years—their first formal step was 4 years before our formal step of passing the National Aeronautics and Space Act.

Now, in both countries there was interest of individuals ahead of these dates.

Mr. BASS. Didn't the Russians work rather intensively on a big booster long before 1954?

Dr. DRYDEN. The big booster situation developed as a result of the choices made in the development of the Soviet ICBM. This story has been told many times before. Their atomic bombs weighed considerably more than the ones which we later developed and they went ahead with the design of a very large booster to put this early bomb into their missile.

On the other hand, our first estimates of an ICBM called for the same very large booster and in fact about the same capacity as the present Russian boosters. However, by the time this was crystallized to an urgent program, the nuclear people, the Atomic Energy Commission, had developed bombs of lower weight for the same explosive power so we did not, as we saw it, need the same weight of booster for intercontinental ballistic missiles as was thought when the projects were first started.

Mr. BASS. Thank you, Dr. Dryden.

Mr. Chairman, I see I have used my 5 minutes. I have other questions, but I will withhold them.

The CHAIRMAN. You are not being cut off now because this morning some of the members consumed more than their 5 minutes. Mr. Karth.

Mr. KARTH. Dr. Dryden, the decision to develop the ballistic missile pretty much rested on the so-called breakthrough in the atomic energy field——

Dr. DRYDEN. The decision to give a high priority was certainly based on that. There was a project carried out at a slow rate before that.

Mr. KARTH. Before the breakthrough in the nuclear energy field, didn't most scientists agree that it would be rather difficult to develop a missile of the size and proportions necessary to carry the nuclear bomb as they knew it at that time?

Dr. DRYDEN. I think they felt that this was a very high weight for the result accomplished and the complications of the program were such that they were not enthusiastic about proceeding on a crash basis.

Now, I was not directly associated with these decisions. I don't know whether Mr. Horner cares to add anything or not.

Mr. HORNER. Well, the——

Mr. KARTH. Didn't most of the scientists at that time feel it was unfeasible to develop a missile because of the tremendous weight connected with the atomic bomb?

Mr. HORNER. The ICBM project at the time was a study which indicated that an operational vehicle, using payload weights that seemed to be necessary, and rocket engines that were under development, would probably need as many as 11 separate rocket engines. There were various configurations; 11 in one and 7 in another, as I recall.

This led to an extremely complex system, one in which it was difficult to engender much enthusiasm.

Mr. KARTH. After the 1952–53 breakthrough, there was the first indication at that time that a ballistic missile would be feasible because of the reduction——

Dr. DRYDEN. It was very practical then to get a weapon with three engines that were of the size then existing.

Mr. KARTH. So can we conclude, Doctor, that prior to that time, from a military standpoint, the missile had relatively little significance?

Dr. DRYDEN. At that time, as far as I can recall, there was no real interest in space. Space exploration was not a consideration in determining the size of booster which would be developed by this country.

Mr. KARTH. One other question, Doctor. What, if any, effect is the transfer of the Huntsville group going to have on morale, or did it have, when it was announced it would be transferred from the Army to the NASA? Was there any display of moral differences?

Dr. DRYDEN. To the best of my knowledge there has been some enthusiasm that they will now be free to turn their energies to space, a subject in which they have been interested, and I think some realization that now they will become a major element in the whole national space program.

Mr. KARTH. Does Dr. von Braun share that enthusiasm?

Dr. DRYDEN. I think so. He will be before you in the next 3 days and I suggest that you inquire.

Mr. KARTH. Thank you.

The CHAIRMAN. May I interrupt at this point to tell the members of the committee that we have arranged to have Dr. von Braun here Monday afternoon at 2 o'clock. Since he is coming up from Alabama, we will have everything in shape so we can get promptly to Dr. von Braun and not keep him here any longer than is necessary.

Mr. RIEHLMAN. Doctor, recently the President requested your Administration to make a study of your programs and to advise him as to what was necessary to speed them up.

Dr. DRYDEN. Yes, sir.

Mr. RIEHLMAN. Is that study underway?

Dr. DRYDEN. It is practically completed, but we expect that the results will be before you next week. I mentioned this this morning, sir.

Mr. RIEHLMAN. Has there been anything done in the administration to speed up these projects?

Dr. DRYDEN. One step that has been taken is to authorize overtime on the Saturn project.

Mr. RIEHLMAN. Are there people working overtime on this now?

Dr. DRYDEN. Yes, sir.

Mr. RIEHLMAN. Do you have the funds available to carry that out?

Dr. DRYDEN. The exact financing—that is, what specific appropriation this will come from is not identified at this moment, but we see our way clear on the funds, yes, sir.

Mr. RIEHLMAN. I am happy to know that because we are all vitally interested in that project advancing as fast as it possibly can.

Now, I would like to just make this comment. I followed your presentation this morning and also that of your associate, Mr. Horner, in outlining a very extensive and what I think is a progressive program for the next 10 years.

We all realize that there will have to be some adjustments in these programs as they move forward.

I am hopeful that you, as one of the top directors in the program, will not hesitate to tell this committee your actual position and what the plans are for your administration of these programs.

Now, a great many questions have been asked this morning with respect to the need for additional funds. I for one, want to see that you have every dollar that you need and which you can spend wisely and efficiently to promote this program.

I want to ask you this question. In the administration of your program this past year, up to the present time, in presenting your needs to the top echelon and through the Bureau of the Budget, have you been seriously cut in any respect, or your requests reduced in any major amount?

Dr. DRYDEN. I testified this morning about the amounts which we had requested and we do have the information here, but not in very good form.

I don't know whether the chairman wishes to take time to read this into the record now or let us give you a memorandum later.

The CHAIRMAN. How long is it, Doctor?

Dr. DRYDEN. Well, it is a whole complex of figures.

Mr. RIEHLMAN. Mr. Chairman, for the purpose of saving time, if it is too lengthy, I suggest we put it in the record.

Dr. DRYDEN. The numbers roughly were 957 requested—this is obtained by adding together 783 that NASA requested, plus the $140 million on Saturn, plus $34 million in a supplemental figure.

Mr. RIEHLMAN. What would the overall figure be then?

Dr. DRYDEN. As compared with the 957, we were allocated or allotted $802 million and there is still to come before you the requests resulting from this study for which I gave a "horseback" estimate of the order of $100 million.

Mr. RIEHLMAN. You will be back about to your original request?

Dr. DRYDEN. Certainly somewhere very close to the original request.

The CHAIRMAN. Will the gentleman yield?

Mr. RIEHLMAN. Yes.

The CHAIRMAN. You are $50 million short from the original request, roughly.

Dr. DRYDEN. It depends on the exact number that comes out of this study. I said of the order of $100 million. If it is $125 million or $75 million—I am just giving you a "ballpark" estimate of the order of magnitude.

Mr. RIEHLMAN. Of course, if your study reveals additional expenditures in some of these areas and projects that go beyond what you had in mind in your original estimate, then, of course, you would be short?

Dr. DRYDEN. Yes. I should be accurate about the studies. We have the raw material submitted from Dr. von Braun. We are in process this afternoon of reviewing this in some detail because we have to justify these numbers before your committee and we must get familiar with the background.

Mr. BASS. Will you yield?

Mr. RIEHLMAN. I will yield to Mr. Bass temporarily.

Mr. BASS. Dr. Dryden, the President's budget provides for $140 million for the Saturn's project?

Dr. DRYDEN. That is correct.

Mr. BASS. Just to make sure, I want to ask you and Mr. Horner again, in your opinion is that a sufficient amount for you to go——

Dr. DRYDEN. No; it is not and there is why you are going to get additional requests resulting from this study.

Mr. BASS. Do you know how much?

Dr. DRYDEN. I have said that in the super booster program it will be in the "ballpark" area of another hundred million dollars.

Mr. BASS. In the Saturn project alone?

Dr. DRYDEN. The Saturn, the F-1 engine, and the upper stages needed for use in the Saturn booster. They are programs that will be under the jurisdiction of the Huntsville facility and Dr. von Braun's program.

Mr. BASS. But that amount was not included in the original request?

Dr. DRYDEN. It was not.

Mr. RIEHLMAN. Is there any reason for that?

Dr. DRYDEN. I think the decision and the statement of the President that Saturn was to be accelerated was made in October after the budget material was entered.

Mr. RIEHLMAN. This is because of his request that these additional funds are being asked for?

Dr. DRYDEN. He stated publicly that he was going to accelerate the program and then he addressed a request, directing us to make a study of the additional funds that might be needed.

Mr. RIEHLMAN. Just one other question. As I followed the testimony, Doctor, if we once are able to have the thrust that is necessary to put a large satellite in orbit, we can then expect to use less sophisticated equipment; it will be less expensive for us to build and it will cut down our cost of operating this type of activity.

Dr. DRYDEN. At the present time we have to miniaturize to the extreme and reduce the weight in every possible degree to stay within the capacity of the vehicles we now have.

Mr. REIEHLMAN. That is very expensive, isn't it?

Dr. DRYDEN. It is expensive. I don't want to leave the impression that the payload for the Saturn is going to be inexpensive, because it is not.

Mr. RIEHLMAN. I recognize that, but I have read considerable about it and heard statements that it will be less expensive once we are able to put into orbit the satellite to carry heavy pieces of equipment.

Dr. DRYDEN. Less expensive per pound of payload. If you put it that way, I agree with the statement.

The CHAIRMAN. And more efficient?

Dr. DRYDEN. More reliable. You have to define efficiency.

The CHAIRMAN. Mr. Hechler.

Mr. HECHLER. Dr. Dryden, to summarize what we were saying this morning, you definitely believe we are in a space race with Russia. Is that correct?

Dr. DRYDEN. I have used the word "competition," distinguishing this from a specific event in which the other fellow is halfway down the track already.

Mr. HECHLER. You use two words, "our competitor" in defining Russia, which would indicate that we are certainly in competition?

Dr. DRYDEN. We are in competition over a very broad front. Space is one of those which is very important. We are competing in many other ways.

Mr. HECHLER. In that competition over a broad front, would you say that our international prestige is at stake in relation to what progress we make here in this country in that competition?

Dr. DRYDEN. I think you get a better assessment of this from witnesses you have already heard, those who are feeling the pulse of international public opinion. I have read the testimony of Mr. Allen. This is the judgment of an informed person in this area.

Mr. HECHLER. Well, we on this committee would like to help you as a dedicated official. We want to help your agency. We want to help Dr. York and all others in both the missile and space programs. I think when other officials occasionally say that our international prestige is not at stake, it is not helping you and I would like to see if we can do everything possible to help you.

Dr. DRYDEN. I can answer one within my competence. Our prestige among the scientists of other nations is very high, including the Russians. Among the scientists, for the scientific results of the space program, that is. This is not, of course, very familiar to the average citizen of another country. He isn't much interested in it; he doesn't understand the meaning of measuring more electrons, or Van Allen radiation belts. But you have heard from Mr. Allen of the U.S. Information Agency about the opinions expressed in newspapers and other mediums abroad and he is much more qualified to give an opinion on that than I am.

Mr. HECHLER. Thank you.

Mr. Horner, I would like to ask you one or two questions about your defense of the current administrative arrangements which you so ably set forth at the end of your testimony. I would merely like to raise a question about this sentence at the bottom of page 24 where you say, "When undesirable duplication is identified, it is eliminated."

I would say we certainly deserve to award you some kind of a medal as the all-time administrator in history, if you are able to achieve that.

However, I want to pin this down to a more specific question. It seems to me that the deliberation of committees, coordinating committees, liaison committees and other ad hoc committees, standing committees, sitting committees, reclining committees, has disturbed a number of people in this whole program. This has raised the question of whether an organization such as the Atomic Energy Commission, with a Military Applications Division, would not provide a more clear-cut leadership for the entire space and missile program? I would like to get your direct comment on that.

Mr. HORNER. There was one kind of committee, Mr. Hechler, that you failed to mention and I, perhaps, should have emphasized this morning. Of the committees that you see listed on the chart that I showed, they are almost without exception, working committees. I think this is a very useful method of coordination. It has been very successful in our experience thus far.

In support of my statement here to the effect that undesirable duplication is eliminated, I think we do have some cases that we can set forth, the most notable of which is the cancellation of the Vega program which we felt had become an area of duplication where we could usefully accommodate our requirements within the capabilities of the Agena vehicle which was being developed in the Department of Defense.

With regard to the analogy with the Atomic Energy Commission, I think this is a very difficult analogy to apply to the space business.

The whole area of nuclear development as it applies to the Defense Department has been largely one of weapons where the Atomic

Energy Commission has been given the direct responsibility for development of what you might call the end stages of the weapons systems in the Department of Defense; that is, the final explosive. This is in no way analogous to the situation that we have in space, where there has been a statement in the law, promulgated and passed by the Congress, for the desirability of a peaceful exploration of space for the benefit of all mankind, to be under the management of the civilian agency.

Mr. HECHLER. The progress which is made in the Department of Defense on its military work has a definite relationship and contribution toward our progress in space, does it not?

Mr. HORNER. It has a definite relation. It has in the past shown a tendency to have a positive and a negative relationship. The best example I can think of at the moment is the question we have been discussing here of the Saturn.

In the Department of Defense, as we have pointed out, the Saturn was supported at the rate for this coming fiscal year of $140 million.

Now, it was at that rate, not because this was what the project management stated as a need for the optimum development of the project, but because there was, in fact, no identified military requirement for the Saturn booster; and the management in the Department of Defense felt that was the proper rate at which to support a project that did indeed not meet an immediate military requirement.

Now, we do have a direct requirement for this in space exploration and it is because of this requirement in the space exploration program, that we have gone through this study of the real needs of the program to optimize its developments and as Dr. Dryden has pointed out, we will submit a recommendation to the committee here for augmentation of that program.

Well, that is the kind of an example that illustrates the possibility of a development project in the Department of Defense being influenced in a negative way, as far as the project is concerned.

Mr. HECHLER. What is accomplished in this program depends not alone on what you can do, what Dr. Dryden can do, what the other high officials, in fact, all the employees of your agency can do. It depends also upon an understanding and support by all of the American people.

I think there is a certain frustration among the people. It results in such questions as, "Button, button, who's got the button?" who is in charge here? On top of this comes the statement of the President at his news conference that our international prestige is not particularly at stake.

I think the combination of all these things creates the impression for the American people, the bad impression that we don't have a centralized, clear-cut leadership of this program.

I don't expect you to answer in detail these observations, but I merely wanted to throw them out as perhaps helpful observations which may eventually result, I hope, in more clear-cut leadership in this whole area. This is not meant in a critical way toward the gentlemen who have been testifying here.

Dr. DRYDEN. I think the changes in the legislation submitted were to make it quite clear that we had the "button" as you expressed it, in the area of space exploration, that the military had the button for exploiting the military uses of space, just as early as practicable.

Mr. HECHLER. Then what we really need is leadership at the top.

Mr. Chairman, that is all I have.

The CHAIRMAN. Mr. Chenoweth?

Mr. CHENOWETH. Dr. Dryden, going back to the question Mr. Riehlman asked a moment ago concerning the amount of money the administration is making available for the whole program, I am not quite sure I got your answer correctly.

What has been your position as far as funds are concerned? Have the space efforts been retarded in any way by lack of funds? Is there a failure of Congress to give you the money requested or have you had sufficient funds to carry on your objectives for the immediate future?

Dr. DRYDEN. We asked for funds for the program. We came fairly close. We said if what was given wasn't enough we would be back, and we are back for $23 million in fiscal 1960.

Mr. CHENOWETH. That will take care of you for this fiscal year?

Dr. DRYDEN. That is true.

Mr. CHENOWETH. I understand you are coming in with a request for another $100 million for Saturn.

Dr. DRYDEN. Roughly that order of magnitude.

Mr. CHENOWETH. Then it is reasonable to assume that perhaps during the next fiscal year you may be in at different times with additional requests?

Dr. DRYDEN. All I can say is if we think we need more we will be back.

Mr. CHENOWETH. I hope you do come back. I think it is the sense of Congress that we give you what you need to do this job.

I was anxious to know whether we had succeeded in that in the past. That is why I related myself to the question of Mr. Riehlman.

I wanted to ask you one further question concerning the Russian participation in the space program. I had the year 1948 in mind, in some connection, that that was when the Russians took over some of the German installations.

Dr. DRYDEN. I think that was when they took up the missile program.

Mr. CHENOWETH. What was it in 1948?

Dr. DRYDEN. I think that is when they started V–2's, which they had taken over from the German site at Peenemunde.

Mr. CHENOWETH. From 1948 on, have they been pretty active and diligent in pursuing the program?

Dr. DRYDEN. Very active.

Mr. CHENOWETH. What were the years of 1952 and 1954 that you mentioned a moment ago? What was their significance?

Dr. DRYDEN. This was when they set up at a high level within the government a commission whose duty it was to move ahead in space research and the corresponding action in this country was the passage by Congress of the National Aeronautics and Space Act which set up NASA.

In both countries there was activity among individuals before and activity in the missiles field before this time.

Mr. CHENOWETH. I wanted to make it clear then that the Russians were in before 1952. Would 1948 be the year?

Dr. DRYDEN. Just as we date our interests in space back to the time of Goddard, they date their interests back to the time of Tsiolkovsky.

When R. H. Goddard was working, nobody paid any attention to it. He was the first to use liquid-fuel rockets with the same fuels we are now using. But this was way ahead of the time when this was accepted.

Mr. CHENOWETH. These dates are interesting because there is a great deal of discussion as to just when we started and why we are behind the Russians, if we were.

That is all, Mr. Chairman.

The CHAIRMAN. Mr. Daddario.

Mr. DADDARIO. Mr. Horner, you are very happy, as I understand it, with the cooperation which exists between NASA and the Department of Defense.

Mr. HORNER. I have been quite satisfied with the performance thus far.

Mr. DADDARIO. If that is the case, why has it become necessary to switch the so-called Von Braun team from the Department of Defense to NASA? I can recall when people from your agency came before this committee last year and they were asked this question. They said that everything was going along very well and there was a wonderful spirit of cooperation between them. Yet apparently, because of the fact that that was not so, it has become necessary to make a transfer.

Mr. HORNER. This question, which you are all familiar with, of the transfer of the Von Braun team to NASA did come under very close scrutiny and consideration a year ago this last October or November.

At that time the technical people at the Huntsville agency were working on a program that was approximately 80 percent missiles and 20 percent space work. To transfer the team at that time would have required quite a displacement of project activity and it would certainly have been difficult to assure continuity in all of the very important military programs of the Department of Defense.

As a matter of fact, out of consideration for this very situation, we at that time proposed to take only a limited number of the Von Braun team. However, in the past year this situation has changed markedly. Whereas the work there now is developing to the point where it is more on the order of 80 percent space work, and primarily in the Saturn booster, which has its primary requirement in the space program, and 20 percent and in the very near future, it will still be less, in the missile program.

Now, you see we can take the transfer of the Von Braun team without this serious dislocation problem in the military missile program, and that is fundamentally the reason for the transfer.

It is just a streamlining of administrative procedures. We certainly could use the Von Braun team by contract arrangements through the Army. It is just a reduction of the overhead by having a direct relationship with it, rather than having to go through another agency.

Mr. DADDARIO. If that is the case, why did you ask for the whole Von Braun team in the very first instance? You didn't ask for just part of them in the first instance. It was only after you had had some kind of argument and dispute about it that you were willing to come to this agreement to have them coordinate with you.

Mr. HORNER. No, sir; you are mistaken. We only asked for about 2,200 people in the first instance, plus the contract with the California Institute of Technology, which employs the Jet Propulsion Laboratory.

After careful consideration of this with the Department of Defense, it was decided to only transfer the jet propulsion laboratory contract.

Now, the total number of people who are being transferred this year are more than twice the 2,200 people who were originally asked for.

Mr. DADDARIO. Then is it your statement here that in the very first instance, when you asked for certain of the Von Braun team, that you got all of the team you wanted?

Mr. HORNER. A year ago we didn't get any. There was none of the transfer effected last year.

Mr. DADDARIO. Didn't you ask for a transfer of some of that team?

Mr. HORNER. We asked for consideration of transfer of about 2,200, as I remember. Something less than half.

Mr. DADDARIO. What did you get?

Mr. HORNER. Nothing.

Mr. DADDARIO. Therefore, you did ask for at least some of the Von Braun team and got nothing?

Mr. HORNER. Indeed, we did, and, as I said, after very careful consideration of this problem with the Department of Defense, consideration of the dislocation problems in the military missile programs, we agreed with the Department of Defense that it would be inadvisable to transfer the Von Braun team at that time.

Mr. DADDARIO. It was that simple? There was no particular argument about it?

Mr. HORNER. These things are never simple, but as I said, NASA did agree that it was inappropriate to transfer the team at that time.

Mr. DADDARIO. And when the team was transferred from the Department of Defense to NASA, was that also done with full cooperation and no discussion about it?

Mr. HORNER. We have had very considerable discussion about it, and we have had excellent cooperation from all elements of the Army, from all elements of the Office of the Secretary of Defense, and we have had excellent cooperation from the Von Braun staff in itself.

Mr. DADDARIO. Was it General Medaris' position that the team ought to be transferred to NASA and that it was the time to do it?

Mr. HORNER. Yes, sir; and I think he has so stated.

Mr. DADDARIO. And you had his cooperation?

Mr. HORNER. Yes, sir.

Mr. DADDARIO. We are having General Medaris before this committee sometime, are we not?

The CHAIRMAN. I think so; later on.

Mr. DADDARIO. I direct you to section 309(a), the coordination-cooperation section. Who wrote that?

Mr. HORNER. That section actually was drafted in collaboration with the Department of Defense. It was largely drafted in a working meeting with the officials of the Department of Defense and the current language represents their modification of the joint drafting.

Mr. DADDARIO. You say "their modifications." To whom?

Mr. HORNER. There were certain word changes that were introduced by Department of Defense officials. Since our objective in that particular section was to insure not only the fact of no inhibition to the Department of Defense and their necessary activities in space, but also the appearance of it, we were most happy to take their suggestion as to what they felt was the best language to accomplish that.

Mr. DADDARIO. And then you say the Department of Defense, the Navy, Army, and Air Corps had representatives at the meeting that you have referred to, who participated in the language and presented suggestions for the changes?

Mr. HORNER. At that particular meeting, the representatives from the Department of Defense, I believe, were all from the Office of the Secretary of Defense. As I have mentioned this morning, I believe, at a later time and at the suggestion of the Office of the Secretary of Defense, we talked in some detail with officials of the Air Force because of their interest in the launch vehicle operation, and at still another time we had discussions with the Director of Research and Development for the Army, Mr. Morris, and Assistant Secretary for Research and Development of the Navy, Mr. Wakelin.

Mr. DADDARIO. That is all, Mr. Chairman.

The CHAIRMAN. Mr. Van Pelt.

Mr. VAN PELT. No questions.

The CHAIRMAN. Mr. King.

Mr. KING. Mr. Horner, this morning you devoted some time in your prepared testimony to the delineation of the authority and activities of NASA, vis-a-vis the Department of Defense. You had a chart and went into some detail on that.

I wonder if we might pursue that just a little further. What I want to get into my mind as a layman is a rather clear picture as to where the authority of NASA ends and that of DOD begins, or vice versa, insofar as you find yourself jointly dividing up the general field of space activities.

Specifically, there are many activities in which you have joint interests. I realize DOD is concerned with that aspect of space activity which deals largely with our defense effort, broadly speaking, and that NASA generally is concerned with space, insofar as the field of peaceful exploration of space is concerned, and so on and so on.

Yet there are many areas which obviously overlap. Both NASA and DOD will have joint interest in one missile, perhaps, or they will benefit equally from one particular mission or project, such as navigation projects and space exploration and communications, and so forth.

And there will be many areas of research and investigation which would mutually benefit both NASA and DOD, such as tracking and data reduction operations in which you have joint interests.

So, could you again just briefly clarify in my mind where your line of division is with regard to these areas in which you have joint interests?

Mr. HORNER. Well, I think the things that fall clearly on one side or the other—you have identified very well, Mr. King, the military applications on the military side, the space exploration on the NASA side, together with civil applications. And then this morning I identified three areas of mutual interest. They were the space launch vehicle development and operations, because launch vehicles can be used quite frequently for both military applications and space exploration——

Mr. KING. Are you talking about boosters, your big rockets?

Mr. HORNER. Yes, sir.

Mr. KING. Titan, Atlas, Thor, and Jupiter.

Mr. HORNER. That is correct.

Another area, of course, is all of the background research and development which is of interest to both agencies and useful to both agencies. And then the third area is this area of applications; because, whereas there are a few applications that seem to be uniquely of interest to the military, and of no civil application, there are hardly any applications that one can think of today for civil uses that are not also of use and of interest to the military.

Now, in actually deciding responsibility for who is going to, you might say, be the executive agent for carrying out developments in the applications field, we have sat down with the officials of the Department of Defense—the cases are not very numerous, they are relatively few—and decided on the basis of talents that happened to be in the various laboratories on either side, the inclinations, the relative utility in the military or the civil side and on the basis of this, we decided that, for example, the passive communications satellite, that is currently under development, would be the responsibility of NASA whereas, the active communications satellite is the responsibility of the Department of Defense.

Now, this was influenced by such factors as a very healthy, imaginative group within the NASA that had done quite a bit of work upon erectable structures which is very important to the passive communications.

On the other hand, there had been a very low level of work in the NACA, which represents a large part of the NASA staff, on electronics, and the electronics work had been very largely carried out under the responsibilities of the Department of Defense. So this made the active satellite fit very nicely into the Department of Defense.

Well, you see, it is on the basis of these kinds of determinations that decisions were made as to which responsibility would rest on which side.

Mr. KING. All these historical patterns entered into your decisions and in some cases you have to just arbitrarily allocate to one or the other. Is that right?

Mr. HORNER. It certainly has some appearance of being arbitrary, but in almost every case, there has been good background reason for making the determination one way or the other. And then after the determination is made, we do have working people in both the Department of Defense and in NASA with joint interest in the programs so we are kept immediately up to date on the progress that is made and on possible applications in each area.

Mr. KING. What about, for example, your navigation missions, on which we have had a briefing, I believe, already this week, having primarily military but ultimately tremendous civilian application also?

Mr. HORNER. The Department of Defense has an active navigation satellite development program. We have an interest in it. We have people who work with the Department of Defense, who keep up to date on the activity over there. The determination to put it in the Department of Defense was simply because it was much more important to the Department of Defense or had the appearance of being much more immediately important to the Department of Defense than it did to civilian application.

Mr. KING. When it gets into a larger civilian application, will the military still administer that program?

Mr. HORNER. Well, of course, the navigation satellite is something that is a little bit unique in its own respect, in that the airborne elements that are useful to the Department of Defense will very likely be useful to anybody else who wants to use it also. And so it is entirely possible that in this particular case, the net result will be a navigation satellite that is useful not only to the military, but for civilian applications, too.

There have been some questions as regards security, requirements for tolerances, how closely one must be able to navigate to a given spot on earth, for military versus civil applications, but these kinds of questions can be fairly easily accommodated with rather modest changes in the hardware and we have not yet determined that we will at some point need to have a development of a civil navigation satellite. But under any circumstances we will be able to make great use of the hardware that has been developed in the military program.

Mr. KING. Well, that gets to the heart of my problem. Where a project starts out clearly military, because of certain military exigencies of the moment, but where ultimately its greatest application will be in peaceful fields, rather than those of the military, do you contemplate that there will be a shifting from DOD to NASA?

Mr. HORNER. Assuming the military requirement was real in the first place and was proven to be so by the development, it would be more a case of our peeling off a civil adaptation of the development, rather than shifting responsibility from one agency to the other, because I presume there would continue to be a military requirement.

Mr. KING. I see. We have mentioned navigation. Communications, I imagine, would be really your big field. We have been told in glowing terms just how communications will fit into the future of transmitting radio waves and TV, of course, all over the world.

Now, eventually, will that broad dynamic program be administered by NASA?

Mr. HORNER. If there is a successful communications satellite system resulting from the development programs, I am sure that the military will have a continuing interest in it and we will undoubtedly also have an interest in it. To the extent that any communications system established by the military is not satisfactory for civilian uses, we will take from their developments those hardwares that are needed for a civil system and engineer such a system.

Today there are protagonists for the active satellite system and for the passive satellite system. Frankly, we don't know which is the best system for commercial or industrial applications. It may be a combination of both. And if that appears to be the case, then we will use both.

Dr. DRYDEN. May I make a remark in this connection? In the use of a navigation satellite for civil purposes, there is a very high premium on low cost of the equipment in every ship or other group that wants to use the satellite data. This is not a consideration in the military application of navigation satellites. In military application, if you can get a very high degree of accuracy, you are willing to put a lot more money in the equipment on, say, naval vessels, than would be practical on a system of value to every owner of a small boat, for example.

Mr. BASS. Then you are saying as of now it would have more use to the military than to the civilian?

Dr. DRYDEN. We have no active program. We have some feeling that in the long run that the equipment needed for this will be so small in weight that it can be tacked on, just as an extra load, on some of the other satellites that we fire.

Mr. KING. May I pursue this just a moment further?

You mentioned a minute ago, Mr. Horner, background material, or background research. Do I understand from that that NASA and DOD have worked out between themselves the arrangement that NASA shall take over as its prime responsibility the very, very basic background research for both of them?

Mr. HORNER. Certainly not. No, sir; I am sorry if I left that impression. We are both interested in each others programs. We both have what I might call areas of excellence wherein historically a laboratory has specialized in a particular narrow technical area. The products of laboratories on both sides are useful to both programs. I am sure they will continue to be so.

Mr. KING. Do you collaborate as you go along so each one knows what the other is researching so that you will not find yourself in a position of having two teams working on the same bit of basic research?

Mr. HORNER. We collaborate, but sometimes it is desirable to have two teams or even more than two teams working on a research area. Two teams usually means two different approaches and it is fundamental to research that you don't know what answer you are going to get when you start it, or you shouldn't be doing it.

Mr. KING. That is true, but suppose one team comes up with the answer and the other team doesn't know about it and goes on and wastes a lot of valuable time. Then the collaboration becomes important.

Mr. HORNER. We spend most of our time correcting the communications problem which is always a problem, but the dissemination of information is very important to us and we think we are doing pretty well at it.

Mr. KING. Then there is a certain degree of validity in your arrangement here. It depends upon constant collaboration and working it out as you go along. Is that right?

Dr. DRYDEN. At all levels of the organization.

Mr. KING. Fine. I appreciate that.

May I ask one question of Dr. Dryden about the authorization bill? I notice on the first page, under "A," you have "Salaries and expenses," but no specific figure is mentioned.

Under "B," "Construction and equipment," you do have the specific figure of $89-plus million and that is broken down into 1 through 9. Then you get to "C" on page 3. You have "Research and development" and again no specific figure is mentioned, although Mr. Horner gave us the three figures this morning on the pie chart, showing us the division.

I am curious why the three figures are not specifically mentioned under the A, B, and C categories, respectively.

Mr. HORNER. This is proposed authorization legislation and it was left in that condition specifically because at the time it was submitted we had this study active, which we have discussed earlier, and although we had the numbers that pertained to the $802 million total, we recognized we would want to amend those numbers and thus we left them open at that time.

As Dr. Dryden mentioned this morning, we hope to correct that within the next week.

Mr. KING. Well, then, when this bill is submitted to Congress, those three figures will be inserted. Is that correct?

Mr. HORNER. Yes, sir.

The CHAIRMAN. I think the committee will probably insert them; all right.

Dr. DRYDEN. I think the committee will probably insert them. I might point out that the effect of leaving this open would permit prompt action on supplemental appropriations without the necessity of new authorizations during that year.

Mr. HORNER. Mr. Chairman, if I may I might point out one thing Mr. King has called to our attention and that is the fact that a number was included there on the construction and equipment and that number undoubtedly will be changed.

The CHAIRMAN. When this bill came to me it did not have those figures inserted. The question was whether we would hold them up until we could get the figures, or put in a bill without the figures which could be considered by the committee and later amended.

I think I know what the committee probably would want to do.

May I ask you this, Doctor? Why doesn't the F–1, which is the big engine project for 1½-million-pound thrust, with a single chamber engine, why doesn't it have a top DX priority?

Dr. DRYDEN. Merely because it is further in the future and there is more time available on that. We think it will make satisfactory progress without that if we can get sufficient money into it.

The CHAIRMAN. We are going to wake up some day and find ourselves with the F–1, which is our offset to a larger booster of the Russians, in the same shape we are now in with the big booster that the Russians have and we don't.

Dr. DRYDEN. I don't think we have the knowledge at the moment to proceed with an accelerated program on a Nova vehicle. This is quite a jump beyond the Saturn and it will be either next year or the following year that we will begin the development of a vehicle for the F–1 engine. And the current time scale, with somewhat more funding we hope to get on it, will meet this without the necessity of a DX priority.

The CHAIRMAN. Doctor, didn't NASA actually ask for a DX priority for the F–1 program?

Dr. DRYDEN. I do not recall that we ever did.

The CHAIRMAN. I had some information somewhere that that was requested by NASA. You are sure it was not?

Dr. DRYDEN. It may have been considered at the same time that Mercury was put in for DX priority and, if so, there was no formal request transmitted.

The CHAIRMAN. Why wasn't Saturn considered for peaceful use as well as military use?

Dr. DRYDEN. It was.

The CHAIRMAN. So it has a joint use?

Dr. DRYDEN. That is true.

The CHAIRMAN. Now, all of these programs, it seems to me, have a joint use. Is that not true?

Dr. DRYDEN. They do. The only difference is perhaps in the time scale as to when they will be more urgently needed. We need the Saturn right now.

The CHAIRMAN. As I read H.R. 9675, we would try to decide now which is military and which is peacetime and it seems to me they both have peacetime as well as military application.

Dr. DRYDEN. Which bill are you referring to now, sir?

The CHAIRMAN. H.R. 9675.

If that is the case, we are proceeding to dub one program as a military program. On the other hand, we designate another as a peacetime program, when the program themselves have either use or joint use.

Dr. DRYDEN. I have caught up with you now, Mr. Chairman. You are referring, I think to section 309(b).

The CHAIRMAN. Subsection (b) is one of the subsections, but there are several of them there.

Dr. DRYDEN. This merely provides that the President shall decide which agency shall develop a specific new booster. There is no implication in that selection as to whether it is military or civilian. It is developed for joint use.

The CHAIRMAN. May I respectfully refer you, Doctor, to section 309(a) which says:

> Nothing in this act shall preclude the Department of Defense from undertaking such activities involving the utilization of space as may be necessary for the defense of the United States.

So all through the bill there is the thought that you can separate these projects from peacetime and military uses. I don't believe you can.

Dr. DRYDEN. I think the next section, sir, is a qualification of 309(a). It says that—

> The development of each new launch vehicle, whether intended for use by the Administration or the Department of Defense or both, shall be assigned by the President to either the Administration or the Department of Defense.

I take that to mean that neither the Department of Defense nor NASA can develop a new launch vehicle without the specific assignment of responsibility by the President.

The CHAIRMAN. Well, that gives the President the authority, that is true, to designate the Department; but the idea that is there is that he would make designations of one project to the military department because it is a military proposition, and to NASA because it is peacetime.

Dr. DRYDEN. This was not the idea. The idea was to determine which should be the development agency, regardless of the end use.

The CHAIRMAN. So there is no intent in this bill to try to separate the usage of these projects.

I think it would be bad if we got into this position, as we did, for instance, with TVA. When I came to Congress, TVA was under the jurisdiction of the Armed Services Committee because, originally, it was handled by the Army Engineers and they did a good job in working on it. But as time went on, it had no place in the Armed Services Committee and it was dropped out.

I would think this: If we try to designate the ultimate usages of the projects, we will get into trouble if we designate on that basis.

Dr. DRYDEN. It designates only the developing agency regardless of the use and it is a restriction on both NASA and the Department of Defense insofar as freedom to go into these multihundred-million-dollar projects is concerned for new booster vehicles.

The CHAIRMAN. Any further questions?

Mr. FULTON. Yes.

The CHAIRMAN. Mr. Fulton.

Mr. FULTON. I think the chairman has a good point there. I would add to it by saying I don't think we should attempt ahead of time, by statute, to make jurisdictional distinctions which will not hold up.

I would like to clarify one or two things for Mr. King. I would say the communications projects generally are being assigned from the Advanced Research Projects Agency of the Department of Defense to the Air Force because the Air Force is already working on the Agena–B, the upper level booster if you want to call it that, for the Discoverer, the Samos and the Midas. That was done November 17, 1959.

Then, on the navigational program, Transit, as well as Notus, the communications system, they are intended to be transfered to the Air Force by the end of this fiscal year, before June 30th.

The point I am making is that defining is merely a matter of convenience at this particular time in the development of the programs.

I would like to agree with the chairman thoroughly that it is not a division of jurisdiction.

For example, within ARPA there will still be left programs such as the Shepherd program. There will still be left the Defender program. There will be the basic materials program, Pontus, and you can't by any stretch of the imagination say that is done on a jurisdictional basis.

Or, for example, if you look ahead even to this project Vela for the handling of the atomic explosions surveillance, that is being left under ARPA, but I can see that it could be under some other agency completely, maybe the Atomic Energy Commission.

Dr. DRYDEN. If I understand you, Mr. Fulton, you are saying it is impractical to write into legislative language a split which would have validity as you go down the road?

Mr. FULTON. That is right, and I hope that you people, simply because this project Principia—the development of these solid propellants—is left in ARPA, that you do not think that that is an exclusive jurisdiction in ARPA, but that you likewise should keep on going on boron and various——

Dr. DRYDEN. May I correct one statement I made, Mr. Brooks? I am told we did ask for DX priority on the F–1 engine.

The CHAIRMAN. I thought you had, sir.

Mr. FULTON. Let me say on my last question, do you agree with the general principle the chairman and I are enunciating here that it is not a matter of jurisdiction but it is a matter largely of the best place——

Dr. DRYDEN. To apply the talents.

Mr. FULTON. Yes. It is the best place—at the particular time in the various programs—either to combine them or to put them under one administration because they are allied at a particular juncture. Not that there is a jurisdictional giving up of anything by, let's say either yourselves or the DOD, or the Atomic Energy Commission, or this committee.

Do you agree, Mr. Chairman?

The CHAIRMAN. That is right. I certainly agree fully.

Doctor, may I ask you then, since you say that you did ask for a DX priority for the F-1 project, you were turned down, weren't you?

Mr. HORNER. We raised this question with the Department of Defense about a year ago. I think it was in February. This was the mechanism for initiating discussions both with the Department of Defense, the contractor, and the Department of Commerce.

After a rather extensive analysis, we were persuaded—and we now agree—that a DX priority would not accelerate that project.

It was and is at a point in its development cycle where it does not have large demands for materials that are in short supply, which is the main area of application of a DX priority rating.

The CHAIRMAN. When you made the request though, it was in shape where you could have speeded it up at that time; is that it?

Dr. DRYDEN. This was a debatable point. As I explained earlier, the effect of the DX priority is to put you on the list to get materials which are in short supply at an earlier date. It turned out upon examination of what was required for this engine that there was not very much material in that class.

The CHAIRMAN. In other words, you made a mistake in making the request?

Dr. DRYDEN. It turned out to be unnecessary.

The CHAIRMAN. Are there any further questions?

If not, gentlemen of the committee, we have here Dr. Silverstein, who has a statement prepared and ready for delivery.

Now, is it the pleasure of the committee to take it up this afternoon or take it up in the morning? Would you rather proceed, now, Doctor

Dr. DRYDEN. It will take about 30 minutes, probably.

The CHAIRMAN. I hope you gentlemen on the committee will stay with the chairman now and hear the good doctor because he is a very able scientist.

I don't want his statement wasted here by not having full attendance of the committee.

Mr. DADDARIO. I have the full support of this end.

The CHAIRMAN. Doctor, we will be pleased to hear from you now.

Doctor, just a moment. We are swearing in all the witnesses now and we will ask you, if you will, to raise your right hand.

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

Dr. SILVERSTEIN. I do.

STATEMENT OF DR. ABE SILVERSTEIN, DIRECTOR OF SPACE FLIGHT PROGRAMS, NASA

Mr. Chairman, in testimony before the Congress a year ago, the NASA made a detailed technical presentation of the scope of its proposed space program. At that time we had only existed as an agency for a few months. Much of our discussion, therefore, dealt with future rather than current programs.

We have now had over a year of operating experience. In this period we have made an aggressive start on the space program that we described last year. We have already achieved certain scientific goals. We have clarified other areas so that we can now plan our experiments with greater certainty. In the light of our experience, we have been able to sharpen, and in some cases redefine our objectives.

I should like to take this opportunity to review our space flight attempts and accomplishments during the past year and to indicate to you our plans for the next several years.

During calendar year 1959, the NASA attempted 16 major vehicle launchings for various missions in the space program. This chart lists these launchings in chronological order (fig. 25).

This shows our 16 flights with the successful flights in heavy black and the unsuccessful flights shown in gray. We had, as you can see from the listings in gray, our share of unsuccessful launchings. This.

MAJOR NASA LAUNCHINGS
CY 1959

FEB 17	VANGUARD II	SATELLITE
MAR 3	PIONEER IV	LUNAR PROBE
APRIL 13	VANGUARD	
JUNE 22	VANGUARD	
JULY 16	JUNO II	
AUG 7	EXPLORER VI	SATELLITE
AUG 14	JUNO II	
AUG 21	LITTLE JOE	
SEPT 9	BIG JOE	MERCURY SUBORBITAL
SEPT 18	VANGUARD III	SATELLITE
SEPT 24	ATLAS ABLE	
OCT 4	LITTLE JOE	MERCURY SUBORBITAL
OCT 13	EXPLORER VII	SATELLITE
NOV 4	LITTLE JOE	MERCURY SUBORBITAL
NOV 26	ATLAS ABLE	
DEC 4	LITTLE JOE	MERCURY SUBORBITAL

FIGURE 25

we feel, is to be expected at the present state of the rocket vehicle art. We have in each case been able to determine the probable cause of failure and have taken corrective action in subsequent flights. The ratio of successes to failures has increased as the year progressed, and we have every cause to expect our future flight schedule to show an increasing percentage of successful flights.

Let me review each of our launchings for you.

On February 17, a Vanguard rocket placed a satellite into an elliptical orbit. The launch was completely successful. The instrumentation worked as planned and the data transmitters operated longer than was anticipated. The satellite contained two photocells to measure cloud cover over the earth. A wobble occurred in the satellite spinning motion during the launch, however, so that the interpretation of the data has, thus far, been difficult. Analysis is still underway.

On March 3, a Juno II vehicle launched a conical 13.4-pound payload past the Moon and into a virtually perpetual orbit around the Sun. The payload, known as Pioneer IV, yielded excellent radiation data during the more than 82 hours that it was tracked to a distance of 407,000 miles from the Earth. It now courses through space as a new satellite of the Sun.

In the next 4 months we had no successful launches. Two consecutive Vanguard launchings failed. On April 13, there was a failure during second stage separation. This caused the second stage to tumble and led to an impact of the payload only a few hundred miles off Cape Canaveral. On June 22, a regulator on a helium pressurization line failed. This flight also terminated only a few hundred miles from launch as a result.

On July 16, a Juno II vehicle had to be destroyed only 5½ seconds after launch when there was a failure in the guidance power supply. This was the same type of vehicle that performed so well in the Pioneer IV shot.

The Thor-Able vehicle successfully launched the Explorer VI satellite on August 7. This payload weighed 142 pounds and was placed in a highly elliptical orbit extending to more than 26,000 miles from the Earth. This was the most complex payload yet launched by the United States. Fourteen scientific and technological experiments were conducted in this one mission (fig. 26).

On August 14, we experienced another failure with a June II vehicle. The payload, a 12-foot-diameter inflatable sphere designed to measure air density at extreme altitudes, was plunged into the mid-Atlantic after launch when the altitude control system for the upper stages malfunctioned.

A week later, our first test firing of the Little Joe rocket in support of Project Mercury was aborted when the escape rocket on the capsule mockup fired 30 minutes before scheduled booster launching. The Little Joe booster rocket itself was left undamaged on the pad. The separation rocket malfunction was traced to a wiring error.

A little later during the next presentation—I suppose that will be tomorrow—we will have a movie showing some of the Little Joe firings.

On September 9, a very successful firing was made for the Mercury program when an Atlas booster, known as Big Joe launched a boiler-

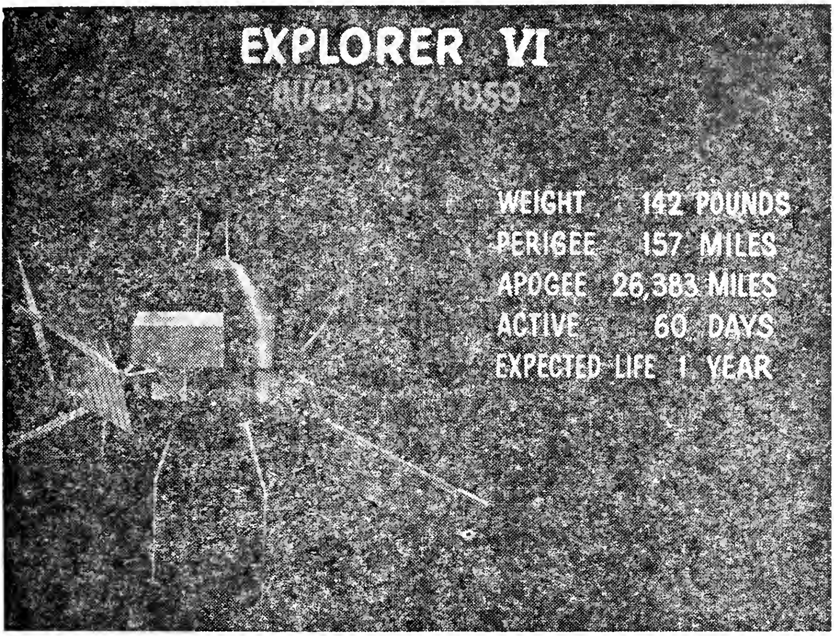

FIGURE 26

plate Mercury capsule into a ballistic trajectory downrange from Cape Canaveral. Although there was some malfunctioning of the booster, thereby exposing the capsule to more severe reentry dynamic conditions than had been planned, the capsule came through with flying colors. So successful was the experiment, in fact, that a second, similar test was eliminated from the Mercury program (fig. 27, p. 246).

On September 18, the last Vanguard rocket, with an alternate third stage solid rocket motor, placed a 50-pound scientific payload into an elliptical orbit. Much valuable scientific information was obtained from the multiple instrumentation. This launching was the third successful launching with the Vanguard vehicle (fig. 28, p. 247).

We were scheduled to make yet another launching during September. An Atlas-Able vehicle was to place a payload in orbit around the Moon, but during a static firing of the booster on September 24 the booster was destroyed by a fire and explosion.

On October 4, the Little Joe booster system for Project Mercury was successfully tested. In this test the rocket was topped by a dummy nonseparating capsule and escape tower. The launching and flight were completely successful in producing the desired information on the integrity of the booster system, including the launcher and the destruct system (fig. 29, p. 248).

On October 13, a Juno II vehicle made another successful launching of a satellite known as Explorer VII. This payload, weighing 91.5 pounds, contained five separate scientific experiments and was a duplicate of the payload that failed to go into orbit during the August 14 launching. The transmitters are powered by solar cells and are still in good active working order. The transmitters will be shut off

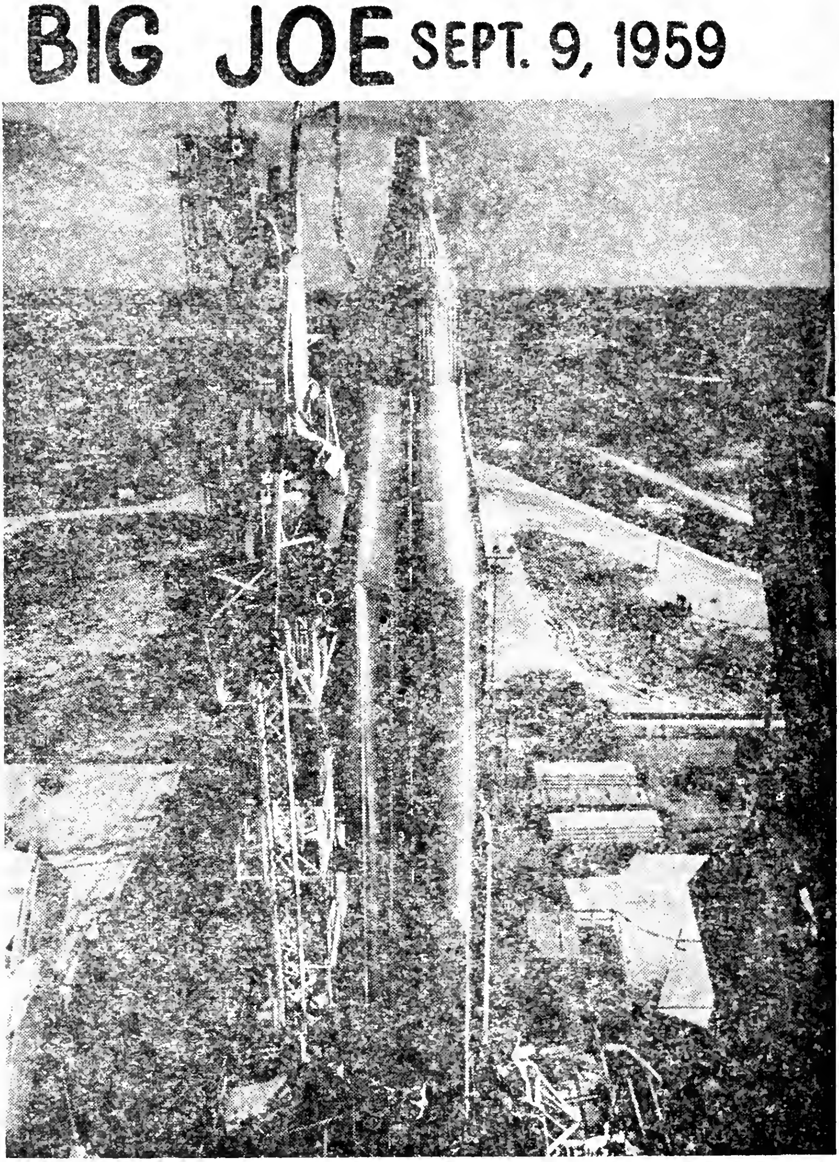

FIGURE 27

after a year of operation, although the satellite is expected to remain aloft for at least 20 years (fig. 30, p. 249).

A second, successful Little Joe firing was accomplished on November 4. It was our objective in this test to evaluate the escape system during a simulated abort at maximum dynamic pressure conditions. The separation of the capsule and recovery was excellent. The capsule was recovered by a Navy fleet tug about 45 minutes after launch. A post-test evaluation indicated that the escape rocket ignition was

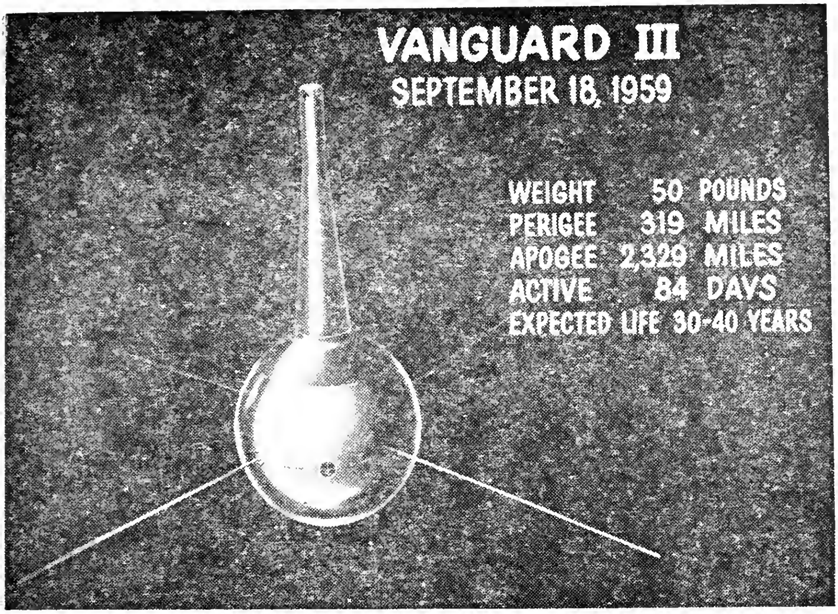

FIGURE 28

delayed a few seconds, so that dynamic pressure at separation had fallen from the anticipate value. Thus, the test, although successful in all other respects, was not as severe as desired. A later successful test was, therefore, made on January 21 to reevaluate this critical point.

On November 26th we suffered a disappointment when a second Atlas-Able lunar orbiter failed during the launch phase. There was no booster difficulty on this flight. Rather it was determined that the fiberglas shield around the payload came off during an early phase of the flight. This led to premature payload separation from the vehicle.

We ended the year with a third successful Little Joe firing on December 4. On this test we planned a simulated abort, or separation of the capsule, at 100,000 feet altitude. This was completely successful. The capsule coasted to 278,000 feet before reentering the atmosphere. It impacted about 177 nautical miles from the launch point at Wallops Island, Va., and was recovered within 1½ hours by a Navy destroyer that was about 25 miles from the impact point at the time of landing. As you probably all know, the capsule contained a biopack with a monkey enclosed. The monkey was in excellent condition upon recovery and still remains so.

The NASA flight record during 1959 shows that we now have underway the start of a sizable, significant space program. You will observe that during the first 6 months of the year we attempted only four launchings, and only two of these were successful. During the last half of the year we increased our tempo to 12 firings, and 7 of these were successful.

I should also like to point out that in addition to the major vehicle launchings shown here, we made seven sounding rocket scientific

FIGURE 29

flights in the last half of 1959, and a number of sounding rocket development flights.

The pace that we have established will accelerate in the near future. This chart summarizes our planned schedule of Earth satellite firings for the next several years. I should like to point out that only major vehicle flights are shown here. The scientific missions will be supplemented by a sounding rocket program that will rise to and level off at a rate of about 100 to 120 firings per year. This will be about the level established during the IGY by the United States (fig. 31).

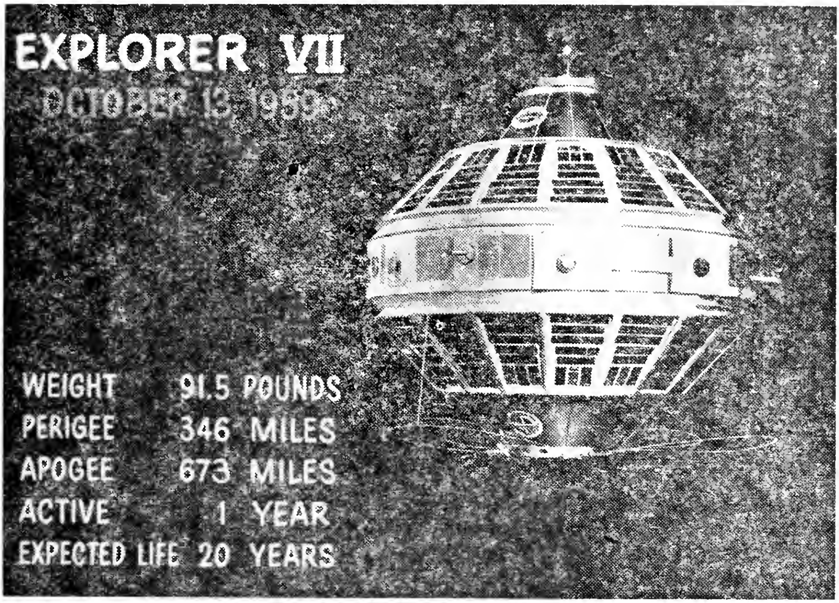

FIGURE 30

EARTH SATELLITE MISSIONS

FY	1960		1961				1962	1963
Q	3	4	1	2	3	4		
JUNO II	S		S	2S				
THOR-ABLE	M							
SCOUT		S	S	S	2S		5S	2S
DELTA		C	M	S	S	C	C 3S	
THOR-AGENA B							2M S	S
ATLAS-AGENA B								C 2S

S-SCIENTIFIC

C-COMMUNICATIONS

M-METEOROLOGICAL

FIGURE 31

During the next year we will complete that part of our scientific satellite program that uses the Juno II launch vehicle. The payloads will all contribute to a further understanding of the energetic particle distributions and of the ionosphere.

The Scout vehicle will also become available during 1960. The initial firings will be primarily concerned with verification of vehicle performance, and hence will carry minimum scientific payloads. As the vehicle development is proven, it will become an increasingly important part of our science program. It will eventually be used in this time period for a number of scientific satellites as well as near-space probe missions.

The Delta vehicle will also become available in the near future. A subsequent witness will present technical performance data on all these vehicles. Suffice it to say at this point that the Delta will give us a satellite capability several times larger than any we have flown to date.

In fiscal year 1962 we expect to add Agena vehicles to our stable of boosters. This was mentioned earlier by Mr. Horner.

The greater capabilities of these vehicles, now under development for Air Force programs, will enable us to incorporate improved instrumentation, both in type and in sensitivity, into our scientific program to give us an increasing insight into the scientific phenomena that are the objectives of this phase of our overall program.

The number of phenomena that we are concerned with is large. Consequently the number and variety of scientific payloads must assume the proportions you see here if we are to obtain a comprehensive understanding of that part of space fairly near the Earth.

We will, in these flights, variously measure atmospheric and ionospheric properties, energetic particle distributions, and magnetic and gravitational field distributions. We already know that some of these phenomena are variable and are affected by a number of external factors such as the Earth's latitude, seasonal changes, solar activity, and so forth.

To evaluate all these factors, it will be necessary to launch our vehicles along various flight paths. Some will be vertical probes to several thousand miles. Some will fly in nearly circular orbits several hundred miles above the Earth; others will be launched on highly eccentric orbits extending as much as 100,000 miles from the Earth at apogee. Some will fly at low angles to the equator, others will be launched in polar paths.

The very nature of the instruments that we fly, further adds to the picture. Certain instruments must operate in a nonmagnetic field and hence cannot be combined with some others that must be made of magnetic materials. Some instruments designed to measure certain phenomena would be saturated and rendered inoperable by very high particle strengths—these cannot be flown in the highly elliptical orbits that pass through the great radiation belt.

When we consider all of these factors and consolidate our findings, we arrive at a scientific satellite program such as shown in the chart.

All of our Earth satellites will not be making purely scientific measurements of the properties of space about the Earth. We shall also be launching a smaller number of satellites in the next several years to directly utilize space for man's benefit.

As you will note, the scientific experiments are in blue. In green are shown the communications experiments and in red, the meteorological.

This spring we shall launch our first payload specifically designed for the acquisition of meteorological data. Known as Tiros, this satellite will be launched by a Thor-Able vehicle (fig. 32).

A second version of the same payload, with additional sensing equipment, will be launched in early fiscal year 1961 using a Delta vehicle. By 1962 it will be possible to launch a more advanced meteorological satellite known as Nimbus. This will contain more instrumentation than Tiros and will be stabilized so that the sensors will point at the earth throughout the flight path (fig. 33).

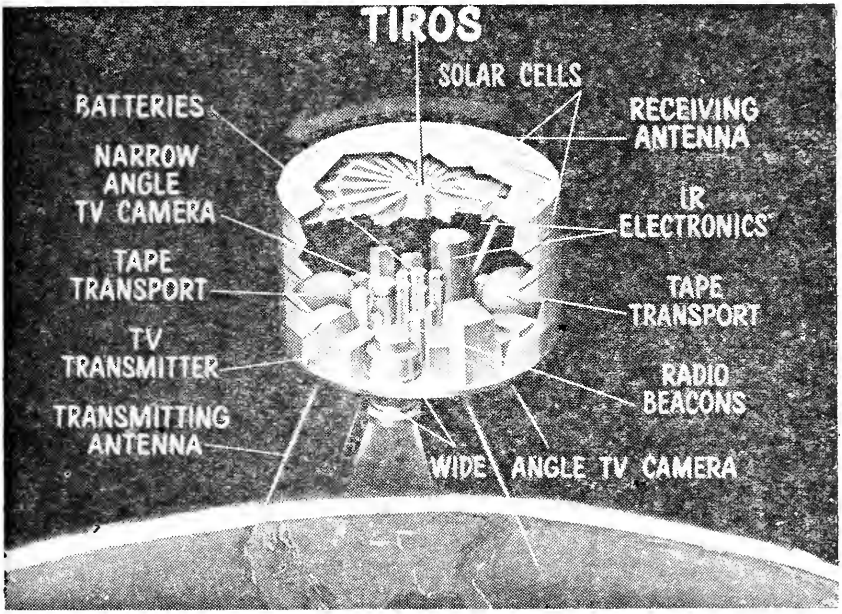

FIGURE 32

Before the end of this fiscal year we will also launch the first of our passive communication experiments known as Project Echo. The very thin aluminum-coated Mylar 100-foot sphere will be used to reflect radio signals from one ground transmitting station to other ground receiving stations. We expect to make a number of such launches to develop the techniques and technologies in this area. We have already made two nonorbital launchings of the spheres from Wallops Island, Va., to evaluate such technical considerations as its separation and inflation (fig. 34).

I should like to caution you that neither the meteorological nor communications experiments in the next several years should be considered as an early approach to an operational system. These are experiments aimed at furthering the science and technology in these areas. Operational systems will come later and only after the problems have been identified and solved.

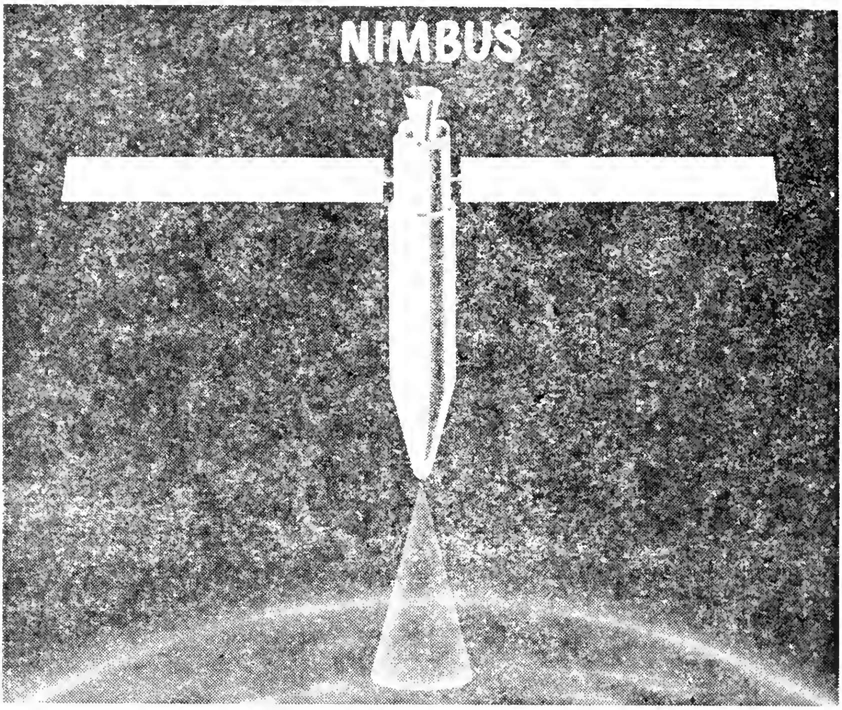

FIGURE 33

FIGURE 34

In addition to our flights near the Earth, we will be engaged in a vigorous lunar and deep-space program in the next several years. The Thor-Able vehicle will shortly be used to launch a probe into space to great distances from the Earth. This probe should extend inward toward the Sun as far as the orbital path of Venus. A number of scientific measurements will be made in the sweep-out path. One of the primary objectives will be an evaluation of long-distance data communication techniques (fig. 35).

LUNAR AND PLANETARY MISSIONS

FY	1960		1961				1962	1963
Q	3	4	1	2	3	4		
THOR-ABLE	I							
DELTA				I				
ATLAS-ABLE			L	L				
ATLAS-AGENA						L	4L	
CENTAUR								2P

L-LUNAR

P-PLANETARY

I-INTERPLANETARY

FIGURE 35

We shall use a Delta vehicle to launch a very sensitive magnetometer and a plasma probe in toward the Sun. In addition to scientific information on the properties of space, this experiment will serve as a developmental test of the new magnetometer that will be incorporated in many later spacecraft.

You will recall that we had two failures in our lunar orbiter program in fiscal year 1959. We plan to make further attempts to launch similar payloads during fiscal year 1961.

Late that fiscal year the Atlas-Agena B vehicle will give us sufficient capacity to make experiments involving closeup TV pictures of the Moon and the placing of scientific instruments on the Moon's surface in working order. This will be a gradually built-up program, starting with technological developments flights of the vehicle and spacecraft (fig. 36, p. 254).

The Earth and the nearby planets, Venus and Mars, attain favorable positions in fiscal year 1963 relative to the Earth for space missions. The Centaur vehicle, having increased

50976—60——17

payload capacity because of the use of a hydrogen upper stage, will be used to launch payloads to the vicinity of these planets at that time, shown by the shots marked 2–P, in 1963.

Our Project Mercury program will continue at the fastest pace possible for such a complex research and development program. In 1960 we will have additional Little Joe flights to evaluate and qualify components. We had the first of these about a week ago. It was highly successful. We will begin longer range Redstone flights in a few months. These Redstone vehicles will also be used to evaluate and qualify components and, at an appropriate time, will introduce man to the experiences of short-duration space flight (fig. 37).

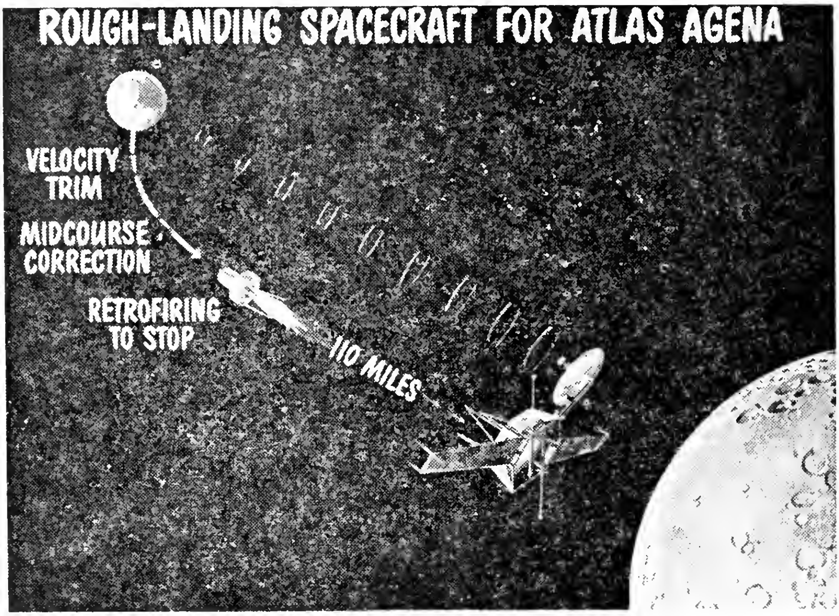

FIGURE 36

I would emphasize that these Redstone flights will not be orbital but will subject the pilot to the launch and reentry dynamics of flight as well as giving a period of weightless flight experience.

Further Atlas flights will be made in the time periods indicated. Some of these will be for technical qualifications of capsule components and for further operational and recovery training. This vehicle will also place man into orbital flight in space around the Earth. I would hope to anticipate your obvious question of when man will make this first orbital flight by simply stating that it will occur at the earliest date that we feel there has been a satisfactory demonstration of the reliability of every element in the whole program.

Among the elements of the program that must be functioning perfectly is our tracking and data acquisition system. Western Electric Co. has been given a prime contract to install the necessary system at a number of places throughout the world. There will be 18 Mercury stations including some ships and a control center at Cape Canaveral. This network is being developed using maximum possible equipment and sites already developed by the military services.

Not only is this tracking net expansion necessary in the conduct of Project Mercury, but other tracking facilities are being expanded or modified as necessary for the conduct of our whole space flight program. A later witness will discuss in some detail the various technical requirements that dictate the need for different data acquisition nets for different missions. Work is underway or has been completed

PROJECT MERCURY

FY	1960		1961				1962
Q	3	4	1	2	3	4	
LITTLE JOE	1	1					
REDSTONE			2	3	2	1	
ATLAS		1	2	2	2	2	5

SUBORBITAL

ORBITAL

FIGURE 37

for all of these stations such as our minitrack network, the optical tracking net, and the deep space net for tracking our lunar and planetary probes.

We at the NASA believe that the space flight program I have outlined is a sound, vigorous program for the exploration of space. We recognize and do not minimize the limitations that are placed on us by the launching vehicle capabilities now available to us. As more advanced vehicles become available, we are increasing and will continue to increase the scope and depth of the space program to the greatest extent possible.

The CHAIRMAN. Thank you, Doctor, for a very detailed and comprehensive statement regarding our launchings.

Will your program as announced here bring us up to date and enable us to catch up with the Russians in their program?

Dr. SILVERSTEIN. There are many aspects of our program that will carry us a long way toward accomplishing this. I think that in the scientific areas the experiments we plan to carry on in all probability will certainly bring us up to the Russians.

The CHAIRMAN. I will ask you this, then. It has been testified that some of NASA's requests for building facilities have been turned down. Will that interfere with the program that you have given us?

Dr. SILVERSTEIN. I think in general the facilities that have been reduced apply to basic research in advanced technology area, rather than the flight area. In the long-distant future, of course, as you move along and need this added technology, you can say that you will reduce your capability.

The CHAIRMAN. In other words, it is not applicable to any one project that you have given us this afternoon, but the discoveries or the developments might be available to all of these projects and to other projects?

Dr. SILVERSTEIN. Yes, sir; that is correct.

The CHAIRMAN. So we just take a chance on that by not having the facility?

Mr. Fulton?

Mr. FULTON. We are glad to have you here, Dr. Silverstein.

Could you have somebody prepare what has been done in the Russian program and what you expect them to do? I realize that the future may not be too clear, but you probably have some idea of their advances.

Could I ask you this. I saw one of the most successful——

The CHAIRMAN. Just a moment. Do you think you could do that, Doctor?

Dr. SILVERSTEIN. It is quite easy to fulfill all his requests with the possible exception of being able to predict very accurately what the Russians will do.

Mr. FULTON. I agree, but just what you may expect.

The CHAIRMAN. Do the best you can.

(The information requested is as follows:)

U.S. AND U.S.S.R. SPACE SCIENCE RESULTS

(By Homer E. Newell, Jr., Assistant Director, Space Sciences, National Aeronautics and Space Administration)

Results obtained

The United States has been using sounding rockets for upper air research and rocket astronomy since the close of World War II. WAC Corporal, V–2, Viking, Aerobee, Aerobee-Hi, Nike-Deacon, Nike-Cajun, Nike-ASP, and Rockoons used. Altitudes attained were below 200 miles for the most part. Many hundreds of rockets were fired prior to the start of the International Geophysical Year; an additional 200 were fired as part of the International Geophysical Year program. Current rate of rocket soundings is somewhat below 100 per year. Higher altitude rockets are being introduced into the work to extend the atmospheric observations to one to several thousands of miles altitude. Launchings have been carried out at White Sands, N. Mex.; Wallops Island, Va.; San Nicolas Island, Calif.; Cape Canaveral, Fla.; Fort Churchill, Canada; Guam, and from shipboard in the North Atlantic, the Mid-Pacific and South Pacific, and the vicinity of Antarctica.

The U.S. program has produced hundreds of research papers and reports giving results on the pressure, temperature, density, winds, and composition of the upper atmosphere, the ionosphere; the earth's magnetic field, the aurora and airglow, cosmic rays, micrometeors, solar radiations, and ultraviolet astronomy. Some experiments have been carried out on modifying the upper atmosphere by the release of special chemicals, and on modifying the radiation belt by nuclear explosions. Some bioscience experiments have been performed.

The U.S.S.R. has also been carrying out a rocket sounding program since the last war. Although the precise number of rocket soundings to date is not known, they number in the hundreds. Firings have been made from Franz Josef Land and from Mirny in Antarctica, as well as from European U.S.S.R. The Soviets have perfected a meteorological sounding rocket that is used for more or less routine soundings of the atmosphere to measure air pressures, densities, and temperatures up to 35 miles altitude. In addition, their "geophysical rocket" is capable of carrying ton and a half payloads up to 300-mile altitudes.

From their sounding rocket program the U.S.S.R. has obtained a broad collection of results. The meteeorological soundings have produced detailed data on the structure of the upper atmosphere just above the troposphere, showing its temporal and seasonal variations. The geophysical rocket program has provided considerable information on the very high atmosphere, including the ionosphere. The description of one of the geophysical rocket payloads is so similar to the description of Sputnik III and its instrumentation as to lead one to conjecture that the payload may have been essentially the Sputnik III payload. Whether or not this is the case, the instrumentation provided for a broad range of measurements on the ionosphere, atmospheric structure, energetic particles, and the earth's magnetic field. The U.S.S.R. rocket program has also include considerable work on biological researches. There have been some 20 tests in which dogs, and/or rabbits were sent aloft and recovered for study. During the flight the behavior of the animals was telemetered to ground.

The U.S.S.R. launched the first successful artificial earth satellite. To date the U.S.S.R. has successfully launched three earth satellites, and three space probes. Two of the space probes achieved earth escape velocity; the first passed within two or three moon diameters of the moon. The second Soviet space probe actually hit the moon. The third space probe was launched so as to pass close enough to the moon to take pictures of the unseen side of the moon's surface, then to loop around the moon returning to the earth. The lunar pictures were successfully obtained.

The United States has to date successfully launched 15 earth satellites; namely 5 Explorers, 3 Vanguards, Project Score, and 6 Discoverers; and 3 space probes, all called Pioneers. Only one of the space probes achieved earth escape velocity, passing by the moon at some 37,000 miles distance.

Both the United States and Soviet satellites and space probes have produced valuable scientific results. Included are some spectacular discoveries and achievements, some of which are given in the accompanying table No. 1. In addition to the more spectacular output, these satellite and space probe flights are turning out a steady flow of information and results that build up gradually to an impressive advancement of mankind's knowledge of the earth and outer space. Some of these are listed in table 2.

Problems being attacked

In attempting to compare the relative stages of advancement of the U.S. and U.S.S.R. in space research, one might proceed by trying to list item by item the individual results from the two programs and to relate these results item to item. This would turn out to be difficult even if one were sure that all the results obtained by the Soviets were actually at hand, for there would be many observations obtained by the Russians that had not yet been obtained by the United States, and conversely, many obtained by the United States that had not yet been obtained by the Russians. A more effective, and perhaps more significant way of comparing the relative stages of advancement, would be to isolate the general areas of investigation and the general problems being attacked by the two countries.

Taking this approach one can say that the U.S. and U.S.S.R. appear to be at about the same stage of advancement in the upper air research. The U.S. results on the atmosphere below 200 miles appear to be more detailed and complete, but the Soviets have made higher altitude measurements by means of their geophysical rocket. The Soviets appear to have done far less than the United States on solar radiations, but the U.S.S.R. has done much more than the United States on bioscience experiments, having conducted numerous flight tests in which dogs were carried aloft in rockets and safely recovered. The U.S.S.R. has carried the technique of ejecting instrumented packages from the rocket carrier farther than has the United States, which has carried the technique of telemetering to a high degree of refinement.

Likewise, the U.S. and U.S.S.R. seem to be at about the same stage of advancement in studies of the earth's environs where satellite techniques are adequate for making the necessary observations. In fact it may be that in this regard the United States has the slight edge. The big advantage the Soviets have in attacking these problems lies in their greater payload capacity. On the other hand, the United States has launched many more satellites than the Soviet Union.

In deep space probe work the U.S.S.R. has definitely taken the lead. This is directly attributable to their clear lead in vehicle technology.

Table 3 provides a comparison of the states of advancement of the U.S. and the U.S.S.R.

A review of table 3 shows fairly clearly that the United States and the U.S.S.R. scientists are at about equal stages of advancement in the problems they are attacking or are about to attack in space research. As groups they undoubtedly have comparable competencies and understandings of the significant problems that ought to be tackled. Their instrumentations are roughly equivalent, although the United States may have a slight edge here, as indicated by the fact that the U.S.S.R. quite often simply copies U.S. equipment for its own instrumentation. The conclusion follows then that the side that has the more advanced technology in the way of payload capabilities, guidance, etc., will have the distinct edge and by virtue of the increased flexibility and capabilities provided by the more advanced technology will force steadily ahead. Thus, one may predict a time lead in vehicle technology will be transformed into a corresponding time lead in the exploration and investigation of outer space.

TABLE 1.—*Significant firsts in sounding rocket, satellite, and space probe research*

UNITED STATES

1. A number of firsts in high altitude rocket research, including among others—
   First detailed photo of solar ultraviolet spectrum.
   First photo of complete tropical storm.
   First penetration of equatorial ionospheric current sheets.
   First detection of X-rays in high atmosphere.
   First detection of auroral particles in high atmosphere.
2. Discovery of the Van Allen Radiation Belt.
3. Discovery that the Van Allen Radiation Belt consists of at least two zones.
4. Performance of the Argus experiments.
5. The first precise geodetic use of artificial earth satellites (Vanguard I) to obtain refined information on the size and shape of the earth, providing an improved value for the flattening and showing that the earth is actually slightly pear shaped.
6. First achievement of an elementary communication satellite, in Score.

U.S.S.R.

1. First artificial earth satellite.
2. First lunar near miss.
3. First lunar impact.
4. First pictures of the hiterto unseen of the moon.
5. First direction of what may be a current ring about the earth (the Chapman Strømer ring).
6. First routine recovery of large animals (dogs and rabbits) from high altitude rocket flights.
7. Development and routine use of meteorological sounding rocket, recoverable and reflyable.
8. First launching of a large animal (Laika) in a satellite of the earth.
9. First high capacity, maneuverable, heavily instrumented, spacecraft with fully Successful long-range communications (Lunik III).

TABLE 2.—*Sounding rocket, satellite, and space probe results*

Field	United States	U.S.S.R
Upper atmosphere	1. Rocket observations have been made of pressure, temperature, density, composition, and winds of the high atmosphere at a wide variety of locations, both day and night, and in the various seasons.	1. Rocket observations have been made of pressure, temperature, density, composition and winds of the high atmosphere at a wide variety of locations, both day and night, and in the various seasons.
	2. Upper air densities have been obtained from the tracking of both U.S. and U.S.S.R. satellites.	2. Upper air densities in the higher latitude regions obtained from drags on Sputniks I and III.
	3. It has been shown that the radiation belt may account for much higher atmospheric temperatures observed in the auroral zone atmosphere than in the high atmosphere above the middle and equatorial regions.	3. High enough flux of low energy electrons measured with Sputnik III instruments in the northern regions to account for the higher atmospheric temperatures there.
	4.	4. Direct measurement of upper air densities made with gages in Sputnik III, for heights up to 355 kilometers.
	5. Fluctuation in satellite drag, hence presumably upper air densities, have been shown, from observations on Vanguard I and Sputnik II, to be directly correlated with fluctuations in the 10 centimeters radiation from the sun, and hence solar activity.	5.
	6.	6. The routine meteorological sounding rocket has been used to give atmospheric structure data at middle-European, Arctic, and Antarctic locations showing seasonal variations as well as geographic. It turns out that the seasonal variations are different for the different altitude ranges.
	7. From both satellite and rocket observations high altitude air densities have been shown to vary widely with time of day, season, and geographic position.	7.
	8. The amounts of diffusive separation both below and above the E region of the ionosphere have been measured in sounding rocket experiments, and shown to be very slight below the E region and quite pronounced above altitudes of 110 to 120 kilometers.	8. Diffusive separation in the upper atmosphere below the E region has been measured with results that agree in general with the U.S. observations.
Ionosphere	1. Extensive electron density data have been obtained for a number of locations from rocket soundings.	1. From rocket soundings electron densities have been obtained up to and above the F region maximum.
	2. From radio signals of both U.S. and U.S.S.R. satellites, propagation characteristics of the ionosphere and electron density distributions have been obtained.	2. Electron densities above 300 kilometers were obtained by observation of the radio signals of Sputniks I and III.
	3.	3. Observations on Sputnik I showed 3.5 times as many electrons above the F region maximum as below.
	4. The heavy ions in the ionosphere above White Sands and Fort Churchill have been identified up to the F region in rocket sounding experiments.	4. The ionic composition of the ionosphere has been measured in sounding rockets to above the F region maximum.
	5.	5. Sputnik III observations showed that the predominant ion from 250 to 950 kilometers is positive atomic oxygen, $O+$.
	6.	6. In Sputnik III the satellite potential in the daytime ionosphere was observed to be as much as -7 volts.
	7. Very low frequency propagation data were obtained from Explorer VI.	7.
	8.	8. In the 2d Lunik, evidence of a lunar ionosphere was obtained.

TABLE 2.—*Sounding rocket, satellite, and space probe results*—Continued

Field	United States	U.S.S.R
Magnetic field	1. Data on earth's magnetic field were obtained from Pioneer I and Explorer VI, and a great deal of additional high-quality data are being obtained from Vanguard III.	1. Data on earth's magnetic field obtained from Sputnik III.
	2. By their magnetic effect, electric current flows were plotted in the E and lower F regions, in rocket sounding experiments in the equatorial regions.	2.
	3. ----------	3. On Mechta measurements were made of the earth's magnetic field and its extension into space. A marked dip in the field was discovered in the region of the radiation belt, indicating perhaps the existence of a current ring such as postulated by Chapman.
	4. Rocket measurements of the earth's magnetic field have been made in the auroral regions.	4.
	5. ----------	5. Lunik II, on its plunge to the surface of moon, showed that the lunar magnetic field is not greater than 50 gamma.
Cosmic rays	1. Extensive data on cosmic ray intensities, composition, and interactions with matter were obtained from sounding rockets in various locations and throughout all the seasons.	1. Cosmic radiation measurements have been made in U.S.S.R. sounding rockets.
	2. The cosmic ray count was obtained above the atmosphere with counters in Explorer satellites and Pioneer probe.	2. The cosmic radiation was measured in Soviet satellites and space probes.
	3. Cosmic ray counts in the first Explorers gave discovery of the radiation belt.	3. Sputnik II observations showed an increase in counting rate with height (this being at the time, an unrecognized hint of the presence of the radiation belt.)
	4. Details on the cosmic radiation as a function of time and position in space have been obtained from Explorer VI, and are being obtained from Explorer VII.	4. Sputnik III and cosmic rockets provided measurements on the heavy nuclei in the cosmic radiation.
Radiation belt	1. Radiation belt discovered with instruments in Explorer I ----------	1. Abnormally high cosmic ray counts were observed in Sputnik II, particularly at the high latitudes. Sputnik III showed a very high electron flux in the northern latitudes.
	2. A great amount of additional detail obtained on belt in Explorers III and IV, and the Pioneer probes. Extent of radiation belt shown by Pioneer I. Pioneer III showed belt to consist of at least 2 zones.	2. Sputnik III, Mechta, and other Soviet satellite and space probe observations confirm the U.S. findings.
	3. Pioneer IV showed the extent of the outer radiation belt to have increased greatly following a 5-day period of high solar activity, thus proving that the outer belt is of solar origin.	3.
	4. Argus experiments showed individual inner zones of the radiation belt to be very stable.	4.
	5. Argus observations lend support to conclusion that inner radiation belt produced by cosmic rays. See No. 7 below.	5.
	6. Detailed energy spectrum of radiation in radiation belt was obtained by Explorer VI.	6.
	7. Sounding rocket observations showed that the energetic particles of the inner radiation belt are protons of energy spectrum expected from β decay of neutrons, hence supports cosmic ray origin for hard components of inner belt.	7.

	8. Extensive additional information on the radiation belt was obtained from Explorer VI and is being obtained from Explorer VII and Vanguard III. Huge variations of many orders of magnitude in counting rates were observed in outer zone.	8.
	9. Radiological hazard of radiation belt estimated to be not serious for a direct traverse of the belt; but quite serious for a space station that spends a lot of time in the belt.	9. Radiological hazard of radiation belt estimated to be not serious for a direct traverse of the belt; but quite serious for a space station that spends a lot of time in the belt.
	10. ----------	10. The moon was shown not to have a radiation belt detectable within the sensitivity of Lunik instruments.
Aurora	1. Rocket soundings have been used to study the electromagnetic and particle radiations in the aurora. It was found that soft radiation flux above 40 kilometers was many times the primary cosmic ray count.	1.
	2. ----------	2. A very high flux of low energy electrons was observed in Sputniks II and III. This flux was taken to be the cause of the very high atmospheric temperature in these regions.
	3. The particles in the outer radiation belt have been shown to be the likely immediate cause of the aurora.	3. The particles in the outer radiation belt have been shown to be the likely immediate cause of the aurora.
Geodesy	1. Vanguard I observations give an oblateness of the earth of 1/298.3	1.
	2. Vanguard I observations show the earth to be pear shaped with a 50-foot peak at the North Pole, and a 50-foot flattening at the South Pole; this appears to imply an internal strength to the earth, rather than a free flowing plasticity.	2.
Meteors	1. A fairly low count of micrometeors corresponding to a total influx of 1,000 to 10,000 tons of material per day, from Explorer and Pioneer observations.	1. Influx of material per day indicated by Sputnik III observations in general agreement with the U.S. results.
	2. A very large amount of additional data are being obtained from the Vanguard III instrumentation.	2. Additional measurements made in Soviet cosmic rocket flights.
Astronomy	1. In sounding rocket experiments ultraviolet sources in the sky have been detected and plotted.	1.
	2. The solar spectrum has been observed and photographed down to 303 angstroms.	2.
	3. Solar radiations have been observed and measured in the X-ray regions.	3.
Lunar explorations	1. ----------	1. First photos taken of the hitherto unseen side of the moon.
	2. ----------	2. The lunar magnetic field shown to be no greater than 50 gamma.
	3. ----------	3. Lunar ionosphere detected.
Miscellaneous experiments.	1. The Argus experiments were carried out	1.
	2. Sodium vapor was released in the high atmosphere and observed to measure its radiations, atmospheric winds, and diffusion.	2. Sodium clouds were released from Luniks II and III and observed from the ground.
	3. Various chemical contaminants were released in the high atmosphere to study the photochemical reactions that resulted.	3.
Biosciences	1. On numerous sounding rocket flights biological specimens of seeds, fruit flies, etc., have been flown and recovered for study. Larger animals, such as rats and monkeys, have been flown for study of their behavior and the effects of the flight environment on them. Recovery of such animals has been effected on numerous occasions.	1. Large numbers of sounding rocket experiments have been carried out with dogs and rabbits, in which the animals were both studied during flight and recovered after flight for further study.
	2. ----------	2. Observations were made on the behavior of Laika, particularly heartbeat and respiration, in Sputnik II.

TABLE 2.—*Sounding rocket, satellite, and space probe results*—Continued

Field	United States	U.S.S.R
Engineering data	1. U.S. satellites show that moderate temperatures can be achieved in orbiting vehicle.	1. U.S.S.R. satellites and space probes show that moderate temperatures can be achieved by appropriate engineering.
	2. Elementary communications link checked out in Project Score.	2.
	3. Based on radiation belt data, it is deduced that satellites may charge to a potential of some hundreds of volts in the radiation belt.	3. Sputnik III measurements show that in the daytime ionosphere the satellite acquired an appreciable negative charge corresponding to a negative potential of several volts.
	4. The meteor erosion and puncture problems have been shown in general to be not particularly serious.	4. The meteor erosion problem appears to be not particularly serious.
	5. An elementary TV scanner was checked out in Explorer VI, while some of the basic elements of a meteorological satellite were checked out in Vanguard II.	5.
	6.	6. Automatic photography of the moon and the televising of the photographs obtained back to earth has been achieved.
	7. Solar cells have been shown to be a practical, reliable source of power.	7. Solar cells have been shown to be a practical, reliable source of power.
	8.	8. A complete spacecraft, maneuverable, with temperature control, power supply, long range communications link, complicated instrumentation, etc., has been engineered and flown successfully—namely, Lunik III.
	9. It appears that the radiological hazard to space vehicle crews traversing the radiation belt directly may be relatively low, while the hazard to those in a satellite orbiting through the radiation belt would be quite serious. In addition, marked increases in proton intensities of the cosmic radiation found at the time of solar activity may be a very serious radiological hazard: dose rates of 1,000 roentgens per hour.	9. It appears that the radiological hazard to space vehicle crews traversing the radiation belt directly may be relatively low, while the hazard to those in a satellite orbiting through the radiation belt would be quite serious.
Meteorology	1. Numerous sounding rocket photos of cloud formations and significant weather areas have been taken. In particular a composite photo from one sounding rocket showed a completely developed tropical storm approaching hurricane proportions.	1.
	2.	2. A meteorological sounding rocket was developed and has been used on a routine basis for meteorological studies.
	3.	3. Detailed measures of pressures and temperatures have been obtained with the meteorological rocket for Antarctic, Arctic, and Middle European locations.
	4. Cloud picture data were obtained in Vanguard I, but motions of the satellite have so far prevented reducing the data to useful pictures. Also, very low resolution, elementary television pictures have been taken of cloud formations as seen from Explorer VI. One of these pictures was assembled and released.	4.

TABLE 3.—*Problems currently under attack*

Field	United States	U.S.S.R.
Upper atmosphere	1. A detailed study of the structure, winds, and composition of the ionospheric regions and beyond in the earth's atmosphere is underway by means of sounding rockets and earth satellites. 2. Work is underway to develop a routine rocket sonde for synoptic studies of the lower portion of the upper atmosphere in association with meteorological soundings.	1. A detailed study of the structure, winds, and composition of the ionospheric regions and beyond in the earth's atmosphere is underway by means of sounding rockets and earth satellites. 2. The U.S.S.R. has already achieved the development of a routine rocket sonde for meteorological-type soundings into the lower portion of the upper atmosphere.
Ionosphere	Intensive rocket and satellite studies of the ionosphere in the F region and beyond are underway.	Intensive rocket and satellite studies of the ionosphere in the F region and beyond are underway.
Magnetic field	The United States has used search coils, saturable core magnetometers, and proton precession magnetometers in its measurements of the earth's magnetic field. The United States is preparing to use a much more sensitive instrument, the alkali vapor resonance magnetometer, for further studies of magnetic fields in space and to measure the magnetic field of the moon.	The U.S.S.R. has also used standard-type magnetometers and proton precession magnetometers for observations of the earth's magnetic field. The U.S.S.R. has made a measurement to detect the lunar magnetic field, finding none to within the sensitivity of their instrument. It is not known whether the U.S.S.R. is preparing to use the alkali vapor magnetometer in the near future.
Cosmic rays	Balloon, sounding rocket, and satellite observations of the intensity, nature, and effect of cosmic rays are underway.	Balloon, sounding rocket, and satellite observations of the intensity, nature, and effect of cosmic rays are underway.
Radiation belt	Detailed study of the radiation belt by means of sounding rockets, satellites, and space probes, with occasional use of controlled experiments is underway.	The U.S.S.R. made intensive studies of the radiation belt in Sputnik III, but at the present time appears to be investigating the belt incidentally as part of their concentration on deeper space missions; namely, on their lunik flights.
Aurora	U.S. scientists are tackling the problem of both visible and ultraviolet auroral radiations, the particles connected with the aurora, and the ultimate origin of the aurora.	The U.S.S.R. scientists are tackling the same problems.
Geodesy and celestial mechanics.	The United States is continuing use of satellites for geodetic studies.	The U.S.S.R. shows skill in applications of celestial mechanics, as witnessed by their ability to launch Lunik III with the accuracy achieved, and to predict the motions of the Lunik III spacecraft.
Meteors	The United States continues to collect data on meteors in space, using a wide variety of experimental equipments.	The U.S.S.R. has made an intensive study of micrometeors in their satellites and space probes, appearing to attack the general problem very much along the lines followed by the United States.
Astronomy	Active rocket astronomy in being. Orbiting telescopes, solar, and astrophysical observatories being worked on.	Unknown.
Lunar exploration	The United States is preparing to conduct intensive investigations of the moon, but the actual observation of the moon from space vehicles is yet to begin.	The U.S.S.R. has already achieved significant steps in its investigation and study of the moon. It may be presumed that the Soviets will continue their vigorous efforts in this area.
Planetary investigations	The United States has minimal capability in this area at present, and on the present schedule planetary work is proceeding at a very slow pace.	The U.S.S.R. has an advanced capability in this area, and has declared its definite interest in planetary research.
Miscellaneous experiments.	The United States is using upper atmosphere regions for controlled chemical and Argus type experiments. Also planning relativity and gravity experiments.	Unknown.
Biosciences and man-in-space.	The United States has a first stage man-in-space program in Project Mercury. Support work of a research type is being carried out in the Discoverer program. Some experimental work is being carried out in sounding rocket flights. A well rounded, fully developed program of research in both biotechnology and biosciences is yet to be worked out.	The U.S.S.R. has a highly active program of research on animals under rocket flight and satellite conditions. It is not known how fully developed their biotechnical and fundamental biosciences programs are. It is expected, particularly from recent news releases, that the U.S.S.R. does have a man-in-space program.

TABLE 3.—*Problems currently under attack*—Continued

Field	United States	U.S.S.R.
Meteorology	The United States is developing rocket photographic techniques for meteorological purposes. The United States is developing a meteorological sonde for synoptic soundings. The United States is conducting fundamental satellite experiments associated with meteorology, and is taking the initial steps in the development of a meteorological satellite system.	The U.S.S.R. has already developed a working meteorological rocket sonde, which they have already put to extensive use. It is not known what the U.S.S.R. is doing in the matter of developing a satellite meteorological system.
Communications	In its rocket, satellite, and space probe telemetry the United States has shown good capability. Long-range communication systems are being worked on for deep space probes. Communication satellite systems are being worked on.	The U.S.S.R. rocket, satellite, and space probe telemetry has been successful. In particular the communications and telemetry problems of Lunik III appear to have been worked out with a high degree of competence. It is not known whether they are developing a communication satellite system, but it may be presumed that they are.
Navigation	The United States is working on a navigation satellite of high degree of refinement.	It is not known whether the U.S.S.R. is devoting effort to a navigation satellite.

Mr. FULTON. I saw one of the most successful launchings of a Russian satellite that I hope I will ever be privileged to see. I was a U.S. delegate at the United Nations 14th General Assembly. Toward the close of the General Assembly there was quite a ceremony in the main foyer of the United Nations Building, when the Soviet Government presented the United Nations with a full-scale model, hanging in the hall, of sputnik. Actually, it is a tremendously beautifully engineered item and it is tremendously effective.

Could I suggest to you that we, either from the Vanguard program or from the Mercury program space capsule, make some sort of a presentation to show that we are at least as interested as they are.

They likewise gave away, for desk use, small gold sputniks, with quite a flair. Now, if we are talking as we have been today about how the world is viewing the United States and Russia in this—well, lets call it competition in space—probably you people should be looking ahead to a public launching at the United Nations which will in some way typify what we are doing and do it in a rather dramatic way.

Had you thought of that?

Dr. SILVERSTEIN. I don't think we thought of this particular method of presenting our program to the world, but I think there is merit to it, and I think we ought to give it consideration.

Mr. FULTON. One other thing I would like to ask you on a particular program. I guess it was the November 24 program where you had the lunar problem with the shroud. What was the failure that caused the shroud to drop off? Was the propellant discharged too quickly so there were too many G's? Was it an unprogramed launch so there was a motion or a torque that it was subjected to? Or was it just failure to compute what kind of a stress or a strain that shroud would have at the time it was attached and planned to be attached?

Dr. SILVERSTEIN. That was a very interesting failure actually. It turned out to be a design failure as you indicated in the last part of your remark.

However, tests had been made in wind tunnels to determine the loading on the shroud. These tests were made two mach numbers, one at 0.90, and one at 1.06. However, the maximum loading on the shroud, associated with the air pressures on the shroud occurred at a mach number between these two values where tests had not been made, so that the actual loading at the time of failure on the shroud was higher than had been designed for and had been anticipated.

Mr. FULTON. It was a mighty discouraging one. A good many members of the committee were there.

As a matter of fact, I had Prince Ali Khan there to see it and he said he did better with horses than you people did with missiles.

The CHAIRMAN. Are there any questions to the right?

Mr. Hechler.

Mr. HECHLER. Doctor, at page 13 you make reference to the man in orbital flight. In the excellent chart of goals which was presented to us, the date was pinned down to 1961. I wondered if, since you are testifying here, I wondered if you cared to elaborate just a little bit and set a possible timespan when this will occur?

Dr. SILVERSTEIN. Yes. I think the two charts that I showed and Mr. Horner showed are the same. I think mine are shown in fiscal years and his are shown in calendar, but there is the hope that this flight will be accomplished during the calendar year 1961.

However, you must recognize, as I have said in my prepared statement, that we don't intend to fly until we have qualified every element in the program.

Mr. HECHLER. I would like to concur with the remarks of my colleague, Mr. Fulton, on the nature of this business.

You would agree that our international prestige is at stake, in relation to our progress in this whole area?

Dr. SILVERSTEIN. I certainly would concur heartily in that statement.

The CHAIRMAN. I would go much further than that and say our security and in fact our survival is at stake.

Mr. HECHLER. There is a particular reason I used that phrase "international prestige." The President said the other day at his news conference that our international prestige was "not particularly" at stake.

Mr. DADDARIO. Dr. Silverstein, I have just one question. Are you satisfied with the program as it is now established and with its ability to do all we should be doing in space?

Dr. SILVERSTEIN. I think myself it is an excellent program. I think I am prejudiced because I have had a rather substantial part in putting it together, so that I think we should ask others, to get an unbiased point of view, but I think it has, from a scientific point of view, and from the mission's point of view and from the man-in-space point of view, good character and an aggressive intent.

Mr. DADDARIO. And how do you feel about the relationship of NASA with the Department of Defense in the field of cooperation and coordination? Do you feel this is being accomplished properly? Do you feel you are getting the right kind of support, or do you believe there may be a certain amount of hindrance which will prevent you from doing what you have said you are doing? Sharpening and redefining your objectives in space?

Dr. SILVERSTEIN. I would like to make a rather special point and say that the cooperation between the Department of Defense and our own agency is very, very fine.

Now, for example, in the Mercury program, the Department of Defense has set up in support of Mercury a special group headed by General Yates who is, as you know, at the head of the Cape Canaveral operation, to support our work in the tracking area and make available to NASA, in this whole program, the full resources of the Department of Defense tracking system.

Also, the Navy, in the Department of Defense support, is providing us full cooperation in the recovery operation of our capsules from the water.

I think that those of us who have worked closely on it and in detail on the program feel that there has been the finest spirit of cooperation throughout the whole program.

Mr. DADDARIO. And when you look at the section involving coordination and cooperation, proposed section 309(a) and all of its features, do you believe that properly establishes the kind of relationship between NASA and the Department of Defense so that it will eliminate the need of having one overall agency in charge of our space program?

Dr. SILVERSTEIN. I think, speaking most generally on your statement, that cooperation is a matter of spirit and intent. I am not sure any organizational system can be set up that will guarantee cooperation, but it eventually rests upon the desire of the individuals who are participating on both sides to get the job done.

Now, I find it difficult to say whether this particular organizational alinement, or another one, might be better, but I feel that in any event the results will depend on the people involved and their desire to get the job done. That is a quite general answer, but I don't think I can be more specific.

Mr. DADDARIO. Well, do you think it might be easier to do this job if, let's say, NASA were put in charge of everything involving space with one person at the top? It would then be dependent, let's say, on the military to propose those projects which fit together with the developments in space as they progress, so that there would be one person deciding where, along the line, there would be this area of cooperation and of effort?

Dr. SILVERSTEIN. I think there are good and bad points on both systems.

When you leave it up to one man or organization or segment you run certain risks. For example, there is the risk that this particular man may not be imaginative enough or may have a particular interest in one area and not in another. If you make it in two areas, on the other hand, you might find some overlapping. I don't think I can really say which might be the better.

Mr. DADDARIO. That is all, Mr. Chairman.

The CHAIRMAN. There being no further questions, I want to thank you, Dr. Dryden, Mr. Horner, and Dr. Silverstein, for the help that you have given our committee.

I appreciate your statements. They are long, detailed, comprehensive, and helpful.

If there is no further business, the committee will stand adjourned until tomorrow morning at 10 o'clock.

(Whereupon, at 4:30 p.m., the committee was adjourned, to reconvene at 10 a.m., Friday, January 29, 1960.)

REVIEW OF THE SPACE PROGRAM

FRIDAY, JANUARY 29, 1960

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

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

The CHAIRMAN. The committee will come to order.

This morning we have Dr. Keith Glennan, Administrator. Dr. Glennan has been out in Detroit and has had trouble getting back. We are glad he is back with us.

The other day, before he left, Dr. Glennan gave the committee a lengthy general statement on the space posture of NASA at this time. This morning it occurs to me that it might be well to dispose of that matter and let's confine our questions at the start to his statement.

Following that, we will then go into the question of the correctness of the NASA in the position it has taken in withholding contracts and documents from the committee. I do that because some of our members are going to be late in arriving on account of a funeral and it seemed to me that that would be the best way to proceed.

We want to finish with Dr. Glennan, however, and we could do it that way.

Mr. QUIGLEY. Mr. Chairman, would it be possible for the members of the committee to have a copy of the statement that Dr. Glennan made Wednesday?

The CHAIRMAN. We will try to supply that. Yesterday, we had good testimony from your assistants who came here to pinch-hit for you. The committee felt we had obtained a lot of information from them.

This morning, I want to open up again the question of whether we are proceeding with this program with the sense of urgency that I think it is entitled to receive.

Now, I do that with the idea that up until yesterday we didn't know that you were actually authorized to use overtime in reference to any contract, regardless of how important that contract might be. What would you say with reference to that?

STATEMENT OF DR. T. KEITH GLENNAN, ADMINISTRATOR, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Dr. GLENNAN. Mr. Chairman, let me first express my appreciation for the indulgence of the committee with my travel problems yesterday. They were a little difficult to say the least.

As to your question, I think it is clear and should be clear that we are pursuing this program with a real sense of urgency. I think when the committee recognizes the magnitude of the task of putting together a hard hitting and very capable organization, while at the same time absorbing and undertaking to complete a substantial number of programs which had been started by ARPA, laying on the kind of a long-range plan which was described to you yesterday, and beginning the development of a family of launch vehicles which ultimately will give us the kind of thrust that we need, all of this in a short 16 months, I believe, since we have been in business, I think there is evidence of a real sense of urgency.

The fact that we have moved from a level in 1959 of $335 million to something more than $800 million in the 1961 period, again, seems to me to indicate that the kind of program we are undertaking is, while broadly based, one that has some very real and very definitive end points, objectives, and that these are being pursued with a real sense of urgency.

The CHAIRMAN. Well, may I say this, Doctor, that the increase in the amount that is being spent by the agency doesn't impress me as much as the results. I would far rather spend less money and get more results. What impresses me is the fact that we don't have the results which I know you and I both want. Up until the last day or two we have not found any need for using any overtime whatsoever.

Now, there is another way to approach that, too. We have the Project Mercury. It now has been given top priority, but why did we wait so long to request DX priority for the Mercury project?

Dr. GLENNAN. Mr. Chairman, if I may, I would like to comment on both of those statements. We have been using overtime consistently on Project Mercury, and Project Mercury has enjoyed the DX priority almost since its inception. I think it was first requested perhaps in January—what was the date of it?

Dr. DRYDEN. November 14, 1958.

Dr. GLENNAN. On April 27 last year, DX priority was assigned. Overtime has been used not only in Project Mercury but in other elements of the program.

I wouldn't want to mislead the committee. I don't think that you would find continuous, 60-hour weeks except on the part of our very top staff, myself, and the rest of the people in Washington.

The CHAIRMAN. We don't want to use overtime unless it will accomplish something because we don't want to throw away any money.

Dr. GLENNAN. In any research and development program there is a methodology of getting a program underway having many facets such as this does, and bringing all of those elements into an end product at a particular time. I believe that that kind of scheduling has been well done.

As a matter of fact, I am very proud of the way in which the Mercury team has conducted their business.

The CHAIRMAN. Now, that being the case, tell me this. How do you account for the fact that you delayed in presenting your request for a priority for the big engine project? That is the 1.5-million-pound-thrust project. When you finally presented it to the space council it was rejected and you withdrew it?

Dr. GLENNAN. For the big engine project, Mr. Chairman, we requested the DX priority in November 1958. This project as initially laid on called for a preliminary flight rating test, 42 months after the date of signing the contract. It is a project which requires relatively small amounts of critical materials as compared with a Mercury project, for instance.

The increase in the number of projects enjoying the Nation's top priority by an over-large number really means degrading all of the projects.

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

The CHAIRMAN. I have been looking over this statement by General Medaris as set forth in the magazine, Missiles and Rockets, and generally in his statement, which I haven't studied very carefully, he says he would abolish the civilian agency and give the space missile job to a joint military command in order that we might get ahead.

In other words, he just comes out and says he would abolish the NASA.

What is the difficulty there?

Dr. GLENNAN. Mr. Brooks, I have not had an opportunity to read this statement. I would appreciate that opportunity and then I will comment on it.

The CHAIRMAN. It reads this way: "Huntsville, Ala.; Major General Medaris, retired, this week made a lashing attack on the administration's space policies and a call for the abolishment of NASA."

That is pretty strong language.

The general raked the military-civilian separation of the U.S. space program as fundamentally unrealistic and called for the creation of a single missile-space agency, a joint military command.

Dr. GLENNAN. Well, the essence of democracy is that people may speak their minds, and I respect the general for speaking his mind on it.

I would rather read his statement, if I may.

The CHAIRMAN. Yesterday your witnesses testified there was very fine cooperation between General Medaris and NASA, and I am just wondering about that in the light of this statement.

Dr. GLENNAN. I would have absolutely no question about the cooperation that has existed between General Medaris, the command at Huntsville, Dr. von Braun and his people, and our own people since the decision was made by the President to recommend the transfer. Since Dr. Dryden has asked for an opportunity to respond to this—I believe he spoke to the point yesterday—I would ask him to speak.

The CHAIRMAN. Dr. Dryden.

Dr. DRYDEN. I have not talked with General Medaris for about a month, but I know his personal statement has been that this transfer to NASA was a good solution under existing circumstances.

On the basis of those personal conversations more than a month ago, I made the statement that I did about the attitude of General Medaris on the transfer of the ABMA group from the Army to NASA. I told you that on the basis of that I thought that General Medaris would testify in approval of the transfer. It seems that I may be wrong. I have not read the statement to which you refer.

The CHAIRMAN. I just quote you one little item more because I don't want to take up too much time with this one thing.

> Here is the fundamental question—

he said.

> We were dragged into this space business from the beginning and we still act that way. We ought to be in this argument, but instead we are still halfway in and halfway out.

In other words, we are not putting our whole heart and effort into the program of the development of space. From a military viewpoint, I think it is most tragic that that is the case.

Dr. DRYDEN. As Dr. Glennan said, in a democracy we speak our minds. There are many people who write or publish letters saying that the whole space business is foolishness. There are other people who say we ought to be spending many times the effort. We, who are responsible for the program, have testified that we have worked out for you a program to be pursued urgently which we think will bring us to an outstanding position in the field of space.

Since such questions cannot be settled specifically by polls, I think we must say that everyone concerned has the right to speak his mind on the subject.

The CHAIRMAN. Mr. Fulton.

Mr. FULTON. We are glad to have you here. I encountered the same difficulty up in Pittsburgh so I know what you were up against in trying to travel.

There has been the comment by a committee of 17 scientists that the Mercury project, the man-in-space, should have its target point postponed 3 to 5 years, meaning downgrading that Mercury project from the highest national priority, the DX priority.

First, do you agree?

Dr. GLENNAN. I do not.

Mr. FULTON. Secondly, because I feel the man-in-space is a necessary and central step in our getting equal with Russia, and also our orderly progression in space, I believe that we must proceed with the Mercury project with all possible expedition. Do you?

Dr. GLENNAN. I certainly do.

Mr. FULTON. Would you please comment on how necessary Project Mercury is in your planning for the United States catching up to Russia?

Dr. GLENNAN. In the development of a hard-hitting space program, as in almost any difficult research and development task, it is very, very important to have particular aspects of the total program brought out as end objectives which in themselves require us to use all the ingenuity and all the genius and all the energy that we have. And in Project Mercury we have just this. It is a personalized project. People are involved. A man is going to ride in this and the workmen who are involved and the engineers and the scientists who are involved know that, and they work with these astronauts, day in and day out.

Mr. FULTON. It is necessary for man's progress in space, that man get into space, isn't it?

Dr. GLENNAN. I think there is no question about that and the earlier we determine the extent to which man can be useful in space, the more meaning the total program will have.

Mr. FULTON. And if it is said that the United States in its space program lags behind Russia, in some aspects, if the advice of these 17 scientists were taken, that we postpone from 3 to 5 years the target for the man-in-space Mercury project, that would mean that we would fall further behind and lag much further behind Russia in our total space program, and in our U.S. security, would it not?

Dr. GLENNAN. I would think that might well be the case. Again I have to say they have the right to speak their minds. I would oppose them solidly.

Mr. FULTON. Your suggestion is strongly to the contrary?

Dr. GLENNAN. Solidly.

Mr. FULTON. Did any of the 17 scientists, in order to make this judgment that occurred on a Sunday, January 24, with the publicity released on January 25, get in touch with you personally to consult with you on the space program and the projected programs for the coming year or so?

Dr. GLENNAN. No; no one got in touch with me personally on that at all, Mr. Fulton.

Mr. FULTON. Did anyone get in touch with Dr. Dryden from this group of 17 scientists?

Dr. DRYDEN. No, sir.

Mr. FULTON. Were they as a group taken through the installations or shown the details of the programs, either public or secret, that you might have in your files?

Dr. DRYDEN. Not to my knowledge, sir.

Mr. FULTON. Dr. Glennan?

Dr. GLENNAN. No.

Mr. FULTON. What they have is based on their own resources and not on those of your agency. Is that correct?

Dr. GLENNAN. As a group, that is correct.

Mr. BASS. Mr. Chairman, point of order. Are we operating under the 5-minute rule?

The CHAIRMAN. I confined myself to the 5-minute rule.

Mr. FULTON. I want to do that.

The CHAIRMAN. We are operating under the rule.

Mr. FULTON. I want to compliment you both in the handling of your agency. I also say to you, remarkably, in spite of the difference of opinion on various levels of certain individuals, this committee has unanimously backed you so far in your space program, as has the House, and we have not seen any reason to change anything in the authorization law.

I want to compliment you.

Dr. GLENNAN. Thank you.

The CHAIRMAN. Mr. Sisk.

Mr. SISK. Dr. Glennan, I have just been quickly trying to review the statement which you gave us the other day. I think all in all it is a very well-put statement. There are a few things that I would like to ask you about.

If you have a copy of your statement there, on the bottom of page 3 and at the top of page 4, you go into some discussion with reference to some of the problems that we have faced in this so-called race which we have discussed. You conclude that paragraph by a comment discussing the time-consuming task of miniaturization, optimum packaging and other weight-saving practices. It is probable, you say, that the availability of high-thrust launch vehicles operates so as to increase the reliability of their flights; referring to our opposition's flights, of course.

Now, to what extent do you feel that more powerful vehicles would tend to give them greater reliability? Do you mean to indicate that miniaturization has decreased capability from the standpoint of guidance and things of that kind? I was a little startled with this statement and I would just like to have you elaborate. Maybe I have misinterpreted.

Dr. GLENNAN. I think I can see the problem here. No, I don't think that miniaturization has operated to decrease the reliability of our launch vehicles. My comment was directed at the time consumed by the necessity for miniaturization.

More powerful vehicles could undoubtedly improve reliability by giving the opportunity for redundancy, the ability to carry redundant circuits and controls in guidance mechanisms as well as in payloads.

During these early months of experiments flown by our Agency with the help of the military services, we have been pushing right up against the margin of the thrust capability of the vehicles available to us. We have not been able, in all instances, to practice redundancy to the extent that we would like.

I think that is in essence the basis of that comment.

Mr. SISK. Fine.

In order to hurry along here, I don't wish to question you specifically about the statements which the chairman has already referred to because I have just briefly reviewed these statements by General Medaris and, of course, he will be appearing before our committee before very long. At that time, I am sure we will be going into these things.

Now, in view of what I understood to be a rather cordial and cooperative relationship going on, with reference to ABMA, I would like your comments, Dr. Glennan, as to how much opposition actually was voiced at the time the President was considering this transfer back in October.

Now, maybe this falls into the category of things you cannot discuss—and here again, I don't wish to get into this argument of Executive privilege. But are you aware or can you comment on whether some real opposition may have occurred in that discussion of the possible transfer, prior to the President's announcement?

Dr. GLENNAN. I think under the rules of evidence, I can only tell you what I, myself, know. I can conjecture a great many things. But in my discussions with General Hinrichs, with General Schomburg, with General Medaris, with Secretary Brucker, with Colonel Guthrie, with people in the Office of the Secretary of Defense and the Director of Research and Engineering, Dr. York, I cannot recall any statements of opposition. I am as certain as I sit here, of course, that there are and would be—of right, ought to be, probably—feelings among people who have spent a great many years in development of an organization of this kind, that they hate to see it go out of the control of the military.

To my certain knowledge, those statements of opposition have not come to me, if they ever were made.

My own knowledge of this is that there was a cordial relationship from start to finish. Secretary Brucker and I, I believe, had three luncheons together discussing the manner in which we could most expeditiously and most effectively make the transfer, sir.

Mr. Sisk. One question in conclusion there—and I asked this question also of Dr. Dryden and Mr. Horner yesterday—as you know, I have introduced this resolution calling for the immediate turnover to NASA of the Huntsville facility in an effort to expedite the situation and to indicate Congress support for pushing ahead in space.

Now, I have been a great supporter of General Medaris and the Von Braun team, as you know, Dr. Glennan. I am curious to know what your position would be on this resolution at the present time insofar as you have knowledge of the resolution.

Are you in a position to say if you think you would favor it? It simply sets forward the date of the turnover.

Dr. Glennan. I would think so, sir. The sooner we get matters of this kind settled, the better able we will be to do a good job of management.

Mr. Sisk. Thank you, Dr. Glennan.

Mr. Chairman, if I might, I have been submitted a list of questions by another member of the committee. In order to save time, if I might just submit this to Dr. Glennan and ask that the answers to these questions be placed in the record.

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

Mr. Sisk. These are questions that were left with me by Congressman Teague and, of course, in view of the limited time, I will submit them to you.

The Chairman. We are somewhat limited as to time this morning because we want to get into the question of executive privilege sometime around 11 o'clock. Some members are at a funeral and I don't think we ought to begin until then.

(The information requested is as follows:)

1. There is apparently some difference of opinion in the administration over whether or not our prestige has suffered internationally as a result of Russia's lead in space. What is your personal opinion on this subject?

Answer. To obtain an evaluation of the impact of Soviet space activities upon our international prestige, we have turned to USIA and the Department of State. We are informed by them that this Nation has suffered some loss of prestige, and may also have lost status with respect to the credibility of our statements in other fields. The Department of State and USIA believe they have been put at a disadvantage in the political and psychological fields because of these developments. I accept their statements as valid.

2. What sort of feat will the United States have to accomplish before it will be generally conceded throughout the world that we have taken the lead in space away from the Russians?

(*a*) How long will it take us to accomplish such a feat?

(*b*) How much will it cost to do it?

Answer. Currently the U.S. program consists of a number of milestone experiments to be conducted in outer space. Any one of them alone, if successful, is capable of helping to establish U.S. leadership in space activities. The U.S. program is a soundly conceived technical program for the exploration of space. The achievement of manned flight, useful communications or meteorological systems, or further outstanding scientific "firsts" like the discovery of the Van Allen radiation belts—any of these could follow from this program and would help to secure overall leadership for this country. Larger boosters will play a vital part in this program as a necessary technical tool.

(*a*) With respect to the length of time necessary for us to arrive at a position where we can compete for leadership I have already said that we hope to have boosters next year which have the capability of matching past Soviet accomplishments. The Saturn project may then enable us to match or excel the vehicle performance of the Soviets will by then have achieved.

(*b*) It is possible that some of the milestone projects mentioned above could be speeded up with additional money. It is certain that more assurance of successfully meeting established dates would result. However, it must be realized that money is not the only important factor. We must depend upon competent manpower and critical material, as well, and these are not available in unlimited quantities. Further, technology cannot be advanced at continually accelerating rate.

3. Information Agency Director George V. Allen said here last week that the next big contest in space would be to see which side got a man up there first. Now:

(*a*) How confident are you that we will do it before the Russians?

(*b*) What would be the world propaganda effect of a Project Mercury launching that failed; specifically, one in which an astronaut was killed?

(*c*) Would the untimely death of an astronaut set back, or otherwise adversely affect, our space program; if so, to what extent?

Answer. (*a*) We cannot be confident that we are going to launch a man into space before the Russians. We know that they are capable through the use of their big boosters, of putting heavy payloads into orbit now. Their extensive biological experimenting would support the idea that they will attempt manned flight at an early date. Also, because of their security measures and possible lesser regard for the individual involved, they can undertake high-risk projects at a much earlier date than we can. Over and above this, however, we do not have a clear indication of what their intentions are in this area. As you know, we are pursuing our program on an urgent basis. It will avail us little if we win in this contest at the expense of the life of the Astronaut.

(*b*) As you know, Project Mercury is being executed on the premise that the astronaut will have the same chance of survival as would a test pilot, say testing the X–15. It must be realized that there is a chance that the astronaut will be lost. On this basis, then we must assume that such a loss could result in propaganda being used adversely against this program. We are, of course, taking every precaution possible to protect the astronaut.

(*c*) It is difficult to say how a failure of a manned-satellite lancling would affect our space program. This would depend somewhat on the nature of the failure and upon the political climate at the time. Technically speaking, an accident might mean delay if the system had to be redesigned significantly. A failure might actually demonstrate the excellence of escape or alternative systems and emphasize the design values of the project.

Many of our aircraft development programs have cost lives without catastrophic program effects. We believe most people understand this.

The CHAIRMAN. Mr. Chenoweth.

Mr. CHENOWETH. Last night I was listening to a very popular TV program and some people lost $2,000 because they could not identify the Mercury program. How can we get the people to be more familiar with these programs?

Dr. GLENNAN. That would probably require a fourth branch of government.

Mr. CHENOWETH. Have we a proper balance between the military and civilian groups in this space picture? Are we devoting the time, money, and attention we should to our military and strategic program and also devoting what you think is sufficient attention to exploring outer space?

Dr. GLENNAN. I can't speak, of course, for the military. They will have to do that for themselves, but it is my personal opinion that the balance reached is a reasonable one.

Mr. CHENOWETH. You feel you have gone as far as you can go in the division of the responsibilities and the funds and the talents and energies we are putting in. Obviously, we can only do so much and you feel we are devoting enough to the military in this picture?

Dr. GLENNAN. Again, that is a question upon which I would have to defer to the military for a really proper answer.

I think the interlacing of these two programs is very considerable at all levels. I think the tasks which the military have set themselves to do to use outer space are significant tasks and they are military tasks. In our program, we continue to use military teams from time to time: the recovery team on Mercury, the launching teams at Canaveral and some of the tracking teams; that sort of thing.

So there is a continued interlacing all along the line. I think the tasks which they undertake for military purposes, they ought to undertake for military purposes. I don't believe we are invading their territory at all. We have come for the last 5 or 6 months into a fine level of agreement.

Mr. CHENOWETH. You don't feel that a project like Mercury is interfering in any way with an orderly normal military program, which is necessary for the defense of this country?

Dr. GLENNAN. No, sir.

Mr. CHENOWETH. You don't feel we are taking anything away from them that they should have, in the way of funds or manpower or engines?

Dr. GLENNAN. No, sir.

Mr. CHENOWETH. There would be a constant conflict between the two, I would imagine.

Dr. GLENNAN. I would suspect so.

Mr. CHENOWETH. But you see no better solution than that which is already worked out?

Dr. GLENNAN. So long as the law of this land calls for us to have a peaceful program for the exploration of outer space, I see no better solution to it and if the law didn't call for it, I think I would be advocating the solution we have presently.

Mr. CHENOWETH. If we have to have one or the other, we would quit the outer space exploration. Do you agree with that?

Dr. GLENNAN. I would do nothing to decrease the military effectiveness of this Nation.

Mr. CHENOWETH. But you see no reason why the two can't go on simultaneously?

Dr. GLENNAN. None whatsoever, sir.

Mr. CHENOWETH. Thank you very much. That is all, Mr. Chairman.

The CHAIRMAN. Mr. Mitchell.

Mr. MITCHELL. Thank you, Mr. Chairman.

General Medaris said the transfer was a good solution to the problem, according to Dr. Dryden and Dr. Glennan.

I don't recall his ever saying that. I think he said it was the only solution because the Army was not getting the money to carry the project on.

Now, I want to ask you, Dr. Glennan, are you really happy with what we are doing in the space effort?

Dr. GLENNAN. Well, when you say "happy," if I might change that a little bit: I am never satisfied. I don't think any of us should be satisfied with any of the jobs that we undertake. I am of the belief that the program which I believe was presented to you yesterday, looking quite a way down the road with some significant objectives, the development of the program which we presently have before you for funding, to move toward those objectives, I think this is a very excellent program. I am satisfied to the extent that, given just a wee bit of luck and the funds we have asked for, I think you will have no reason for regret.

Mr. MITCHELL. I appreciate your statement. I don't know whether it answers the question, Doctor.

Dr. GLENNAN. I meant it to.

Mr. MITCHELL. Now, let us refer to the transfer of the Saturn project. You know there is some concern as far as I personally am concerned, as to whether the transfer should have been made at the time it was. Don't you think that Saturn is going to cost us more money and actually the time element—the productive element—will be delayed as a result of the transfer from the Army?

Dr. GLENNAN. In no way—it is going to be speeded up.

Mr. MITCHELL. Tell me why.

Dr. GLENNAN. Because the Defense Department did not have a military requirement and not having a military requirement, they could not put a DX priority on it as we have done. They could not seek additional funds as we have done and expect to report to you, which will shorten the time by as much as a year. I think everything is working just the way you would want it to work.

Mr. MITCHELL. That is most comforting, if true. Now, the Army has been supporting Saturn without the necessity of contracting; isn't that right?

Dr. GLENNAN. They have been doing a great deal of inhouse operation on the first stage, the booster stage of Saturn. They had not started on the upper stages. They are now starting on the upper stages. Since we have had technical management of this project, we have decided on what those upper stages should be and they are carrying out that work.

May I make a point—this sounds as though they are carrying out that work inhouse and they are not. They couldn't. They don't have the capacity to do it. This is being done by contract with the Von Braun team monitoring—negotiating and monitoring those contracts.

Dr. DRYDEN. The contract for the engines, the contract for a lot of the hardware that goes into it. In fact, as I recall, something on the order of more than 50 percent of the money in the Defense estimate was for contracts outside of ABMA.

Mr. MITCHELL. Of course, this is a matter of opinion. There is certainly a divergence of opinion on this problem, that the Army has been supporting, without the necessity of negotiated contracts, certainly some minute components of the Saturn project.

Mr. GLENNAN. No, sir. What has been done is not a matter of opinion: it is a matter of record. You can have the entire story if you would like us to give it to you.

Mr. MITCHELL. Doctor, are we making the maximum effort insofar as space is concerned?

Dr. GLENNAN. I think we are making a maximum——

Mr. MITCHELL. Before you answer that, is there such a thing as a maximum effort, insofar as space is concerned?

Dr. GLENNAN. I think the only answer to that question is that in a technology as difficult as this, in a research and development program, certain things have to be done before other things can be done. The effort which is being made, while not "crash" in the sense of wasting money, duplicating systems, going down several roads to one end objective, is a maximum effort in the context of all of the other efforts that have to be made by this Nation in its competition with the Soviet Union. So far as space is concerned, this is a determined, very urgent program.

The CHAIRMAN. Mr. Van Pelt——

Mr. VAN PELT. No questions.

The CHAIRMAN. Mr. Quigley.

Mr. QUIGLEY. Mr. Chairman, I will first start with an observation. In answer to the concern of my colleague from Colorado, I would say perhaps that television program of last night did not reflect adversely on the public relations of Dr. Glennan so much as it reflected credit on the committee and other committees of this body. It seems to me this demonstrated that these shows are no longer rigged.

Mr. CHENOWETH. A good observation.

Mr. QUIGLEY. Doctor, I would like to start out by congratulating you on what I think was an excellent statement you made Wednesday as to the overall NASA program.

I frankly regret that you had to make it under what I consider—which I am sure you consider—to be somewhat less than ideal circumstances. I also regret that in glancing over the testimony that you are going to give later this morning, that I am afraid those circumstances are not improving.

I am concerned about this. I think the old, eternal argument of Executive privilege versus congressional prerogatives as has been witnessed for 150 years, will probably be witnessed for another 150 years. I am not interested in having it resolved one way or the other at the moment. I am interested in seeing the vital space program move forward. You may be right in this instance, but I have a feeling that even if you are right, you are wrong.

Dr. GLENNAN. I understand.

Mr. QUIGLEY. I would like to see this whole program not deteriorate into a partisan political issue or into squabbling and quibbling between the two branches of Government. There is a job to be done and I think you and we want to do it.

Frankly, I see tendencies and indications at the start of this 2d session of the 86th Congress and the start of this Congress in a political year that, frankly, disturbs me, worries me, and frightens me.

If your Vice President and my Vice President and your political candidate for high office was anywhere near right last Wednesday night when he said the issue of this campaign is survival, this is not something that can be delayed until a new President takes over next January. We have to take care of it now. Perhaps we should have gotten to it 2 years ago, 5 years ago, or 10 years ago. I think our job, in any event, is to get to it now.

I have one question I want to direct to one paragraph of your statement on Wednesday. On the second page you said this:

> As you know, the President recently directed me to study the possible need for additional funds to accelerate the high thrust launch vehicle program. As soon as this study has been completed we will be requesting substantial additional funds.

May I ask you this: When did the President direct you to make this study on the possible need for additional funds, on what I consider to be the key to this whole thing, the additional high thrust launching vehicles?

Dr. GLENNAN. The actual date I can give you for the record, sir. I don't recall.

(The date referred to is January 14, 1960.)

Dr. GLENNAN. The discussions which led up to this decision on his part have taken place almost continuously, if I may put it that way, since the decision to give the NASA the responsibility for the super-booster program.

You see, prior to this time the Saturn vehicle was a responsibility of the Defense Department and we really did not have management responsibility for it. When that was turned over to us, sir, the technical responsibility was given us—I have forgotten, maybe 6 weeks ago. Since that time we have been attempting to move up the urgency of this program, and the discussions with the President have been many and the results of them are expressed in that letter and will be expressed in money very shortly.

Mr. QUIGLEY. Have you any idea when this study will be completed?

Dr. GLENNAN. I should say within a week, sir.

Mr. QUIGLEY. And will this committee shortly thereafter have your request for additional funds?

Dr. GLENNAN. Yes, sir.

Mr. QUIGLEY. Let me asks you this: One of the disturbing bits of testimony that has come to my attention in this committee was Dr. York's comment that there is a very definite limit on the amount of money we can spend.

One, the old budgetary bugaboo which seems to be an a priori factor. The second one is the fact that even if the Congress were to smother you with funds there is a limited amount of top-grade scientific personnel who could be acquired by Dr. York or by your department to do the job.

Do you share this opinion?

Dr. GLENNAN. I share that opinion in the large, yes. I think regardless of the field, it is possible to provide more money than the field sensibly can use. This is true in the medical profession, it is true in oceanography, it is true in astronomy, whatever the profession may be.

I don't think that we at the moment are at a saturation point in the field in which we are operating. But with his statement, I must agree.

Mr. QUIGLEY. Now, if this is true, and if, as Mr. Dulles, testifying before our committee last week, indicates that currently the Russians have twice as many engineering, scientific, and technical students in school as we do, isn't there a responsibility on the administration and on the Congress to start doing something about a long-range program so that we will have the supply of scientific, technical, and engineering people we need in this obviously long-range program?

Dr. GLENNAN. There is a responsibility on the people of the United States, Mr. Quigley, in this regard, and that responsibility certainly is shared by the administration and by the Congress.

There is a tradition in this country that I hold very dear, since I happen to be on leave from the presidency of Case Institute of Technology in Cleveland, an institution devoted to the education of scientists and engineers and managers in industrial enterprises, that in a free economy we will get better results by the people undertaking this sort of a responsibility themselves, to the greatest extent possible. If they are failing in it, then I think the Central Government has a responsibility.

Mr. QUIGLEY. Wouldn't Dr. York's testimony in which you concur be pretty persuasive evidence that maybe they are failing? Maybe the responsibility has passed to the executive branch and to the legislative branch to start making some detailed, long-range plans to meet this problem.

Dr. GLENNAN. I am not really prepared to agree with that as yet. I think that the activities which have been undertaken in the last 2 or 3 years throughout the educational community are making very real progress. I think it is a situation which ought really to be watched very carefully.

Mr. QUIGLEY. That is all, Mr. Chairman.

The CHAIRMAN. Doctor, before I recognize Mr. Bass, may I ask, will the committee have access to that study in a week when it is finished?

Dr. GLENNAN. Which is this?

The CHAIRMAN. The study you referred to.

Dr. GLENNAN. Mr. von Braun will present this discussion to you.

The CHAIRMAN. He will present the results of the study?

Dr. GLENNAN. Yes. What is required to move Saturn up and develop a better schedule.

The CHAIRMAN. Mr. Bass.

Mr. BASS. No questions.

The CHAIRMAN. Mr. Karth.

Mr. KARTH. No questions.

The CHAIRMAN. Mr. Riehlman.

Mr. RIEHLMAN. Dr. Glennan, with respect to the questioning by Mr. Quigley and with respect to the discussion on the Saturn program, prior to the time that the President suggested to you a further study be made on the progress being made in this field, had you, yourself, after knowing that you had responsibility for the advancement of the Saturn program, done anything to increase the activity in that field in the way of additional time being spent by the people who are really in the construction end of it?

Did I make my question clear?

Dr. GLENNAN. I think not. Is this the matter of overtime?

Mr. RIEHLMAN. What I am interested in is this: Whether you, prior to the time the President recommended this study, had recognized the need to advance this program and had authorized additional work to be done—overtime?

Dr. GLENNAN. No, we had not authorized additional overtime.

Mr. RIEHLMAN. Well, since that time, have you?

Dr. GLENNAN. Yes, of course.

Mr. RIEHLMAN. To a great degree or just a minimum? How far have you gone?

Dr. GLENNAN. The Saturn project under Department of Defense management and Army prosecution had an overall limitation of, I think, 5 percent on the overtime which they spent. We have increased that to 20 percent, which is the amount requested by the managers of the project. We have been conscious of this program right along but have not had financial responsibility to accelerate the program until recently.

Mr. RIEHLMAN. That is why I am asking the question. You were conscious of it and I want to know what your action has been, because I think it is important. People are feeling that we aren't taking this problem as seriously as we should and that your Administration may not be taking it as seriously as it should. I wanted to pinpoint the fact whether you had taken a constructive move in that direction.

Dr. GLENNAN. Mr. Riehlman, if I can just relate these matters. As the President announced his intention to transfer the superbooster program and the Von Braun group to us, we immediately entered into negotiations with Dr. York looking to the taking over, ahead of the transfer, of the technical responsibility for the project.

This, I think, was accomplished perhaps within 2 weeks after the announcement of the President's decision.

Immediately this was done, we set up a committee which included members of the DOD and Huntsville groups and our own staff, to determine on the upper stages for Saturn. After all, Saturn as conceived at the time it was turned over to us was a base booster rocket only. The upper stages had been in discussion and some tentative conclusions had been reached, but NASA went into action to attempt to determine the upper stages and this was done. And I guess the bidders' conferences are being held——

Dr. DRYDEN. They were held 2 days ago.

Dr. GLENNAN. They were held 2 days ago, so that requests for proposals are now in the hands of industry. I believe in perhaps a month we will have the proposals back on the upper stages for Saturn.

So I think that we have really exhibited an energetic approach to this problem.

Mr. RIEHLMAN. That is all I have.

Mr. FULTON. Will you yield?

Mr. RIEHLMAN. Yes; I will yield.

Mr. FULTON. Just as a matter of humor, I would like to say to the Administrator that Dr. Dryden suggested to us yesterday that we use better language than the scientists have used and call it the national launch vehicle program, so I would caution you on the use of the word "superbooster" which we use on this committee.

Dr. GLENNAN. Thank you.

Mr. FULTON. One other thing. I want to put on the record that I would like to join again with my good friend, Mr. Sisk, from California, in urging prompt action on the transfer of ABMA facilities to the NASA and under a very prompt program to move quickly. I also join with Mr. Quigley in saying that I am one of the eager beavers in the space department and if you can tell us how to get ahead faster, please do it.

The CHAIRMAN. I would like to ask the gentlemen this now. I am an eager beaver, too, as far as pushing this is concerned, but do you think we ought to act on the resolution of Mr. Sisk before we hear from the Army? The Army is slated to appear here in a few days.

Mr. RIEHLMAN. I think I still have my time that has not been used and I would like to ask Dr. Glennan this question. I think he gave the answer to Mr. Sisk or someone down the line. Do you feel that if we pass this resolution that has been introduced by Mr. Sisk it will be effective and helpful in carrying out your program?

Dr. GLENNAN. Yes, sir.

The CHAIRMAN. I would like to see what the gentleman from Pennsylvania is going to say. Do you think we ought to judge before we hear from the Army?

Mr. FULTON. I feel that if the order has been given and it is simply a question of timing, then it is a question as to where the most effective result can be obtained. Of course, the receiving agency is NASA and to me they should determine when the administration should be begun.

If you recall at the time we set up NASA we said to you, more or less at the time—and we will conform to it—with statutory authorization. I would compliment the gentleman from California on his alertness and I think this would be helpful.

The CHAIRMAN. I think it would be excellent too, but the question is whether we should do it.

We will take that up later. I don't want to take time away from Mr. Hechler here.

Mr. Hechler, you are recognized.

Mr. HECHLER. Dr. Glennan, I think you have made an outstanding statement here and I think also you and your associates are doing an outstanding job. I was particularly impressed with the clarity with which the goals for the future were set forth. I am also impressed with what you say on page 2 of your statement: "Our competitor in this business is the Soviet Union."

You say that on page 2.

I assume then, of course, that our international prestige is at stake in the space race?

Mr. GLENNAN. Mr. Hechler, I think our international prestige is at stake in every activity of this Nation. There is nothing from murders to Nobel prizes that doesn't have something to do with the international prestige of this Nation today and that isn't being made use of by the Soviet Union in their propaganda activities.

Everything we do is of vital importance in our international relations, in my opinion.

Mr. HECHLER. I remarked after you left the other day that this little argument we got into, this power struggle between the legislative and executive branches—that I was sorry you had to waste your time in such a power struggle instead of devoting your time to the real power struggle which we have with the Soviet Union.

However, I was very deeply impressed by your statement and was somewhat disturbed when I went home and turned on the television set and heard you say that we are not pacing ourselves by the Russians. I believe that was the phrase that you used.

I just wanted to make sure that your considered judgment on this whole question of urgency was expressed in the statement rather than the offhand comment made in the program.

Dr. GLENNAN. Semantics being what they are, it is very difficult, really, without writing out a statement, to be sure that it will not be misunderstood or taken out of context.

Mr. HECHLER. I would like also—had you finished, Dr. Glennan?

Dr. GLENNAN. I hadn't, but I would be glad to chop off there, if you wish.

I don't recall the statement. It was probably something on the radio, but what I am sure I was saying is that, in a race, as one thinks of a race, there are two people on a track. They are running one against the other and they are going over the same obstacles. They must overcome the same difficulties one after the other. If one is behind the other—that is the kind of a trap I don't think we should fall into. I think we have an obligation to the American people to decide for ourselves as a Nation what we ought to be doing in this and then pursue it very, very diligently and very, very urgently and that, sir, is what I think we are doing.

I think in the long run this must win the competition. That is why I don't like the term "race," because this has a connotation that just doesn't seem to me to make sense in this business.

Mr. HECHLER. What you do, what your associates do, and what those in the Department of Defense do on the missile program and the space related activities is not the whole story. It is what the American people understand about the program and are willing to lend in the way of support to that program. It seems to me that they don't have the clear-cut understanding which you have so well expressed here.

Dr. GLENNAN. I am very disturbed about this same thing as a matter of fact.

Mr. HECHLER. I would like to ask one further question. You made reference to some of the activities in the private scientific and university community.

What is your assessment of the importance of and the adequacy of our educational system in relation to the progress we are making in the space program? How important is it that we have a good educational system in this country—both secondary and higher education?

Dr. GLENNAN. In a democracy I think the most important activity in which we can engage is that of education. Unless we have a really well educated electorate, we don't have a responsible government.

Mr. HECHLER. This is one thing to which witnesses before this committee always respond when I question them. Yet I would be happier if those officials responsible for missile and space matters would stress the vital importance of education in determining the future progress of this Nation. I personally feel that I don't want to vote any money for the space program until we have an adequate aid to education bill passed in this Congress.

The CHAIRMAN. Mr. Daddario.

Mr. DADDARIO. Dr. Glennan, a year ago when there was discussion about the transfer of the missile team to NASA and it was decided it would not be transferred at that time, you said that you believed that the missile position of the country was more important than space. Do you still believe so?

Dr. GLENNAN. Yes, sir.

Mr. Daddario, may I say the defense of the Nation is more important than space. I think I would have wanted to put it that way if I didn't because I don't narrow our defense down to just the missile business.

Mr. DADDARIO. Then what has occurred in this whole effort which would now change that so that the decision which prompted the retaining of the missile team under the Department of Defense last year would now bring us to the point where that same missile team would be transferred to you, taking into consideration that you then felt that the decision was a correct one because of the fact that missiles were more important than space?

Dr. GLENNAN. Mr. Daddario, a year has passed. A year ago the Secretary of Defense and the Secretary of the Army made the direct statement that the Von Braun team was necessary in the missile program of the United States.

This year a good portion apparently of the work upon which they were engaged has been brought to completion. The Jupiter is really phasing out apparently, in that it has been delivered in the quantities required. I believe the test program is completed for the Jupiter and certainly the same must be true of the Redstone which is already deployed.

The requirements for the work of that group at Huntsville in the missile program were going downhill very rapidly and when this became apparent in the Defense Department, they asked of our continued interest in this program, in that team, and, of course, we have a continued interest and we are just delighted to have them as part of our organization.

I think it is the difference in the workload on that team in Huntsville. The missile workload.

Mr. DADDARIO. Last year you said these boosters of varying capabilities are necessary for both civilian and military space programs. NASA undertook the depelopment of DOD in a military program aimed at correcting the program as soon as humanly possible and you were talking about the overall booster situation.

Frankly, I would prefer more of this being under a civilian agency. I wonder if you believe that now that this missile team is being transferred to you that you will continue and be able to have the proper type of coordination and cooperation so that the military needs can be also taken care of within the development of your own program insofar as the booster systems are concerned?

Dr. GLENNAN. I have no question of that, Mr. Daddario.

Mr. DADDARIO. And you believe it is a step in the right direction and you approve of what has been done to this time?

Dr. GLENNAN. I believe so.

Mr. DADDARIO. You feel we could have been further along the road had it been done a year ago when you requested it?

Dr. GLENNAN. Personally, I do.

Mr. DADDARIO. That is all, Mr. Chairman.

The CHAIRMAN. Mr. King?

Mr. KING. Dr. Glennan, I should like to pursue this matter of education just a step further because of your rich background in education. I think you are qualified to answer although you were not called here specifically on that subject. I realize that.

We have received testimony in this committee, and I believe the facts are undisputed and are pretty generally known throughout the country, that for the next 2 years the actual number of scientists and engineers graduated in our country will actually go down. Then in about 2 years the line reverses itself and starts on the upturn so that in about 5 years our rate of increase in scientists and engineers will be about the same as Russia, although we will be trailing Russia very substantially.

In other words, our line is climbing at the same rate as their line, but their line is many inches above ours on the graph, which means that even according to the most optimistic estimates, we will not catch up with the Russians within the foreseeable future. We will be trailing them.

Now, it's your testimony and everyone's testimony that education and space progress are so closely intermeshed that it is hard to separate one from the other.

If all that be true, doesn't that suggest that our country definitely needs an infusion of some sort into its educational system to enable us to close that gap?

As things are now, I can't see how we will ever close the gap and I am very concerned about it.

Dr. Glennan. Mr. King, I think there is no need for this Nation to get into a numbers race with Russia in this particular field. We do train our people very much more broadly, I believe. I made a trip there myself and talked with a good many of the people in higher education, 18 or 20 months ago. I believe we train our people very much more broadly than they do. They turn out larger numbers of very highly trained specialists than we do. We need to turn out more, but I don't think it is a matter of catching up in the sense of numbers alone.

The things that have been done in the last 5 years in this Nation to improve the quality of the educational offerings, I think, are beginning to bear fruit at the present time; just beginning to bear fruit.

I do believe that there must be a real effort made to increase the number of youngsters who will find satisfaction in careers in science and engineering. I think again this effort is being made although the fruits from that effort are much further down the line because one starts in the upper reaches of the secondary schools and in the high schools to encourage that kind of an interest.

Now, in the meantime, I think we do have a problem. We have a problem of the utilization of people who, being well trained, I think, can be better utilized than they presently are. If you want to talk about a gap in this Nation, I think there is a gap in numbers at present of well trained people of special talents.

Mr. King. Dr. Glennan, don't you believe, however, that some of the lack of proper stimulation in the field of science is due to inadequate local school budgets? In other words, in the day school, junior high and high school level, many schools could do a better job in stimulating interest in basic science if they had larger budgets, better trained teachers and better equipment on that level?

Dr. Glennan. I don't think there is any question of it. It seems clear that we did let ourselves fall into a condition of lack of real concern for the quality of our teaching staffs. We fail to recognize the pace, the rate at which the developments in science and technology were accelerated. We fail to recognize this and translate it back far enough into our educational system. To catch up on that is a real task. It is being done very much with the aid of the Federal Government, as you may know, through the National Science Foundation's support of summer institutes for the—call it retreading or upgrading of the teachers of high school science.

My own institution has participated in these programs. I think our proudest alumni are the high school teachers who have spent summers on our campus in this way.

I think we are making progress, but not fast enough.

Mr. KING. Just one final question: Do you not feel, in the light of all that has been said, that if we could increase the number of competent graduates in these technical fields, that that in itself would enable us to accelerate our space program?

Dr. GLENNAN. I think there is no question about that.

Mr. KING. Thank you.

The CHAIRMAN. Mr. Roush.

Mr. ROUSH. Mr. Chairman and Dr. Glennan, first let me say that I especially appreciated the remarks of my colleague, Mr. Quigley. I don't entirely share his views because I think it is necessary for us to be quite critical at times. As I look at my own program as a Congressman, I find that I am strongest in those areas where I am criticized. I think the real reason this additional money is being requested for Project Saturn is because of public opinion and because of the criticism which has come to that program.

Now, in that light, I would like to ask just a couple of questions: First of all, Project Saturn should have had the emphasis, which you now give it, some time ago, should it not, Dr. Glennan?

Dr. GLENNAN. The easy answer to that, Mr. Roush, is "Yes." I do not feel it incumbent upon me to criticize someone else in this area. I think that it does take time to develop the best avenue along which to move with urgency to attain an end objective. I think that during the course of the last year there has been enough exploration and argument about this to have the program rather solidly set down. It might well have gone off in several directions had we not taken this time of gestation.

My own feeling is that the program really has not been set back particularly by the delay in coming to this decision.

Mr. ROUSH. Dr. Glennan, when was it that we first realized the reason the Russians were ahead of us was because they had achieved a greater thrust in rocket propulsion and were capable of putting larger payloads into orbit?

Dr. GLENNAN. I think almost from the beginning.

Mr. ROUSH. Do you mean when they first launched their sputnik?

Dr. GLENNAN. Yes; because as I recall, that weighed 184 pounds.

Mr. ROUSH. In just a few months they had one going over a thousand pounds.

Dr. GLENNAN. That is correct.

Mr. ROUSH. When was it we first made the decision to go ahead with Project Saturn?

Dr. GLENNAN. I would have to supply that date to you. I don't recall it.

Mr. ROUSH. Would 20 or 21 months ago be about right?

Dr. GLENNAN. I would think so. Something of that sort.

(The information requested is as follows:)

Under order of the Advanced Research Projects Agency No. 14–59, the Army Ballistic Missile Agency was instructed to initiate a development program to provide a large space vehicle booster of approximately 1.5 million pounds thrust based on a cluster of available rocket engines. This program is now referred to as Project Saturn. The date of this order was August 15, 1958.

Mr. ROUSH. In an interim period between October 4, 1957, and this period which would have fallen approximately April 1958, did we have any sort of a large-booster program going?

Dr. GLENNAN. A large booster of course, is the end objective of the F-1 engine program and as I recall it within a month after we declared ourselves in business, we moved directly to the F-1 engine. Prior to that, the Air Force had had study contracts looking to the development of a large engine.

In December 1958, we undertook to call together—NASA—all elements interested in this booster program to develop a national booster program out of which came the program we presently have.

Mr. ROUSH. You say that was in the first part of 1958?

Dr. GLENNAN. That was in December 1958.

Mr. ROUSH. This F-1 engine you are speaking of is one that has now been canceled?

Dr. GLENNAN. No; there is a whole family.

Mr. ROUSH. Now, back to the other side, Mr. Quigley's side of this for a moment. We have spoken of more money in order to enhance our program and speed up our program. There are other areas where we can also make improvements, I believe, Dr. Glennan. You spoke of getting more topnotch scientists and people into the program. What is keeping these people out?

Dr. GLENNAN. Well, for the most part the amount of money that we can pay them.

Mr. ROUSH. Then, if we pay these people more money, we could get them in our program and it would help speed it up. Is that correct, sir?

Dr. GLENNAN. I would think that this would be the result.

Mr. ROUSH. Are we also slowed down by administrative processes? The reason I say that, I heard Admiral Rickover, whom we like to quote once in a while. He said, "I believe the real contest we are in with Russia is one between two bureaucracies."

Dr. GLENNAN. He is perfectly right.

Mr. ROUSH. The administrative processes we have to go through then slow this program down. Is that correct, sir?

Dr. GLENNAN. They can't help but do this. But, after all, we have to be responsible for what we are doing. You don't chop off our heads in this Nation when we fail or make an error. I think we attempt to learn by our mistakes and the only way one can learn by mistake is to have administrative processes. They may be unduly complicated at times, but I personally would be quite happy to say to you that the actions of this committee and other committees of the Congress have been helpful to me.

Mr. ROUSH. Well, we hope they continue to be helpful. That is our whole intention, I am sure. Now, have you recommended more money to hire more scientists?

Dr. GLENNAN. Yes, sir.

Mr. ROUSH. Is that included in your budget this year?

Dr. GLENNAN. Yes, sir.

Mr. ROUSH. Is that one of the recommendations that was turned down?

Dr. GLENNAN. That is included in our budget this year.

Mr. ROUSH. Have you recommended the increasing of the pay scale?

Dr. GLENNAN. No; we have not.

The CHAIRMAN. May I say this to the gentlemen on the committee, that our program for 11 o'clock—it is a little after 11 now—is to take up the matter of Executive privilege so as to save Dr. Glennan the necessity of coming back.

At this time, I think we should proceed with the matter of Executive privilege. It is the first chance we have had to question Dr. Glennan in reference to that.

Do you have a general statement, Doctor?

Mr. FULTON. Mr. Chairman.

The CHAIRMAN. Mr. Fulton.

Mr. FULTON. In order to give them notice, either for Dr. Glennan later, or for future hearing, could I just have a second to give some notice here?

I would like to have more of your propellant and your propulsion programs.

Dr. DRYDEN. This is coming, Mr. Fulton.

Mr. FULTON. And especially the ionic plasma and boron programs.

Dr. GLENNAN. That is coming. May I attempt to put a statement in the record about this matter of continuing to use the inhouse competence, ABMA? This is being done fully. They will be doing as much or more than they were before. It is just a fact that they cannot take on this very much enlarged program with their inhouse people.

The CHAIRMAN. If there is no objection, you can file that.

Dr. GLENNAN. I will write to Mr. Mitchell.

(The information referred to is as follows:)

EXTENT OF IN-HOUSE PARTICIPATION OF THE DEVELOPMENT OPERATIONS DIVISION OF THE ARMY BALLISTIC MISSILE AGENCY ON THE SATURN PROJECT

The in-house effort of the Development Operations Division of the Army Ballistic Missile Agency has not, in terms of research and development funding, exceeded 32 percent for the Saturn project. Below are approximate figures for fiscal year 1959 and 1960 which span the Saturn project funding period under the Department of Defense.

Department of Defense Saturn funding breakdown—Funds expended

[Dollars in millions]

	Amount	Percent
Fiscal year 1959:		
In-house ABMA	$8.0	22
External Government agencies	1.5	4
Industrial contracts	18.5	50
Corps of Engineers, U.S. Army	9.0	24
Total	37.0	100
Fiscal year 1960:		
In-house ABMA	22.0	32
Industrial contracts	39.0	57
Corps of Engineers, U.S. Army	8.0	11
Total	69.0	100

The budget for 1961 provides $81 million for basic in-house research and development effort at Huntsville. An additional $134 million is estimated to flow through Huntsville for major industrial contracts associated with developing the Saturn vehicle. The Huntsville establishment will, in the case of these contracts, have an industrial contractor supervision and technical monitoring function to perform.

The CHAIRMAN. We will now proceed with the matter of Executive privilege.

(Whereupon, at 11:25 a.m., the committee proceeded to further business.)

REVIEW OF THE SPACE PROGRAM

MONDAY, FEBRUARY 1, 1960

House of Representatives,
Committee on Science and Astronautics,
Washington, D.C.

The committee met at 10:45 a.m., Hon. Overton Brooks (chairman) presiding.

The Chairman. The committee will come to order.

It had been our plan to take up Resolution 567, sponsored by Mr. Sisk. Since adjournment, we have contacted the Army to see whether the Army wanted to send witnesses here for that program. I understand the Secretary of the Army wants to come here to talk about the resolution, Mr. Sisk.

It so happens that he will be before the Senate tomorrow, but my thought is, after Dr. von Braun finishes his testimony, we can go into executive session and take up this resolution. We can hear the witnesses from NASA who wish to be heard and, if it is not possible for the Secretary of the Army to be here tomorrow, we can leave the matter open until the following day when he will give us his views about H.R. 567.

If there is no objection, that is the order that we will follow.

Now, this morning, do we have the other witnesses from NASA? I could swear them all in at the same time.

If you two gentlemen will stand up and hold up your right hand. Do you and each of you solemnly swear that the testimony you will give before this committee in matters now under consideration will be the truth, the whole truth, and nothing but the truth, so help you God?

Mr. Finger. I do.

Mr. Abbott. I do.

The Chairman. Who is the first witness from NASA?

Mr. Horner. Our first witness this morning is Mr. Abbott, the director of the advanced research programs. He has a prepared statement on the research programs of NASA?

The Chairman. We are happy to have you here this morning. I saw you Saturday at a panel discussion and I am glad to have you here again this morning.

You have a prepared statement. Will you proceed with the statement, sir?

STATEMENT OF IRA H. ABBOTT, DIRECTOR OF ADVANCED RESEARCH PROGRAMS, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION; ACCOMPANIED BY RICHARD E. HORNER, ASSOCIATE ADMINISTRATOR

Mr. Abbott. Thank you, Mr. Chairman and members of the committee.

I want to talk to you about NASA's advanced research activities. It is through these activities that we provide the research information needed to permit the development of the new advanced vehicles that will be required as our Nation's space program progresses. I use the terminology "advanced research" to encompass the following activities (fig. 38).

ADVANCED RESEARCH

1. CONDUCT OBJECTIVE RESEARCH

2. GENERATE NEW FLIGHT CONCEPTS

3. PROVIDE ASSISTANCE IN APPLICATIONS

FIGURE 38

First, the conduct of objective research to provide the technical background necessary for manned and unmanned exploration and use of space;

Second, the use of our research findings as a basis to generate new and advanced concepts for future space missions;

Third, to provide research assistance to assure the prompt and effective application of the research results by NASA, by the Department of Defense, and others.

NASA research is performed by our research centers and also through research grants and contracts with universities and other organizations.

You are, of course, familiar with the fact that the NASA's research centers were acquired from the former National Advisory Committee for Aeronautics. This plant cost about $400 million to build. These facilities are being modernized and the larger part of our effort is now on a broad program of advanced research relating to the many scientific problems of NASA's mission of space exploration.

In addition to this research relating to space technology, we are continuing to respond to our responsibility, inherited from NACA, to conduct research, to support and guide our Nation's activities in aeronautics and missiles.

Much of the research relating to missiles is identical—or nearly so—with that relating to space missions, but special problems do exist. One such problem, for example, on which we are conducting a cooperative program with the Department of Defense, is that of radar acquisition, identification and trajectory prediction of incoming ballistic missile warheads. This problem is, of course, basic to any defense system against this type of attack.

In aeronautics our research is now concentrated on certain special problem areas relating mostly to future types of aircraft. One example is the vertical and steep takeoff and landing aircraft that will be needed for certain Army missions, and, probably, for short-haul commercial use.

Another example is the large, economical transport of the future that will cruise in the neighborhood of 2,000 m.p.h. In addition to providing the scientific information to make such transports possible, we are preparing to cooperate with the Federal Aviation Agency to provide information needed by the FAA before such transports can be put into commercial service.

Another example of our aeronautical research is the X–15 airplane with which you are already familiar. This chart will refresh your memory of the X–15 configuration and the expected surface temperatures ranging up to 1,200° F. You will recall that this airplane will reach speeds in the vicinity of 4,000 m.p.h., and will be able to leap out of the atmosphere for a short time. In addition to the aeronautical implications of this work, the X–15 will enable us to gain operational experience on controlled manned reentry into the atmosphere with a winged vehicle (fig. 39).

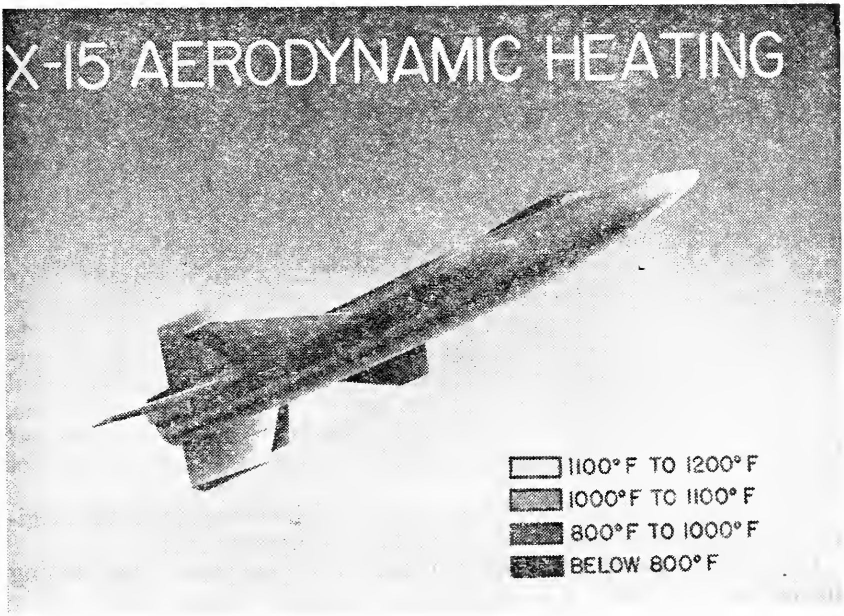

FIGURE 39

During the last year we have been cooperating with the Air Force and the contractor, North American Aviation, on the manufacturer's demonstration flights. It is expected that the first airplane with an interim engine will be accepted by the Air Force within the next week or 10 days and turned over to us for research flight testing in a cooperative program with the Air Force and Navy. The other two airplanes will also be available this year.

In defining our advanced research activities, I used the term "objective research." Some of the broad objectives of our research are indicated on this vehicle spectrum chart. We do not design vehicles at our research centers; however, as implied by the term "objective research," we do seek out the technical problems of missions such as those shown on this chart where sufficient knowledge does not exist to permit practical engineering solutions (fig. 40).

Then through theoretical and experimental investigations, we produce the information needed to reduce these problems to a point where good engineering solutions are brought within the state of the art of our Nation's engineering community.

This was the nature of our activity with regard to the X–15 project between 1952 and 1955. Our early research establishing the blunt body concept for ballistic missile nose cones and the Project Mercury concept was conducted mostly in the time period from 1953 to 1958. During this time period we also carried out studies leading to the Dynasoar I program. The other missions shown on this chart, such as space laboratories, space ferries, and the manned lunar vehicle, are examples of some of the possible future applications of our current research activity.

I would like to describe a representative example of how the research performed at our centers in recent years contributed the basic data required to breach formidable technology barriers and led us to new concepts which are currently being used in the space program.

The example is the research performed by NASA on the use of hydrogen as a rocket fuel. The great potential of hydrogen as a high-energy fuel has been recognized since far back in the last century. However, for all of these years, its inherent disadvantages, such as very low density and the apparent hazards associated with its use, have discouraged its consideration as a practical fuel.

About a decade ago Atomic Energy Commission requirements for liquid hydrogen resulted in studies which made it possible to manufacture and handle liquid hydrogens satisfactorily.

Encouraged by the AEC results, NACA in 1953 started a research program to determine if hydrogen's great potential as a fuel could be realized in improving the performance of rocket engines (fig. 41, p. 296). We knew that hydrogen had several unique advantages, which included large energy content, large cooling capacity and extremely favorable combustion characteristics. The question was, could these advantages be exploited in practical propulsion systems? Among the major problems in realizing these advantages in rocket engines were:

(*a*) How to cool with hydrogen flows which change from the original liquid state to a gaseous vapor in the cooling passages;

(*b*) How to prevent the fast-burning hydrogen flame from burning up the fuel injector.

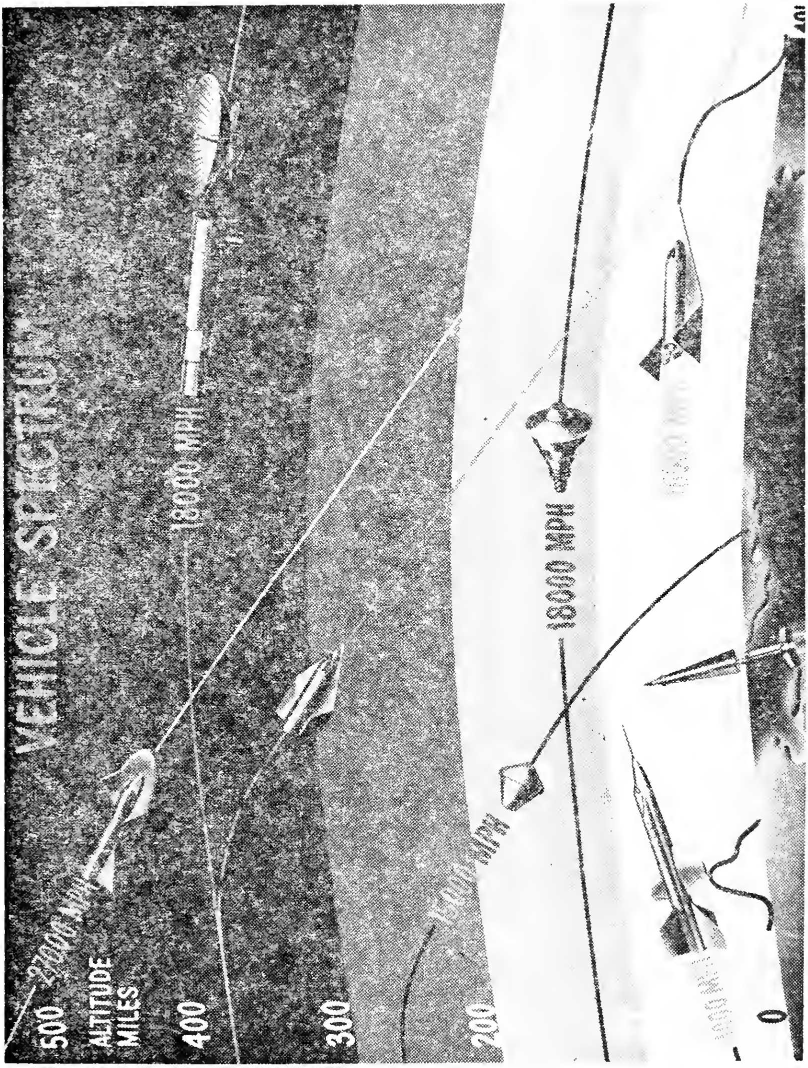
VEHICLE SPECTRUM
500
ALTITUDE
MILES
400
300
200
0
18000 MPH
18000 MPH

FIGURE 40

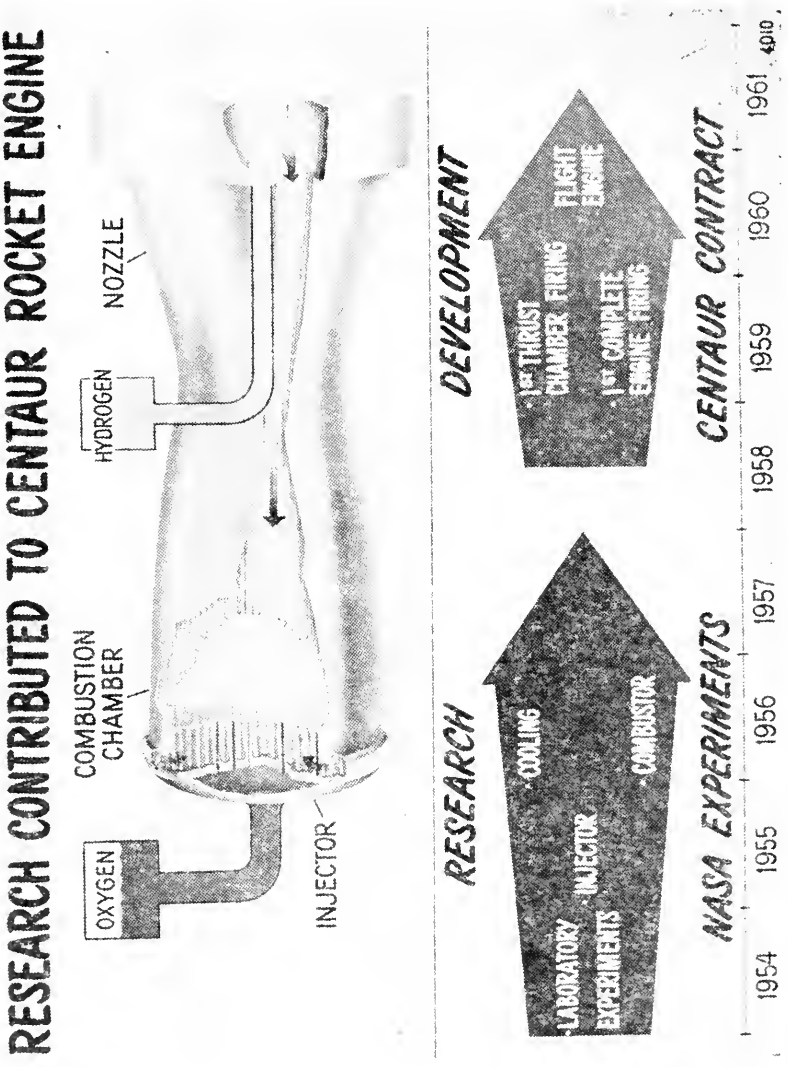
RESEARCH CONTRIBUTED TO CENTAUR ROCKET ENGINE
OXYGEN
INJECTOR
COMBUSTION CHAMBER
HYDROGEN
NOZZLE
RESEARCH
LABORATORY EXPERIMENTS
INJECTOR
COOLING
COMBUSTOR
DEVELOPMENT
1st THRUST CHAMBER FIRING
1st COMPLETE ENGINE FIRING
FLIGHT ENGINE
NASA EXPERIMENTS
CENTAUR CONTRACT
1954
1955
1956
1957
1958
1959
1960
1961

FIGURE 41

Basic studies and experiments were required to determine the heat flow rates of liquid, boiling, and gaseous hydrogen. Using these results, our researchers developed a mathematical procedure for determining the size and shape of the passages required to permit the hydrogen to cool adequately the thrust chamber. Because gaseous hydrogen burns so rapidly, the first injectors based on the existing state of knowledge failed in laboratory experiments. Further laboratory studies of injectors were required to make effective use of the gaseous hydrogen and liquid oxygen to cool them.

Other studies showed that combustion chambers for hydrogen rockets could be reduced to approximately half the length of those using more conventional fuels. Finally, by November 1957 the Lewis Research Center successfully demonstrated in a laboratory setup a hydrogen-burning thrust chamber employing the concepts resulting from the research previously mentioned. Here it is on the table before you. It produced 5,000 pounds thrust. In view of the small scale of this experiment, a larger research thrust chamber capable of 20,000 pounds thrust was tested at Lewis in December 1957. As a result of the new concepts put forth by the research of the Lewis Research Center between 1953 and 1957, the Air Force awarded a contract to Pratt & Whitney in October 1958 to develop a hydrogen-burning rocket engine for the Centaur vehicle. This project was later transferred to NASA. As shown on the chart, the previous laboratory research enabled the contractor to make exceptionally rapid progress in the development of the engine. Many of our hopes for greater achievements in our Nation's space program are wrapped up in the potential of hydrogen-burning rockets.

The CHAIRMAN. Mr. Abbott, at that point will you explain to the members of the committee how this 5,000 pound thrust chamber model that you have here on the desk operates?

Mr. ABBOTT. I will be glad to, Mr. Chairman.

The CHAIRMAN. The members of the committee who can't see might come up closer if they wish. If you will, bear in mind, Mr. Abbott, some of the members are a considerable distance away.

Mr. ABBOTT. Well, as you can see, this is not a flight article, but a heavy laboratory experimental setup. It has been partially disassembled so that you can see it better.

The hydrogen burns in about the area I am indicating now, and the exhaust products flow out the nozzle at this end, thus producing a thrust in this direction.

The hydrogen is introduced into this ring which you see near the exhaust end.

The liquid hydrogen flows through passages which are contained within this surface so you cannot see them, to the back end of the thrust chamber and, in that way, the liquid hydrogen, through boiling and heating up as a gas, cools the thrust chamber to prevent it from melting.

The gaseous hydrogen is then introduced into this injector plate.

Liquid oxygen flows in through this hole on this end and into the injector plate. When assembled, these pieces come together in the same order in which you see them. Then the hydrogen and the oxygen flows through these holes in the injector plate and burn. You must appreciate this hydrogen-oxygen flame is extremely hot. It is hotter than the hydrogen acetylene flame. Consequently, the cooling problem is an extreme one in order that the material of which this rocket is made not be destroyed by this intense flame.

Of course, the reason the hydrogen is so efficient is partially associated with the fact that the flame is so intensely hot and partly associated with the fact that the combustion products, water vapor, have a low molecular weight compared with combustion products of more conventional fuels.

The CHAIRMAN. Thank you.

Are there any questions?

Mr. FULTON?

Mr. FULTON. The question comes up, how much water vapor discharge do you get?

Mr. ABBOTT. If we use a stoichiometric mixture of hydrogen and oxygen, just enough of each to burn completely, the entire combustion products consists of water vapor and nothing else.

However, if we use some excessive hydrogen, for instance, the combustion products will be mostly water vapor with some hot hydrogen. The hydrogen, of course, would burn immediately the hot exhaust products come out into the atmosphere, but this burning would do us no good.

Mr. FULTON. You have no problem with backup or anything of that type?

Mr. ABBOTT. No, sir.

Mr. FULTON. On hydrogen under such pressure and when you put it under such heat, how much does it impregnate or become imbedded in the metal?

For example, would hydrogen atoms or molecules as they might be, become forced by pressure into the various cells of the metal and then over a period of time build up so that you would get either a cracking or an explosive possibility there, that it might age the metal, crack it or else explode?

I am interested in the light of this vehicle. Does it become impregnated so that the metal loses its tensile strength?

Mr. ABBOTT. No, sir.

Hydrogen, of course, does have this tendency to leak into many metals. However, for the rocket engine, this is not a serious problem.

Mr. FULTON. It doesn't, then, by this impregnation of metals cause pockets that would cause an explosion with the continued use of this engine so that they might be dangerous, for example, to people?

Mr. ABBOTT. No, sir; we have not encountered any difficulties of that sort.

Mr. FULTON. How long have you used such type engine?

Mr. ABBOTT. Of course, we have been experimenting with these laboratory setups successfully since 1957.

Mr. FULTON. What is its life in hours? Could you give us that?

Mr. ABBOTT. Well, it would be short in terms of hours. The life of these engines, the satisfactory life, is measured in minutes. A laboratory setup such as this might have a life of a few hours at most, not continuously, but in successive experiments.

Mr. FULTON. So it would be just a booster-type engine and not a cruising-type engine in space?

Mr. ABBOTT. Yes; that is correct. The flight engine's useful life is measured in minutes.

Mr. FULTON. Are you able to control flows so that you do not get all the power at once and you get a controlled flow through this type engine so you get a gradual increase in velocity rather than a bullet bang, say?

Mr. ABBOTT. Yes, sir. Hydrogen has not been especially troublesome that way.

Mr. FULTON. Have you used any other fuels on this type engine, such as boron or things of that type? Have you tried any other mixtures? Lox?

Mr. ABBOTT. Not on this particular engine. This was designed specifically for hydrogen. However, in our research we are experimenting on small-scale setups with various types of advanced fuels.

Mr. FULTON. What kind of a specific impulse do you get out of this kind of an engine?

Mr. ABBOTT. I will have to rely on my memory now, but about 400.

Mr. FULTON. That is all.

The CHAIRMAN. Mr. Anfuso.

Mr. ANFUSO. Doctor, I believe that you intend to use this hydrogen thrust merely for the second stage. Is that correct? Not for the first stage?

Mr. ABBOTT. This is the current plan; yes.

Mr. ANFUSO. What is the biggest thrust that you expect or that you foresee?

Mr. ABBOTT. At any time in the future?

Mr. ANFUSO. Well, within the next year.

Mr. ABBOTT. Well, the immediate plans in the present Centaur engine is in the general thrust range between 15,000 and 20,000 pounds, and I would expect the next step to be about 10 times that.

Mr. ANFUSO. What could you accomplish by such a second thrust——

Mr. ABBOTT. What kind of a mission?

The advantage of the hydrogen engine is that the specific impulse is higher than the conventional fuels. Consequently, the advantage of using the hydrogen engine is that with the same total weight vehicle, one could accomplish either a bigger payload in orbit or a bigger payload into a deep space probe than with the conventional fuels. Alternately, to do the same mission, it would require a smaller total weight on the ground to start with.

I do not have any specific mission weights with me today.

Mr. ANFUSO. I have read somewhere, sir, that upon reentry into the atmosphere the capsule would burn, so if there was a man in there, he would fry to death.

Would the development of hydrogen fuel prevent that?

Mr. ABBOTT. No, I am afraid that the development of the hydrogen rocket does not speak directly to that problem. I have something to say on that problem a little later in my prepared talk.

Mr. ANFUSO. How do you get this hydrogen fuel?

Mr. ABBOTT. It is liquefied. There are a number of plants in the country, chiefly Government plants, that produce this liquid hydrogen. Hydrogen is produced in several ways, such as electrolysis of water.

It is liquefied in generally the same process one uses to liquefy air, except the temperatures are lower and it is a more difficult process.

Mr. ANFUSO. Any country can produce it?

Mr. ABBOTT. Any country can produce it.

Mr. ANFUSO. That is all; thank you.

The CHAIRMAN. Now, Mr. Abbott, you haven't finished your statement and the questions asked were just with reference to that particular machine. That is the reason we paused.

Will you proceed with your statement?

Mr. ABBOTT. I want to turn now to some examples of our current activities which will lead ultimately to new vehicles for the more advanced space missions of the future.

As mentioned by previous witnesses, flight by man through space to the Moon and return to the Earth is a goal that catches the imagination of many of us. However, much research must be undertaken to pave the way before our country can perform such an achievement.

Already the NASA's research centers are in the initial stages of research on a number of problems relating to manned lunar flight. For example, reentry into the Earth's atmosphere from lunar flight speeds poses much more severe problems of guidance and control, deceleration, and heating of the vehicle than will be experienced by the Mercury capsule on reentering the atmosphere at satellite velocities.

Our studies indicate that if we attempt this reentry from a lunar mission with a ballistic capsule, which would be based on a simple extension of our experience with Project Mercury, guidance will be a major problem. Perhaps you can visualize a ballistic capsule traveling from a distance of a quarter million miles out in space and heading toward the Earth at a speed of 27,000 miles an hour.

In order to decelerate and land safely in its first pass around the Earth, a capsule must enter a flight path corridor with an accuracy of only 3½ miles above or below the proper trajectory. For scale, this corridor width is less than 1/1000 of the diameter of the Earth. On this chart the width of the line representing this corridor has been exaggerated about 10 times to permit you to see it. Present guidance technology is not capable of meeting this stringent requirement in a practical way. If our capsule undershoots this corridor, it will be destroyed by aerodynamic heating. On the other hand, if it overshoots the corridor, our manned vehicle will make another excursion out into the radiation belts, involving the probability of several additional days of flight, if, indeed, return to earth can be made at all. We are, of course, extending our work on guidance and trajectory control to find means of meeting the severe accuracy requirements which are imposed by this type of vehicle (fig. 42).

We are also conducting research on other concepts, such as the use of lift during reentry. Results indicate that the permissible entry corridor width can be increased by the use of lift. This concept would, of course, greatly alleviate the guidance problem, and also reduce the accelerations experienced by the astronauts. In addition, the use of lift will provide much more operational flexibility in piloting the vehicle to preselected landing points.

However, we don't get all of this for nothing. The use of lift greatly aggravates the reentry heating problem, as shown on the next chart (fig. 43).

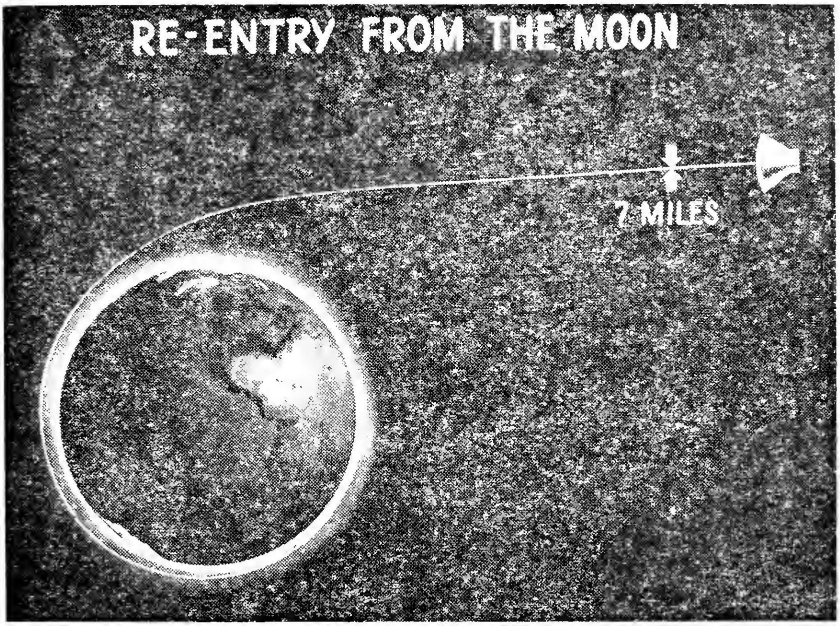

FIGURE 42

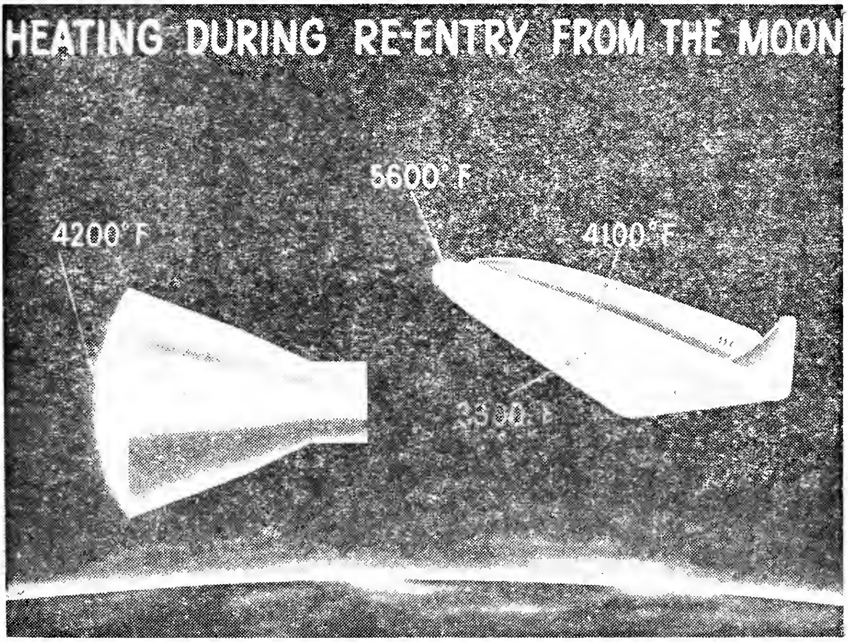

FIGURE 43

50976—60——20

This chart illustrates the nature of the heating problem for both the ballistic and lifting entry configurations. In the case of the ballistic vehicle, severe heating is largely restricted to the front face. The maximum temperature would be of the order of 4,200° F. for relatively short times. We believe that the heating problem of the ballistic vehicle can be resolved by modest extensions of our present research. This is not the case with the lifting vehicle, however. The nose temperatures on lifting configurations, such as shown on the right of the screen, may reach as high as 5,600° F. Although this is the maximum temperature, the rest of the surface is also very hot. These high temperatures will also be experienced for a much longer time than for the ballistic vehicle. You will recall that in 1954 research information permitted us to propose the X–15 research vehicle, which would be capable of withstanding maximum temperatures of 1,200° F. Today we believe that the Dynasoar I vehicle can be developed to withstand maximum temperatures from 2,000° F. to considerably more than 3,000° F. This is about the present status of research information for structures for lifting reentry vehicles. You can see, therefore, that we have a long way to go in research on high-temperature materials and structures to permit a winged lifting vehicle to reenter from lunar flight speeds.

It is apparent that for the next few years much effort must be devoted to research to resolve these problems. In addition to the straightforward approaches of greatly improved guidance systems and heat-resisting structures, other approaches are being investigated. The most obvious one involves a compromise between the ballistic and winged lifting vehicles to retain the best features of each while minimizing their problems.

While the manned exploration of the Moon and planets constitute long-range objectives of space flight, it is not entirely clear at this time exactly what the next major step should be. It has been suggested by some that a manned orbiting space laboratory capable of supporting several men in space for a period of several weeks may be necessary in order that we might gain the knowledge and experience needed to accomplish longer range deep space objectives. Accordingly, we are now focusing some of our advanced research to provide technological background for a manned orbiting laboratory. In order to do this in an intelligent and realistic way, we have started to consider various concepts of how space laboratories might be designed, packaged, injected into orbit, erected, and operated.

I will discuss this work with the aid of this model and mention a few of the research problems which have been identified. I want to emphasize that this model represents only one of several concepts which are being considered. Our model represents the final stages of the rocket-launching system. When this configuration arrives in orbit, it is first pointed at the Sun by the stabilization system, then the nose cone is ejected [nose cone removed]. This allows the two semicircular radiators to open. You can see a cylindrical container between the radiators, which houses equipment for operation of the station. We will now begin to inflate our space station.

While our station is inflating, we can consider some of the research problems which must be studied before such a vehicle could be built. Obviously, the first problem relates to the characteristics of the inflatable wall. We are investigating materials which must be leakproof and strong. However, these materials must also withstand folding and packaging without damage, and be free of odors or toxic fumes in a closed pressure system. Even with a leak-resistant cell wall, we expect leakage through meteorite punctures. Hence our station which you can see inflating is made up in sections, with doors which would be closed in an emergency to seal off a punctured section. We would also expect micrometeorite punctures which would be small and hard to find; hence, it would be prudent to provide an automatic sealing system.

Now that the station is inflated, you will see that it may be considered to represent a 40-foot-diameter station which would have a total weight of between 12,000 and 15,000 pounds. Such a station could be launched with a Saturn launch vehicle.

The heating system of the space laboratory must have fail-safe features, hence we have considered using direct solar radiation to heat it. By adequate control of the reflective properties of the surface, an average temperature of 70° could be achieved. Thermal radiating properties of materials over a wide range of conditions in a hard vacuum environment must be known, as well as the effect of bombardment by high-energy particles. Ultraviolet and X-rays will also affect certain materials.

Such a station must have a source of power which can be provided by this solar collector which focuses the sun's rays on the boiler, which runs the turbogenerator to provide electricity. A zero or low g environment will affect heat transfer in the liquid and gaseous systems of this powerplant. We have considered that the station should be sun-oriented; that is, it spins about an axis directed at the sun. If we rotate our 40-foot-diameter station at six revolutions per minute, a small amount of acceleration of the order of one-fourth normal gravity may be provided for comfort of the occupants over long periods of time.

The principle of operation of this space laboratory is to erect it automatically and place it in operation by a programed sequence. Then, a space ferry containing personnel is sent up to rendevous with the station. The space ferry would approach the station and lock on here at the bottom to discharge personnel and cargo, and to be used as an escape or return vehicle as may be necessary.

In our work to date with such concepts we have identified many other research problems that require study.

In conclusion, I hope that these few examples of the many things we are studying in our research centers, have provided an indication of the nature of the NASA's advanced research work.

The CHAIRMAN. Thank you very much, Mr. Abbott.

You refer to a lift vehicle, as contrasted to a ballastic vehicle.

Mr. ABBOTT. Yes, sir.

The CHAIRMAN. Tell us a little bit more about the lift vehicle.

Mr. ABBOTT. Well, what I mean, of course, is a vehicle that would provide aerodynamic lift once it entered into the atmosphere.

The CHAIRMAN. In other words, return to the atmosphere circling the earth and using the power of the atmosphere to maintain its altitude?

Mr. ABBOTT. Using the life of the atmosphere to slow it down and support it, in a different manner than the ballistic vehicle.

You can see, if we have a lifting vehicle, the corridor in which we have to enter can be wider. If we enter too low, we orient the vehicle to go upward and go back to the right corridor. If we were too high it would be possible to lift downward and pull ourselves down into the atmosphere to the proper point.

The CHAIRMAN. Whereas your ballistic vehicle avoids the use of the atmosphere as a means of lift.

Mr. ABBOTT. Yes, sir. It uses the atmosphere only as a drag brake.

The CHAIRMAN. Now, this last vehicle that you have referred to. What value do you think it is going to have when and if you perfect it?

Mr. ABBOTT. You are referring to the space station?

The CHAIRMAN. Yes; the space station.

Mr. ABBOTT. I think a space station might have two types of values, one of which I mentioned in my prepared statement. That is, it would provide us with a great deal of experience in providing a habitable environment for people in space for a considerable period of time in an orbit not too far removed from the Earth's surface, where the people could be recovered by the use of space ferries if unusual, unexpected, things occurred. This would provide us with operational experience before sending people out into deep space missions to a point—well, the Moon itself is a quarter of a million miles from earth, which is quite a long distance.

The other utility that such a station might have would be as a base for actual laboratory experiments conducted in space. This is a question, the value of which can be debated.

For instance, in an orbiting astronautical laboratory a great many things can be done with instruments, but I am confident that one day we will want to put an astronomer up there along with those instruments in order that he may exercise the knowledge and judgment which only an astronomer has.

The CHAIRMAN. You may want to put a surveyor up there, too, to survey the world.

Mr. ABBOTT. Yes. I used only one example. There are many others.

The CHAIRMAN. I know that the Chief of the Army Engineers has made some statement about making a map of the Moon. Likewise, it would help us in making a map of the United States, would it not?

Mr. ABBOTT. I suspect that experience will indicate that one of the most valuable people who could be up there would be an electronics technician in some cases.

The CHAIRMAN. Why an electronic technician?

Mr. ABBOTT. He could make minor repairs on the equipment.

The CHAIRMAN. Repairs of that and other equipment?

Mr. ABBOTT. Yes.

The CHAIRMAN. It would be sort of like a service station for an automobile.

Mr. ABBOTT. Possibly. I really don't know how it will all work out.

The CHAIRMAN. Mr. Fulton?

Mr. FULTON. It is 17 minutes after.

The question is as to the kind of a reentry target area you would have when your space vehicle first approaches the atmosphere. What is that? Is that diameter of $1\frac{1}{2}$ miles of a circle, that it can come in and aim within a circle, or must it come in and aim with an ellipse, or does it come in and aim within a crescent? Referring to your chart entitled "Reentry From the Moon," I can see unless it comes in on a certain trajectory and is aimed pretty well at a ballistic course around the Earth that you would get a kind of an ellipse, if you got a divergency out of an extreme angle, that, on Kepler's Second Law of Dynamics you would get a very short perigee and a longer apogee away from the Earth.

Mr. ABBOTT. Yes, sir. The figures which I gave relate only to the altitude width of the corridor.

Mr. FULTON. How wide could you get it, because I want to point out a difficulty you are getting into just on the ordinary Kepler's laws.

Mr. ABBOTT. I think you will realize it is more a question of the direction in which the vehicle is going than of the width, since there would be an annular area all the way around the Earth, of this altitude in which he could enter; but, of course, the direction in which he is going is important. I do not have figures with me about this and I don't believe they have been studied, as yet, to anywhere near the same degree as the altitude figures.

Mr. FULTON. Instead of an annular course, a circular course around the world, that would take, if you get a divergence on an angle one side or the other too much, then you get very little of the Earth's atmosphere that is being entered and you go back into a ballistic course much more quickly. So that is really an elliptical flight, not an annular flight. When you get an elliptical flight then you get Kepler's Second Law operating and you run into tremendous difficulties.

So I am saying, what amount of distance, right or left, can you then have as a toleration, on a reentry vehicle, when it comes to the point of entry in the atmosphere and comes to this $12\frac{1}{2}$ miles, as you say, up or down—I don't know whether that is a good description or not. How much, we will say, east or west?

Mr. ABBOTT. I am not prepared to answer that question, Mr. Fulton. I recognize this is a very important thing. I am not prepared to respond to it in any numerical way because this whole subject has not yet been fully explored.

Mr. FULTON. Let's go on to another point. You say if we had our 40-foot-diameter station revolving at 6 revolutions per minute we get a small amount of acceleration and get about one-fourth normal gravity.

It would seem to me when you put your power station or your boiler right in the center around which this station revolves, you then are at zero gravity. It would be much better for you, instead of having one, have two, and put a meter out on the rim and have a mirror reflecting to those. Because at the rim of the space station you will get a quarter gravity, or if you go 20 feet further beyond the perimeter, you would get another 40-foot diameter. You would then, using the 3.11416 formula, probably get gravity at another 20 feet out, wouldn't you?

Mr. ABBOTT. You are quite correct about the arrangements.

Mr. FULTON. Then the question is: Why not put the two stations on arms out away from the perimeter, the outside of the station, and then you have full gravity and you have no trouble with your heat transfer.

Mr. ABBOTT. I think that you are quite right and that any practical vehicle would be designed in some such manner as that. I would like to point out that the only purpose——

Mr. FULTON. I felt that was a defect in this one here.

Mr. ABBOTT. I am sorry, sir, but this model is not intended to represent anything like a practical design but merely to indicate some of the research problems that are associated with it. It is a much more compact thing to bring into the room this way than with the other arrangement.

Mr. FULTON. How long would a station like this stay up?

Mr. ABBOTT. I really don't know. It should be capable of staying up for a long period of time.

Mr. FULTON. With what would you inflate it?

Mr. ABBOTT. I think it would be either air or oxygen.

Mr. FULTON. And there is no danger of the thing just going up in a puff, is there, with that kind of an inflating material?

Mr. ABBOTT. We always have danger of combustion wherever there is air or oxygen. That would have to be taken into account. I would like to point out, though, that I don't think the station would be inflated to full atmospheric pressure. People get along very well at pressures corresponding to 10,000 to 12,000 feet altitude and that is probably the pressure we would use.

Mr. FULTON. When you have that space station Sun oriented you expect it to be equatorial orbit, an annular equatorial orbit or a polar orbit? What kind of a declination would you expect?

Mr. ABBOTT. I think this would depend entirely on what the mission of the station would be.

Mr. FULTON. What is the best?

Mr. ABBOTT. Again, this would depend on the mission of the station.

Mr. FULTON. Suppose it was a communications satellite, what would you do——

Mr. ABBOTT. A communications satellite, I think probably would be best on an equatorial orbit, at a very considerable distance from the Earth.

However, if the station had a mission to examine the Earth's surface, it would be able to see all the Earth only in a polar orbit.

Mr. FULTON. That is all. Thank you.

The CHAIRMAN. Mr. Miller?

Mr. MILLER. Mr. Abbott, I notice on page 3 of your statement you discuss the activities of your agency. You mention the fact that you are doing work in connection with FAA.

Mr. ABBOTT. Yes, sir.

Mr. MILLER. In developing the peaceful uses of the air for the benefit of this country, I think it is one of the original objectives of your predecessor, NACA, and you are carrying them out?

Mr. ABBOTT. Yes, sir, we are. We have certain responsibilities in connection with research that relate to aircraft safety, navigational aids, and that sort of thing, although this primary responsibility rests in the FAA, and we cooperate with them on the research.

Mr. MILLER. Are your research and technical facilities at their disposal in this field, and have they been at their disposal in this field?

Mr. ABBITT. "At their disposal" is perhaps too strong a term, but we cooperate with them.

Mr. MILLER. Your knowledge has been available to them and you have been able to undertake any research that they need in this field when they request it?

Mr. ABBOTT. Yes, sir. Our knowledge is always available to them and where research is needed in a field, we get together with them and discuss how it should be done, and whether it should be done by us or by somebody else.

Mr. MILLER. Mr. Chairman, I think this is a very important facet that NASA has in this drive for outer space which we sometimes neglect. And the very great contributions they make and have made in the past, or their predecessor has made in the whole field of aviation.

I want to congratulate you, sir, on carrying out the work that has been assigned to you in the field of research. I would like to point out to some of my colleagues that some of the things you have told us here today, we read about as the great aviation companies' babies, whereas they were conceived and born in this Federal agency that has never received proper credit for the work that it has done. I believe at Ames right now you are doing certain work preliminary to perhaps getting an astronomer into space. Is that correct?

Mr. ABBOTT. That is correct.

Mr. MILLER. And the fine work that has to be done in this. The value of one of these stations, as I see it, would not only be in that field, but in the field of studying the radiation belts that we must penetrate before we can put a man onto the moon and bring him back again, in which field we are not too knowledgeable. Isn't that correct?

Mr. ABBOTT. That is correct.

I would like to thank you for those kind words. We have many years of experience as the NACA, of course, in working closely in teamwork with the industry of this country, with the Department of Defense and with the Civil Aeronautics Administration, now the Federal Aviation Agency, and we are continuing these activities.

Mr. MILLER. I would just like to close, Mr. Chairman, by saying that I again would encourage my colleagues at any time to visit one of the three laboratories of NASA. And I am certain that Mr. Moeller who saw one of them last year will join me in that.

Mr. MOELLER. Right.

Mr. MILLER. You get a far finer knowledge of some of the things we are trying to do if you take time out to see what this great agency is doing.

Mr. BROOKS. Thank you, Mr. Miller.

I think those words are well chosen and certainly appropriate. I don't think NACA was given proper credit for the fine work it did, as the predecessor to NASA.

I had the privilege of being at Langley during the fall and being briefed on the future development of aviation. I was impressed with the work which NASA is now doing in the aviation field as contrasted to the space field and I commend that briefing to my colleagues on the committee. I hope that we all have an opportunity to participate in such a briefing at some time or other.

Mr. ABBOTT. I hope you do, sir. We would be very happy to have you at any time.

The CHAIRMAN. Now, since we are so far behind on our schedule, if there are questions over here let us proceed. Do you have questions, Mr. Osmers?

Mr. OSMERS. Mr. Chairman, I wanted to make a suggestion to Mr. Abbott. There seems to be some doubt as to whether they should inflate this station with air, or oxygen. I thought I might suggest to them in a nonscientific way, that he use hot air because that has been found here in Washington to inflate earthly bodies and to keep them at high altitude without explosion for a good many years. That might be of some help to him in his program.

The CHAIRMAN. You can't eliminate the heat, though, in the case of Washington.

Mr. OSMERS. As my colleague, Mr. Miller, mentioned, in referring to a part of Dr. Abbott's statement, the top of page 3 relates to the work NASA is doing with regard to the civil aviation industry.

All over the Nation, Mr. Abbott, there are great discussions going on regarding the need for new, very large, very costly, very space-consuming jet airports for the future of the civil aviation program of the country.

Would you care to express yourself to the committee with regard to the imminence of practical vertical and steep landings and takeoff of commercial aircraft for commercial use?

Mr. ABBOTT. I think——

Mr. OSMERS. In order to narrow the question just a bit, sir, I am referring not to transcontinental, or transocean flights, but I am referring to flights between cities in the East and the Midwest, from the New York, Chicago, New Orleans, Miami, quadrangle—200-, 300-, 400-, and 500-mile hops.

Mr. ABBOTT. Thank you for clarifying your question. This makes it easier for me to answer, although I am afraid I do not have a good answer because timing of this sort depends on so many things in which I am not expert. It depends on the economics of the situation and upon how rapidly some organization with sufficient money to get into this venture wishes to push it.

At the present time, it looks to us as though vertical takeoff and landing aircraft will have to be heavier and more highly powered than conventional airplanes. About half again as heavy and about twice the power to do the same chore.

This means they are going to be more expensive to operate. This has to be balanced, on the one hand, against the difficulties of getting from the center of our metropolitan areas out to the large airports, on the other hand. Frankly, I don't know how this is going to end, but I would think that the current trends of metropolitan growth and location of airports would lead to some excellent opportunities for the new types of aircraft, but I cannot speak as an expert on this.

Mr. OSMERS. Do you feel, sir, that it might be possible—and I am sure this was very carefully thought out by your predecessor, NACA—that instead of making the aircraft heavier and more powerful, to use small rockets to help get them off the ground and up into the air high enough so that they can proceed under normal power—whether that be turbojet propellant, gasoline power or what ever.

Mr. ABBOTT. We have another problem here. There is an old saying that commercial aircraft have to support themselves in the air economically as well as aerodynamically. Rockets are very expensive things.

I am afraid the fares that would be charged for any short-haul flight where the aircraft was put into the air with rockets would be rather startling.

Mr. OSMERS. I am thinking more in terms of the roman candle type of rocket, rather than the rocket that is used to lift the Atlas into outer space.

Are you in a position to tell us, Mr. Abbott, approximately how much of the $800 million proposed NASA program for fiscal 1961 will be devoted toward the development of civil aviation projects, conventional projects.

Mr. ABBOTT. It is very difficult to arrive at such a figure because the very nature of research is such that it is often difficult to tell what the application is going to be. However, if I can do a little arithmetic out loud, the salaries and expenses account for the four research centers is in the neighborhood of about $74 million, of which about a third at the present time is applicable to aeronautics, or about $25 million. I would find it extremely difficult to break that down between civil and military because these are very closely intermingled and what is military today will often be civil tomorrow.

Mr. OSMERS. Do you feel that the future development of vertical takeoff and landing aircraft will lie along the lines of the helicopter of today or some of the other models which have engines which invert and turn and wings which change their character as the plane goes up? Do you feel that we will go along the lines of further development of the helicopter, or that we will go into newer, not necessarily newer, because I know some of the models have been under experiment for many years, but some of the other types?

Mr. ABBOTT. I would venture to predict that it will go both ways. Any time that you want to take off vertically with a very large load, the helicopter is far and away the superior type of aircraft for doing this. I think the helicopter is going to continue to be with us and that it will continue to be developed into a better and better vehicle.

However, the helicopter has many disadvantages, too, particularly with regard to efficiency of flight in forward speed and limitations on speed. For this reason, I think we will also see the development of the other types that you have mentioned.

Mr. OSMERS. Yes, I think that the general average low speed of the helicopter will narrow its use to commercial passenger transportation.

The CHAIRMAN. Mr. Anfuso.

Mr. ANFUSO. Mr. Abbott, one of the purposes of this space station is to study habitable environment in space. Is that correct?

Mr. ABBOTT. Yes, sir, that would be one of the purposes.

Mr. ANFUSO. It is true that man exposed to space could not live, could he?

Mr. ABBOTT. Without protection, he would die very rapidly.

Mr. ANFUSO. Are studies being conducted with respect to how man can navigate and survive in space? For example, could he possibly take off from the space station with a space suit on, like you see spacemen taking off into space? Do you think those things are within the realm of possibility, or could he take off from another smaller craft launched from the space station?

Mr. ABBOTT. I think it is entirely credible that a man might be able to exist in space for a short period of time protected only by an adequate space suit. These space suits are getting better all the time. I see no reason why this should not be done.

However, in thinking about the problems of assembling a space station, for instance, we have tended to consider rather impractical those comicbook impressions showing stations being erected out of prefabricated parts using a crew of astronauts dressed only in space suits floating around freely in space, equipped with a variety of hand tools. We don't think this is a very practical sort of thing.

Mr. ANFUSO. That is all.

The CHAIRMAN. Any further questions to the right? Mr. Karth?

Mr. KARTH. Mr. Chairman, just a couple.

I would like to ask the doctor if he knows how much money has been authorized or suggested in the 1961 budget for research work on this whole area of heat-resistant metals or compositions.

Mr. ABBOTT. This is a very difficult question for me to answer, because so many people are working on it. We will provide you the number, though.

(The information requested is as follows:)

The Federal Government is expected to spend about $125 million directly on basic and applied materials research in 1961. The NASA expects to spend about $6 million on materials research relating to NASA responsibilities plus $4 million for new facilities to expand this research in the future.

Mr. KARTH. Has this been assigned a rather high priority, Sir?

Mr. ABBOTT. Yes, sir.

Mr. KARTH. Do you feel the moneys being expended on it are sufficient to meet that priority in the shortest possible time?

Mr. ABBOTT. This is always a very difficult question to answer. I think I can answer best by saying that people who are better qualified than I am to determine such things, have determined the size of the program that should be done and that is going ahead. The question of materials is a very wide area.

Mr. KARTH. Is it your opinion sufficient progress is being made in this area?

Mr. ABBOTT. I would always be dissatisfied with the progress being made in any research area.

Mr. KARTH. This is the standard answer that we are destined to get, sir, or is this really your personal opinion?

Mr. ABBOTT. It is very difficult for me to say. There has been a tremendous upsurge in materials work in this country in the last year or two and there are plans for it to be increased still faster. My suspicion is that in this particular area any attempt to go much faster would run head on into the fact that we just don't have many more people who are really qualified to work in this field.

I think that one of our big problems in this materials area is to train more people and get them into it.

Mr. KARTH. Thank you.

The CHAIRMAN. Mr. Riehlman.

Mr. RIEHLMAN. Mr. Abbott, at page 2 of your testimony you refer to the cooperative program being carried on by the Department of Defense.

With respect to radar acquisition, identification, and predications of incoming ballistic missiles and warheads, as you say in your next statement, this is basic to our defense system.

Can you give us any idea how extensive and how successful this program is, up to this point at least?

Mr. ABBOTT. The program that is being carried on is in conjunction with our Langley Research Center although the actual work is being done at Wallops Island. The Department of Defense has erected there, or is now in the process of erecting, two very advanced radars which can be used to get this information from incoming objects which we will fire from Wallops Island.

I really can't go much further than that in this answer at the present time because we would be getting into a classified area.

Mr. FULTON. I have cautiously a couple of times suggested that trying to catch these missiles as they come down might be the wrong approach because it is like apples falling off a tree and one is going to hit you on the head.

I believe one should try to energize them or divert their course by applying energy of some sort. Because when they are at the height of their apogee in space it would take very little energy to either divert them or boost them and push them on.

If they are in the range of the United States give them a little push further, allowing them to just maintain the velocity they have and they would go on over and fall in the Pacific Ocean or fall in China.

So the question is, maybe, rather than to block these things and destroy their velocity completely, wouldn't it be much better just to maintain their then velocity and push them on?

It might end up like one of these games where you keep pushing the ball back and forth. Couldn't you divert them rather than try to knock them down?

Mr. ABBOTT. There is a subject that I don't think we can discuss profitably in open session. Anyway, it really is a Department of Defense problem.

Mr. FULTON. The second thing is this. Obviously, these space suits will not satisfy any women because these space ships are made by scientists and have no style at all. I think you will never get any women into space.

On this model, if you have no fins on it, it won't go anywhere.

Mr. ABBOTT. I think you are quite right, sir.

The CHAIRMAN. Mr. Hechler?

Mr. HECHLER. Dr. von Braun says we are exhausting our stockpile because of the emergency application of the research that we have done. I wonder whether you find this to be true as of now. Have we a great need for stockpiling additional basic research before we can move ahead?

Mr. ABBOTT. Yes, sir; I think I agree with Dr. von Braun. The only thing is, I would like to point out that this is not a new situation. I have never known any time in over 30 years when research information was stockpiled.

Mr. Hechler. Isn't it more acute, though, at the present time, when we are trying to move forward in this emergency period?

Mr. Abbott. Yes, sir; but the point is that any time we find out something somebody is going to use it right then, and so it is no longer in the stockpile. The application is always right on the edge of what we are doing. Research information really cannot be stockpiled except by slowing down the application which is something that none of us would ever want to do.

Mr. Hechler. Well, doesn't this then point to the absolute need for strengthening our educational system so that we can provide the basis for moving forward in research in the future?

Mr. Abbott. I agree completely. I think this is very important.

Mr. Hechler. Thank you, Mr. Abbott.

The Chairman. Now, there being no more questions, Mr. Abbott, let me say we appreciate very much your appearance here and the able statement that you have made.

I want to say at this time now that we have four more witnesses from NASA to be heard. We hope that we can hear them this afternoon. We want the members of the committee to stand by. However, we must be on the House floor at 12 o'clock. It is 10 minutes until 12 now and, therefore, it seems proper that we adjourn and take up the next witness in the afternoon.

We will adjourn until 2:30 p.m.

I want to say this now: Tomorrow we will have Dr. Wernher von Braun. We have agreed to hear him at 10 o'clock. Then, following the testimony of Dr. von Braun and his group who will come up here from the Redstone plant, we hope to be able to take up Mr. Sisk's resolution and hear testimony on that.

The following morning we will have the Secretary of the Air Force, Mr. Sharp, who will be here in open session, and the Under Secretary, also, at the same time. I am sure they are going to consume all morning, perhaps even more time than that.

What I am getting to is this: We want to proceed with our hearings as rapidly as we can and we are behind at this time. My thought is this: We want to take up the authorization of NASA as soon as possible. We have a commitment to get it to the floor of the House as quickly as we can.

As soon as we can do so, we want to—unless there is objection—to follow the same procedure we followed last year, which is to give the subcommittees an opportunity to operate. In doing so, we would turn over portions of the NASA program to subcommittees 1, 2, 3, and 4, which would be Defense, Army, Navy, Air Force and NASA. They would have authority to go ahead and further run down and tie down these problems that are presented. There are so many, they are so numerous and so difficult that the subcommittees perhaps can handle that in excellent shape.

That is the situation before us. I thought I would just make the announcement. If we need to, we can go into executive session at this time. If there is no need to do so, we will just let the matter stand and meet here at 2:30. Do I hear any observations?

If there is no objection we will adjourn until 2:30.

(Whereupon, at 12 noon the committee adjourned to reconvene at 2:30 o'clock the same day.)

AFTERNOON SESSION

The CHAIRMAN. The committee will come to order.

Since we recessed at noon, the President of the United States announced at Denver, Colo., that he is recommending to Congress the authorization and appropriation of $113 million additional money for the 1961 fiscal year budget of NASA and $23 million additional for the current fiscal year.

Mr. HORNER. I think the $23 million mentioned in the press release, Mr. Chairman, is the supplemental appropriation which we have requested——

The CHAIRMAN. Now, tell me this, gentlemen, if you could, before we get back into the subject of the hearing: What will this do for the program?

Mr. HORNER. The $113 million is the result of our study which the President asked us to conduct on the 14th of January. It will be applied in three parts: $15 million to the F–1 engine; $8 million to the 200–K thrust liquid hydrogen engine which will ultimately be used——

The CHAIRMAN. How much is that?

Mr. HORNER. $8 million, to the 200–K thrust liquid hydrogen engine, which will be in addition to the money that is currrently in the fiscal year 1961 budget authorization proposal. This engine will be used as a component of the Saturn vehicle in its later versions and the balance of $90 million will be applied to the acceleration of the Saturn development program.

The CHAIRMAN. So it is mostly Saturn?

Mr. HORNER. Actually of the 113 million, there is a total of 98 which is applied to the Saturn, or components of the Saturn.

The $8 million being an engine for a later version of Saturn.

The CHAIRMAN. All of this was recommended by the study that you refer to?

Mr. HORNER. Yes, sir.

The CHAIRMAN. Now, the $23 million was not recommended by the study, was it?

Mr. HORNER. No, sir.

The CHAIRMAN. But that comes in the overall effort to speed up the program?

Mr. HORNER. That is right. That amount was submitted to the Congress as a request for supplemental appropriation within the authorization that the Congress provided us last year.

The CHAIRMAN. That will pretty much complete the authorization then, won't it?

Mr. HORNER. It leaves about $7 million, I believe, authorized, but not appropriated, largely in the "Salaries and expenses account."

The CHAIRMAN. Now, does that give you the money that you need? Of course, that question should be directed to Dr. Glennan.

Mr. HORNER. Yes, sir. The intent of this study was to provide an acceleration to the superbooster program which is compatible with the needs of the program. Of course, the bulk of the money is applied to Saturn as we have mentioned previously. As you know, Dr. von Braun is scheduled to be here and will discuss the Saturn program in some detail so the committee can judge for itself.

The CHAIRMAN. We will ask him tomorrow if this money will be sufficient for the program.

Mr. HORNER. I am sure that he will be expecting that question.

The CHAIRMAN. Now, may I say this before we get into the hearings, if there are sufficient members present when we finish the hearings this afternoon, I would like to ask the committee to go into executive session to consider a matter that I think we ought to push diligently. That is the one that you have already approved creating a panel of scientists as advisers to the committee. We approved that some time ago.

Since then, Dr. Sheldon has been working to arrange a meeting at an early date of this panel of scientists in Washington, with an agenda for a program in a meeting with the committee. He has done a fine job, I think, in working out an agenda and he has been assisted by Dr. Edward Wenk, Jr., senior specialist on science and technology, from the Library of Congress, who had been loaned to us by the Library of Congress to help on this work. Dr. Wenk will come here, provided we have enough members to take up that matter in executive session, and go over the program.

Mr. SISK. Mr. Chairman, if you will yield for a minute, I appreciate the urgency of this and I think it is fine. The only thing is, because of a previous commitment I have a later meeting this afternoon. I wondered if it is something we might put over.

The CHAIRMAN. We can't do that on account of Dr. von Braun coming in the morning. Tomorrow afternoon, we wanted to take up your resolution. We have a crowded schedule. While I am talking about the crowded schedule, I want to mention again the subcommittee on the 1961 authorization for NASA. I can tell you this, it is going to require us to burn the midnight oil, get up early in the morning to handle this program and get it out as it should be gotten out, as quickly as possible.

We have a commitment to report at an early date a bill covering NASA authorizations. We want to get it out. And while I am on that subject, I would like to ask you gentlemen this. The committee tells me the NASA backup books have not arrived yet on the authorization bill. Are they available so that the staff could look them over?

Mr. HORNER. Almost all of the backup information is available, Mr. Chairman, and, of course, the augmentation indicated by the President's announcement this morning will be submitted within the next few days.

The CHAIRMAN. So you have the backup books ready for the staff to look over or will have in the next few days?

Mr. HORNER. Yes, sir.

The CHAIRMAN. As you know, the committee can't very well take up something they haven't even seen the backup books on.

I think that covers what I had to say.

Mr. SISK. In view of the comment with reference to this, I might ask a question on where is the money. It is the money for the present proposed Saturn contract on which many of these companies are now preparing their bids with reference to the hydrogen engine. Is that in the 1960 money? Is that coming out of that 1960 money or is that a part of the new money being requested?

Mr. HORNER. There is money in the 1960 budget that has already been appropriated to initiate the Saturn upper stage which is currently being initiated. The augmentation we are proposing is for new obligating authority in fiscal year 1961 which is in addition to the obligating authority that we have requested within the $802 million.

Mr. SISK. Thank you, Mr. Chairman.

The CHAIRMAN. Any further questions on that?

Before we go into the testimony of Mr. Harold B. Finger, is there anything you could give us on the report that we get regarding the new Russian missile in the Pacific?

Mr. HORNER. I have no further information, Mr. Chairman, I would care to give in open session. I am sure you would want to get more specific information from the same source we get our intelligence information from.

The CHAIRMAN. We have Harold B. Finger on propulsion technology, and research.

You have been sworn, Mr. Finger?

Mr. FINGER. Yes, sir.

The CHAIRMAN. You have a prepared statement which the committee will be glad to receive from you. As I understand it, you would rather brief your statement and have the entire statement filed in the record.

Mr. FINGER. That is correct, Mr. Chairman.

The CHAIRMAN. If there is no objection, we will file the statement of Mr. Harold B. Finger in the record and then he will brief his statement for the committee.

(The statement referred to is as follows:)

STATEMENT OF HAROLD B. FINGER ON PROPULSION TECHNOLOGY AND RESEARCH

Mr. Chairman, members of the committee, it is the purpose of our propulsion technology programs to develop existing engine concepts for application to specific missions and to improve existing engine systems so that we may be able to deliver higher payloads over longer distances with these engines. In addition, it is a major objective of our propulsion technology program to evaluate the feasibility of the exciting new propulsion concepts that have been proposed. Not all of these new concepts will necessarily lead to useful applications; however, the potential of many of these concepts is sufficiently great that they must not be neglected.

When I speak of existing engine concepts, I am thinking of the chemical rocket engine systems such as the one shown schematically on the first chart (fig. 44). As you all know, in this system a fuel such as kerosene in our conventional engines and hydrogen in our higher performance engines, and an oxidant such as oxygen in our present-day engines, and possibly fluorine in advanced systems, are mixed together and burned in a combustion chamber. The resulting high-temperature gas is accelerated through a jet nozzle producing the thrust that propels the rocket. The specific impulse of the amount of thrust that can be developed for each pound of gas flowing out the jet nozzle is limited by the chemical energy contained within the fuels used in the chemical rocket. For the best chemical rockets, specific impulses up to approximately 450 pounds of thrust per pound of gas flowing through the jet nozzle are possible.

As examples of our propulsion work aimed at the development of particular engines that are required for our space missions, we are developing a million-and-a-half-pound thrust, single-chamber engine which will be used in vehicles following the Saturn vehicle. For example, this engine is intended for use in vehicles such as the NOVA concept. We are also developing a 200,000-pound-thrust hydrogen-oxygen engine which is intended for use in the Saturn development program.

In addition to development of specific chemical rocket engines to be applied in our space missions, we are doing work, as illustrated on the next chart (fig. 45), to improve the performance of our chemical rockets. For example, in our solid rocket research and development program we are studying ways of reducing the empty weight of the rocket, which is made up of such items as the pressure shell and the jet nozzle. Since these stages will generally be used in the last stage of the multistage rocket, every pound that we shave off the empty weight of the rocket permits an extra pound to be installed as payload. It has been found that we can operate the solid propellent space rockets with a low internal pressure so that we may be able to use lightweight structures and lightweight materials in the castings. For example, we may be able to use thin Fiberglas casings rather than heavy steel casings. In addition, we are studying methods of cooling rocket jet nozzles and of using suitable heat-resistant materials so that the jet nozzle, which constitutes a major portion of the empty weight of solid propellent rockets, may be made significantly lighter.

In addition to this work aimed at reducing the empty weight of our solid propellent space rockets, research and development work is being done on storable liquid propellent rockets. Methods of accurately controlling the path of our space missions using these storable propellent and solid propellent rockets are being studied. These two classes of propellents are particularly well suited for long-range missions because they are stable at room temperature conditions and will not boil off excessively during the long interplanetary trips.

In addition to our work on chemical rocket systems, a large part of our propulsion technology program is aimed at evaluating the feasibility and at developing advanced propulsion. One such concept that is of particular interest to us is the nuclear heat transfer rocket, the engine of which is shown on the next chart (fig. 46). In this system, liquid hydrogen is pumped out of the tank and is used to cool the jet nozzle. This hydrogen is then passed through a nuclear reactor where it is heated to high temperature. The hydrogen is then accelerated through the jet nozzle producing the rocket thrust. In this system the specific impulse is no longer limited by the chemical energy available within the hydrogen itself. The hydrogen is heated in the reactor by passing it over fuel elements. These fuel elements are made of uranium enclosed within a structural material capable of withstanding high temperature. The fission of the uranium produces heat which is transferred to the flowing hydrogen. The specific impulse is limited, in this case, by the maximum temperature at which we can operate the fuel elements. It may be possible to obtain 1,000 pounds of thrust per pound of hydrogen flowing through the jet nozzle for such a solid fuel element nuclear rocket system. It is essential that if this system is to be superior to our chemical rocket systems, we must be able to heat the hydrogen to high temperature and we must be able to build small, lightweight reactors.

Another new concept for space propulsion that is being extensively studied in industry, as well as within NASA, is the electric rocket shown on the next chart (fig. 47). Essentially, the electric rocket consists of a system for generating electric power. This electric power is then supplied to a thrust generator. In all of the electric rocket systems, the weight of the electric generator equipment is far more than the thrust that can be produced by the thrust generator. In fact, present estimates indicate that the thrust may be as low as one ten-thousandths of the weight of the rocket.

Because the thrust is lower than the weight, the electric rocket cannot be used to boost a payload from the surface of the Earth. It can only be used after it has been established in an Earth orbit by either the chemical rocket or the nuclear rocket system. As I will indicate later, there are many different kinds of electric generating systems. There are also many different kinds of thrust generators. In this diagram, I have indicated several ion accelerators, of the type being studied at our Lewis Research Center, clustered to give the desired thrust. A photograph of one of these ion-thrust generators operating in a vacuum tank test facility at Lewis Research Center is shown on the next chart (fig. 48).

Ions, which are atoms with electrons removed, are produced in the ion source. These positively charged ions are accelerated through an electrical accelerator producing the blue ion beam. The electron gun discharges electrons into the ion stream so that the jet will be neutralized and will not build up a positive charge in this region causing the jet to be slowed down.

Our interest in both the nuclear rocket and the electric rocket stems from the capability of these advanced concepts to perform missions, when combined with the chemical rockets, that are beyond the capability of the largest all-chemical rockets that are being studied. The important characteristic of the nuclear and electric rockets is that they are capable of giving much higher specific impulses than the chemical systems. This high impulse or high thrust per pound of propellant flow reduces the total amount of propellant that is required to accomplish a given mission. With this lower propellant weight, we have more room available in a certain gross weight vehicle for engine, structure, and payload.

When we insert estimated weights for the nuclear rocket and electric rocket engine and structure, the payload capabilities shown in figure 49 indicate the marked potential advantages of using nuclear rockets and electric rockets over our chemical rocket systems for space propulsion. In this case, I have assumed that the gross weight of each of these rockets established in an Earth orbit is 150,000 pounds. This 150,000-pound rocket would be either a chemical, a nuclear, or an electric rocket. It leaves the Earth orbit and goes out to a Mars orbit round trip. The payload that returns to an Earth orbit is shown on the chart. The nuclear and electric rockets are comparable with each other and both are far above the value shown for the chemical rocket. In addition to the payload advantage, the nuclear and electric rockets may do this job with one stage while the chemical rocket will require at least three and probably four stages.

Up to this point I have indicated the types of systems in which we are interested and the potential performance of these systems. I would like now to discuss some of our development work on these systems. I should also emphasize that the research and development program that we are supporting in industry in our propulsion program is backed up by fundamental research at our research centers on materials studies, flow systems, combustion studies, etc. These fundamental research programs are aimed at supplying industry with detailed information needed in design of advanced systems and components.

As you all know, the NASA is working with the Atomic Energy Commission on a research and development program on nuclear rockets. The broad objectives of this program are shown in figure 50. The AEC, through its Los Alamos Scientific Laboratory, has prime responsibility for the evaluation of reactor feasibility which will be achieved with the demonstration of breadboard engine operation. The broadboard engine is a system which contains all of the principal components of the nuclear rocket, but is not necessarily packaged so as to resemble an operational engine system. In addition, the components are not necessarily flight weight components. In support of the AEC prorgam, the NASA is supplying certain nonnuclear components and the hydrogen propellant that is required for the program. With the completion of the breadboard engine demonstration, prime responsibility for the following steps of the program transfer to NASA with the AEC supplying reactor support. The NASA is responsible for developing a flight test engine, the flight test vehicle system, and for application of the nuclear rocket to those missions for which it may be particularly well suited.

As you all know, the first step in achieving the breadboard engine goal was accomplished just this past summer when the Los Alamos Scientific Laboratory tested the research reactor called the KIWI–A at the AEC Nevada test site. This reactor is shown on the next chart (fig. 51) on its railroad test car. The reactor was moved by remote control from the assembly building to the test cell and after testing it was remotely moved back to be disassembled. The reactor was fired upward in order to simplify the test installation. The jet nozzle which is shown here was cooled by water for this test. The propellant used was gaseous hydrogen supplied from a gas storage tank farm. The gaseous hydrogen propellant and the water cooled nozzle were used in order to simplify the test facility and the text operations so that the required reactor information could be most easily obtained. The follow-on steps to this KIWI–A reactor test will be aimed at a logical development of the breadboard engine including all of the principal components of the nuclear rocket shown on the next chart (fig. 52). The breadboard engine will include a reactor, propellant tank, liquid hydrogen turbopump, a liquid hydrogen cooled jet nozzle, and an automatic controls system that will simultaneously control the reactor and all of the flow system. These major components will not necessarily be packaged or positioned as would be required of a flight system such as the one indicated here.

As I indicated earlier, the NASA is supporting the breadboard engine development by developing certain nonnuclear components. The NASA is developing, or will develop, all of these nonnuclear components shown on the chart. We are now funding the development of a suitable turbopump. This industrial development of the turbopump is backed up by a research program at our Lewis Research Center aimed at improving pump design methods and supplying data needed to improve turbopump performance. In addition, we are, during this fiscal year, initiating the development of a liquid hydrogen cooled jet nozzle to be used in the reactor test program.

This integrated AEC–NASA program will continue through the development of the flight test engine, development and operation of the flight test vehicle, and finally, the application of nuclear rockets to useful missions. Design studies are now underway at NASA and will be initiated in private industry to evaluate the best methods of flight testing nuclear rocket systems.

One possible flight test configuration is shown in the next chart (fig. 53). In this case, the two-stage Saturn vehicle is used to boost a nuclear rocket stage into an Earth orbit. After the stage is in orbit it could be started up and tested under conditions that simulate the conditions that would be encountered in accomplishing a useful, long-range mission. Such an orbital nuclear rocket stage could be a low thrust, low reactor power system. For example, on the Saturn vehicle, a reactor power of 200 megawatts would be sufficient. However, if we are to apply nuclear rockets as second stages rather than orbital stages, and if we are to apply them for useful missions to larger vehicles than the Saturn, then significantly higher powers will be required.

Another important area in our program is aimed at the development of systems to generate electrical power both for auxiliary power and propulsive power. The auxiliary power is needed in every satellite and space probe for collection and transmission of the data that are required. In addition, auxiliary power is needed for our applied satellites. I have already indicated the possible use of electric power for electrical propulsion.

Some of the many different types of electric power generating systems are shown on the next chart (fig. 54). In general, a power source supplies energy to a system for converting that input energy to electric power output. The power source may be a chemical system, a solar system, or a nuclear system. The chemical system could be a battery or it could be some kind of a chemical combustion system. In addition, the heat of the Sun may be used or the fission of uranium may be used to produce heat. There are also many different kinds of power-conversion equipment. Some of them, indicated here, are the turbogenerator system which directly converts from the input energy to the electric power. For example, the thermionic emitter is one of these direct conversion systems. In this system the cathode is heated by one of the power sources. This heat drives electrons off the cathode surface and forces them to flow to the cold plate (anode), producing an electric current. The thermoelectric system is the one that was used in the small SNAP–3 power generator which was demonstrated by the President and the Atomic Energy Commission a year ago. Any one of these power sources could be combined with any one of these power converter systems to produce useful electrical power output.

We are now initiating the development of one system using solar power and another one using nuclear power. The solar power system is a 3-kilowatt system and is called Sunflower-1. Proposals are now being invited from private industry for the development of that system. One possible configuration is shown on the next chart (fig. 55). This is a solar turboelectric power unit. In this case, the Sun's rays are collected by this large area collector or mirror. The rays are focused on a boiler in which some working fluid and very likely a liquid metal, is boiled. This vaporized liquid metal is then used to drive a turbogenerator which generates electrical power. It is necessary to package the collector during launch periods and then to erect it once we are established in the space environment. A 30-foot-diameter collector is required to generate 3 kilowatts of electric power. At 30 kilowatts of electric power a collector of upwards of 60-foot diameter is required. In order to generate power most efficiently, the collector must be oriented very accurately so that it faces the Sun. This is accomplished by this "Sun seeker" and attitude-control system. In addition, a heat-storage unit must be supplied in order to permit the system to continue generating electric power when the system is on the dark side of an Earth orbit. The Sunflower-1 system will be useful for supplying power to payloads that will be used in our Centaur and Saturn vehicle program.

For generation of large amounts of electric power, nuclear reactor power sources must be used to achieve lightweight systems. For example, nuclear power sources will be required to supply the power required for the high payload electric rockets that I discussed earlier. A schematic drawing of a nuclear electric rocket system is shown on the next chart (fig. 56). In this case, heat from this nuclear reactor is used to boil a liquid metal. The boiled metal is then used to drive a turbine which drives an electric generator and all the pumps needed in the system. The electric power may then be transmitted to an electric accelerator system such as the ion accelerator I described earlier, or it may be used as auxiliary power. Because the system is not 100 percent efficient (in general, a turbogenerator system will have an efficiency up to approximately 20 percent), at least 80 percent of the heat supplied by the power source must be rejected to the surrounding environment. In our ground power stations large condenser coils are set up in flowing water to reject this waste heat. In the space system, we must use a large radiator which will reject the waste heat out to the space environment. For large powers, these radiators may become as large as football fields and methods of packaging them during the launch period and then erecting them in orbit must be developed.

The NASA is now evaluating proposals for the development of a nuclear electric power generating system similar to this one shown here. This system will generate 30 electric kilowatts and is designated as the SNAP–8 system. This project is being conducted jointly with the Atomic Energy Commission. The AEC is developing the reactor for the system and the NASA will develop the equipment to convert from reactor heat power to electrical power output. The SNAP–8 system is the first electric generating system that will be capable of supplying both auxiliary power and useful propulsive power.

On the final chart (fig. 57), I have summarized the budget requests in the area of propulsion technology. For solid rockets, we are requesting $2.8 million during fiscal year 1961. Liquid rockets, which includes the development of the million and a half pound engine and the 200,000-pound hydrogen-oxygen engine, as well as some advanced technology, we are requesting $40 million. For nuclear systems technology, including both the nuclear electric generating systems and the nuclear rocket, we are requesting $10 million. For space power technology, including the development work being done on electric thrust generators and on nonnuclear electric power generating systems such as the Sunflower–1 system, we are requesting $8 million.

(NOTE.—The 14 charts cited in Mr. Finger's prepared statement will be found in his oral presentation, which follows:)

TESTIMONY OF HAROLD B. FINGER, CHIEF NUCLEAR ENGINES DIVISION, SPACE FLIGHT DEVELOPMENT, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Mr. FINGER. Mr. Chairman and members of the committee, the NASA propulsion technology program is directed toward three principal objectives. First, we are trying to develop existing engine concepts for specific missions and specific applications.

Second, we are trying to improve these existing chemical rocket systems so that we can get more payload or greater range out of them; and third, we are trying to demonstrate and evaluate the feasibility of many exciting concepts that have been proposed for space missions.

I should point out that not all of these new concepts will necessarily be usefully applied, but their potential, their payload potential is so great that we must not neglect them.

Our first chart deals with chemical rocket systems, specifically liquid propellant systems (fig. 44, p. 321).

As you know, the oxygen and the fuel are mixed in a combustion chamber producing a high-temperature gas as a result of burning.

This high temperature is exhausted through the jet nozzle producing the thrust that propels the rocket.

In our conventional engines we use oxygen although we are doing research work for advanced systems where we might use fluorine as the oxidant.

In addition, in our present-day engines, we have been using kerosene and now, more and more, we are using hydrogen as the fuel.

As examples of our work in this system, as you already know, we are developing a million and a half pound thrust single-chamber engine for use in vehicles beyond the Saturn vehicle.

This engine is also intended for use in the Nova vehicle concept which Mr. Horner mentioned last week and which will be discussed later in these hearings.

We will also initiate the development of a 200,000-pound hydrogen-oxygen engine for application to upper stages in our Saturn vehicle and this engine I am sure will be discussed by Dr. von Braun, tomorrow.

In these chemical systems as you know, the specific impulse or the amount of thrust we get out of every pound of fuel flowing out of the jet nozzle in a second is limited by the chemical energy of the fuel. For the very best chemical rockets, we can expect up to 450 pounds of thrust per pound per second of flow out the jet nozzle.

As an example of our work aimed at improving these systems, I have selected the solid propellant research and development program.

This chart indicates some of our work in this area (fig. 45).

Specifically, we are trying to develop high performance solid propellent rockets. By "high performance" I mean that we are trying to develop rockets which have a very small empty weight. This empty weight is made up of such items as the propellent casing and the jet nozzle. In liquid rockets it is also made up of structural weight.

Since these rockets will generally be used in the last stage of our multistage vehicles, every pound we shave off the empty weight of the rocket permits a pound to be added to payload, or a pound to be added to propellant so we can propel the vehicle farther.

In addition to trying to reduce this weight, we are also trying to develop methods for steering these rocket motors and also for controlling the path of our vehicle. The solid and storable liquid propellent rockets are very well suited for these applications because these propellants are stable and don't boil off. We can use them for controlling our flight paths over the very long interplanetary trajectories.

With regard to lowering the empty weight of these rockets, we have found we can operate the solid propellent rockets at low internal pressure and, with a low pressure, we can go to very light weight structures in the propellent casing.

For example, we are talking about using fiber glass—thin fiber glass, plastic impregnated casings rather than steel casings.

In addition we are studying ways of cooling the jet nozzle. This is another way of reducing the weight of the jet nozzle which incidentally, in the solid propellent systems, makes up the largest part of the empty weight of the rocket.

I should also mention some work on solid propellent rockets, on analysis and research experimental work aimed at studying the applicability of these rockets to large ground boosting systems; that is, large thrust systems. This has been proposed, and we are studying the applicability of these systems to such application.

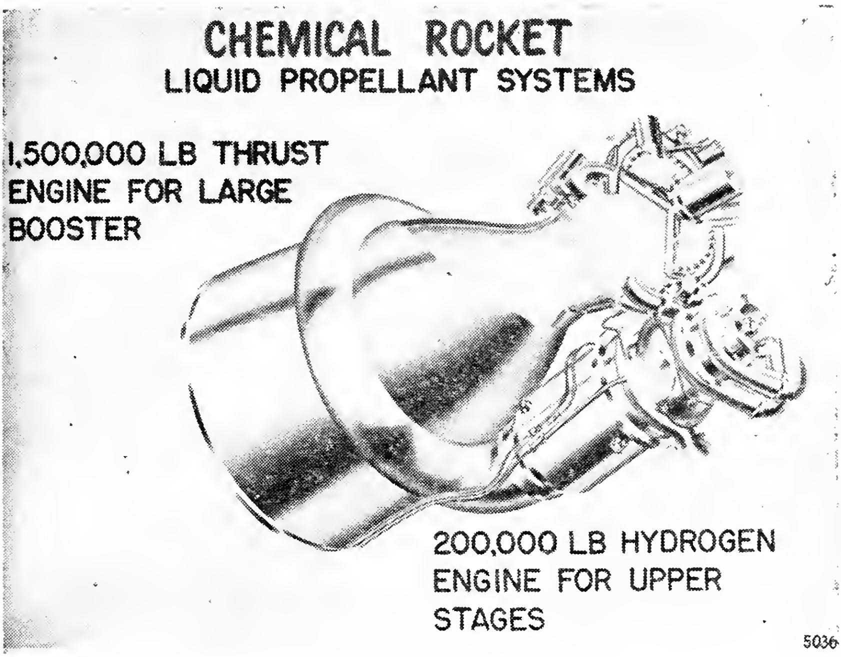

FIGURE 44

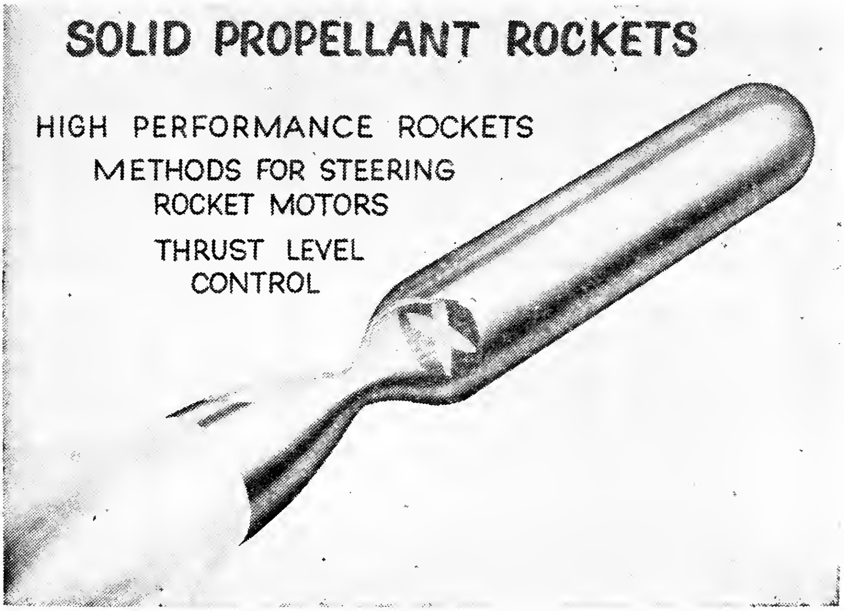

FIGURE 45

Now, to go on to our advanced systems. We will hear more discussion on the chemical systems with each vehicle that is discussed, and I believe that you are familiar with our developments in this area (fig. 46).

I would like to discuss first the nuclear rocket program. The nuclear rocket is an area in which we are particularly interested. Here I have indicated an engine for such a system made up of a liquid hydrogen storage tank, a pump which pumps hydrogen out of the tank and passes this hydrogen down to the jet nozzle where the hydrogen is used to cool the jet nozzle. This hydrogen passes through the reactor where it is heated to high temperature and is expanded through the jet nozzle, producing thrust.

In this system the specific impulse is no longer limited by the energy contained within the hydrogen itself. Rather, the specific impulse

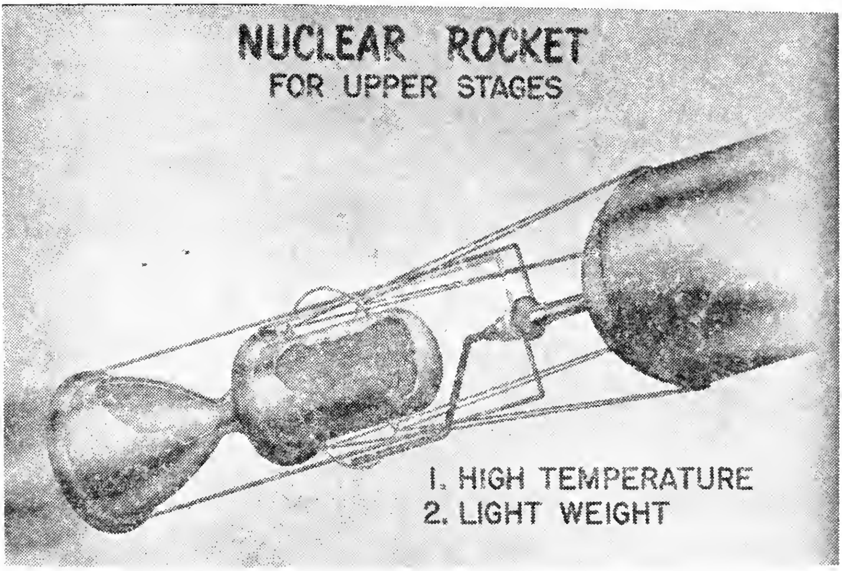

FIGURE 46

is limited by the temperature at which we can operate these fuel elements in the reactor.

The fuel element is made up of uranium impregnated in some structural material which can stand high temperature. The uranium fissions, produces heat in the fuel element, and these hot fuel elements then transfer the heat to the hydrogen that flows by them.

We can expect to develop these systems so we will be able to get up to a thousand pounds of thrust for every pound of hydrogen flowing per second. A specific impulse of a thousand compared with, say, 450, for the best liquid propellant chemical systems is conceivable.

In order, however, to make these systems superior in performance to the chemical systems we must learn to operate them at very high temperatures. The higher the temperature, the higher the specific impulse. If we want 1,000 specific impulse, we must go to extremely high temperatures.

In addition, we must learn to build reactors that are small and therefore light in weight.

Another propulsion system that has been proposed and is being worked on both in industry and NASA is the electric rocket.

Here I have indicated what this system might look like. It is complicated, and therefore a great deal of research and development must be done on this system (fig. 47).

In general it consists of a system for generating electrical power. This power is then supplied to an electric thrust generator. In all of these systems, the electric generating equipment weighs significantly more than the thrust that can be produced by the electrical accelerator.

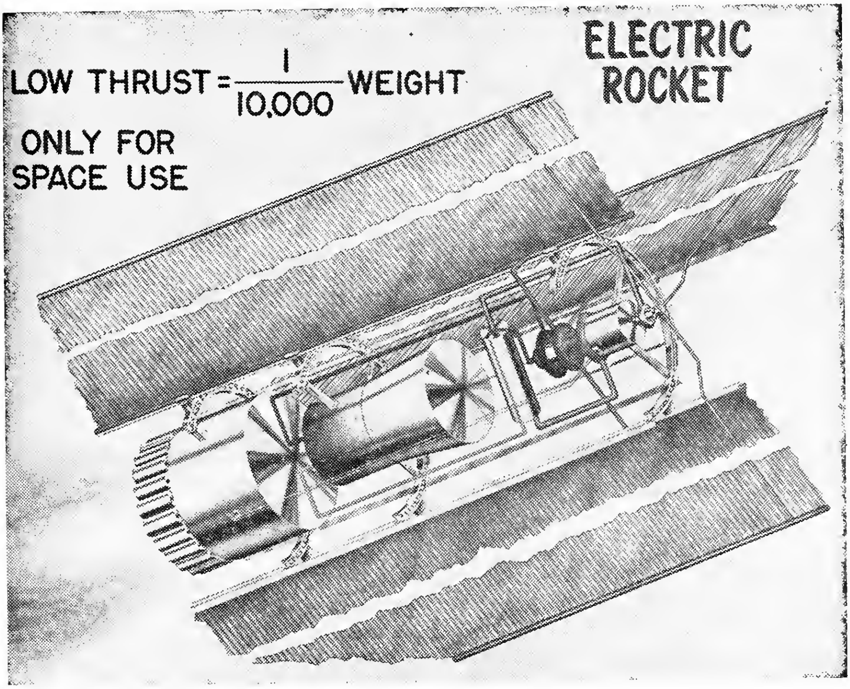

FIGURE 47

In fact, our present estimates indicate that the low thrust may be one ten-thousandths of the weight of the electric rocket. Since thrust is lower than the weight, this rocket cannot boost itself from the ground. It can be used once we are established in an orbit around the Earth. It may be raised by chemical or other means and once it is in orbit, it can use this small thrust to propel a spacecraft.

Therefore, this rocket is only applicable for space missions.

In this case, I have indicated several ion accelerators, such as those we are studying at the Lewis Research Center, clustered together to give the thrust desired. There are many kinds of electrical thrust accelerators and later I will show that there are also many kinds of electric generating systems.

On the next chart I have shown one of these electrical thrust accelerators, an ion-thrust accelerator, operating in a vacuum tank facility.

The area here is the ion source. Ions are positively charged atoms. Electrons have been driven off of the atomic structure. The ions are produced here at the ion source. They are then accelerated electrically through an electrical accelerator producing the blue ion beam (fig. 48).

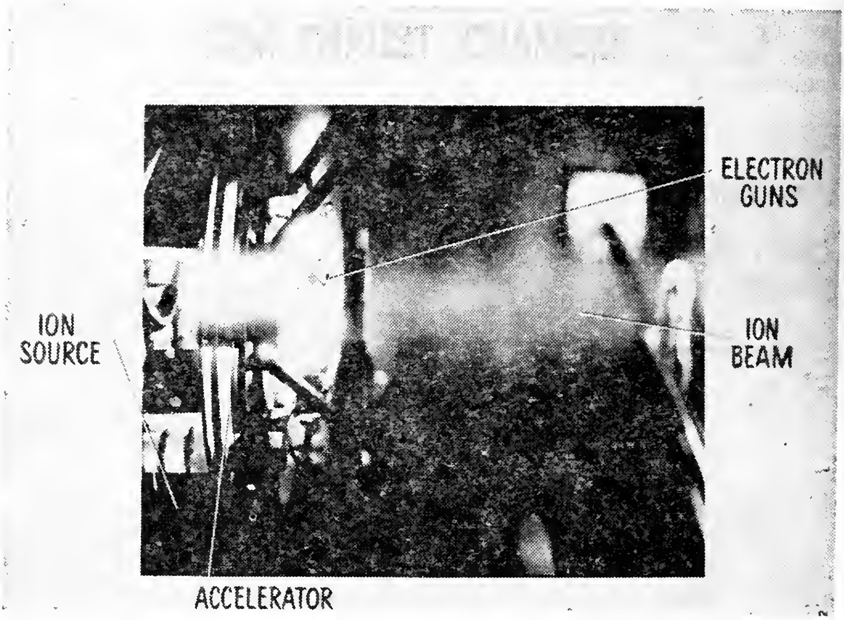

FIGURE 48

These electron guns are used to fire electrons into the beam and the reason for this is that we must neutralize the charge in this jet area. If we were left with a large positive charge, the positive charge here would keep the positive ions from moving out the jet, giving us a low impulse.

The reason we are particularly interested in both the nuclear rocket and these electrical rockets is that they give us the capability of performing missions that we can't do with even the large chemical launch vehicles we are studying.

We can get a large specific impulse out of the nuclear and electric rocket systems. In other words, we get a large amount of thrust for every pound of propellant flowing through the system, so we need a small total amount of propellant to do a specified job. This leaves us room for engine, structure, and payload (fig. 49).

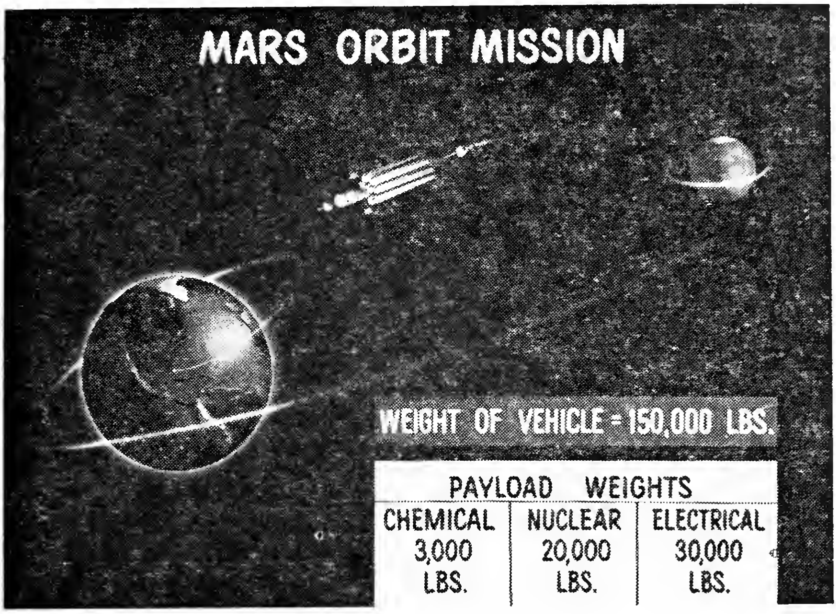

FIGURE 49

Here we have the payloads shown for these advanced systems. I have selected here, for example, a Mars orbit mission, in which case the space vehicle weighs 150,000 pounds. It may have been boosted there by chemical means or nuclear rockets combined with a chemical rocket.

This spacecraft vehicle takes off from the Earth orbit, goes out and orbits Mars and then returns to the Earth orbit.

Down here in the yellow block I have indicated payloads that can be returned to the Earth orbit using a chemical vehicle, nuclear or electrical. The nuclear and electrical can return significant payloads, 20,000 to 30,000 pounds, almost 7 to 10 times as large as the chemical rocket system.

In addition to this payload advantage, the nuclear and electrical system may be able to do this job with one stage while the chemical would be at least a three-stage vehicle, and very likely a four-stage vehicle.

Now, thus far I have discussed our proposed development program objectives. I have indicated some of the chemical rockets that we are developing. I have also indicated these advanced systems that we are working on.

Now, I would like to go into a further discussion of the development work on the nuclear and the electric systems and I will not dwell further on the chemical systems.

We are conducting a program jointly with the Atomic Energy Commission aimed at evaluating the performance capability of nuclear rockets (fig. 50, p. 326).

This chart indicates our nuclear project program goals.

The Atomic Energy Commission, through its Los Alamos Laboratory, is charged with the responsibility of investigating reactor feasibility which will be achieved when we have demonstrated the operation of a breadboard engine.

Now, this research breadboard engine is made up of the principal components of a flight nuclear rocket. However, these components may not be packaged as they would be in a true flight system. Also, they are not necessarily flight-weight components, but they do give us the interaction of all the principal components, so we determine how these engines will operate.

In developing this breadboard engine, NASA is supplying support to the Atomic Energy Commission. Specifically, we are supply-

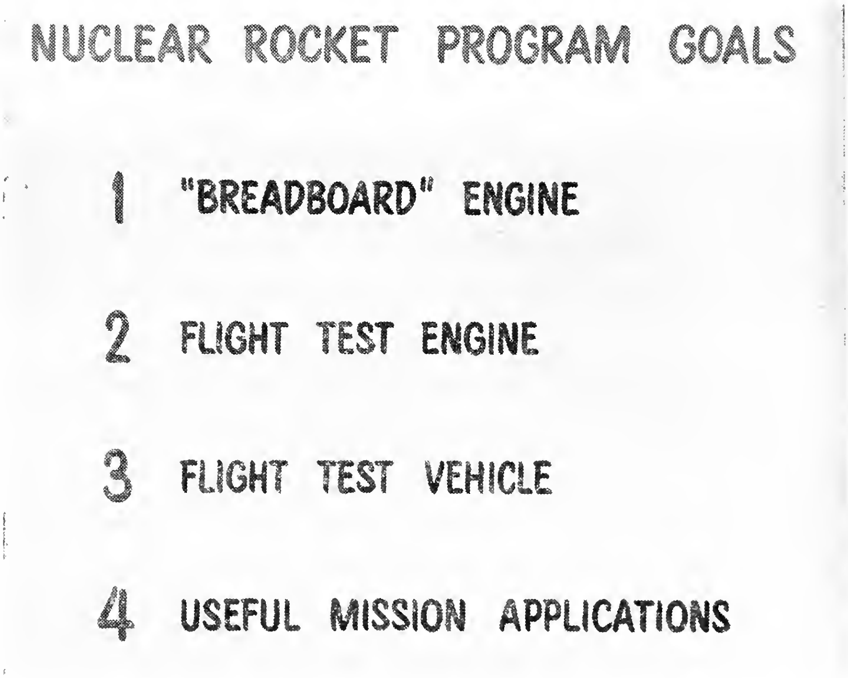

FIGURE 50

ing and developing certain nonnuclear components to the reactor tests and we are also supplying all the liquid hydrogen needed in the program.

Beyond the breadboard engine development, prime responsibility for the program transfers to NASA in these following steps, with the Atomic Energy Commission supplying all of the reactor support to this program. Specifically, NASA is responsible for the development of the flight test engine, developing and operation of the flight test vehicle, and finally, application of the rockets for those applications to which it is particularly well suited.

As you all know, the first step in achieving the breadboard engine was taken just this past summer when the Los Alamos Scientific Laboratory tested the research reactor, the KIWI–A reactor.

This shows the reactor on its movable railroad test car. It was moved from the assembly building by remote control on this car. It was tested, and after testing was moved back for disassembly (fig. 51).

The reactor was fired upward in this case—this is the jet nozzle—in order to simplify the test facility.

In addition, this reactor is water cooled rather than liquid hydrogen cooled and the propellant was gaseous hydrogen rather than liquid hydrogen. The choice of water for cooling the jet nozzle and gaseous hydrogen for the propellant were dictated to keep the operations as simple as possible so we would be sure of getting the necessary reaction.

Mr. FULTON. Show us the breadboard engine.

Mr. FINGER. I don't have a picture of the breadboard.

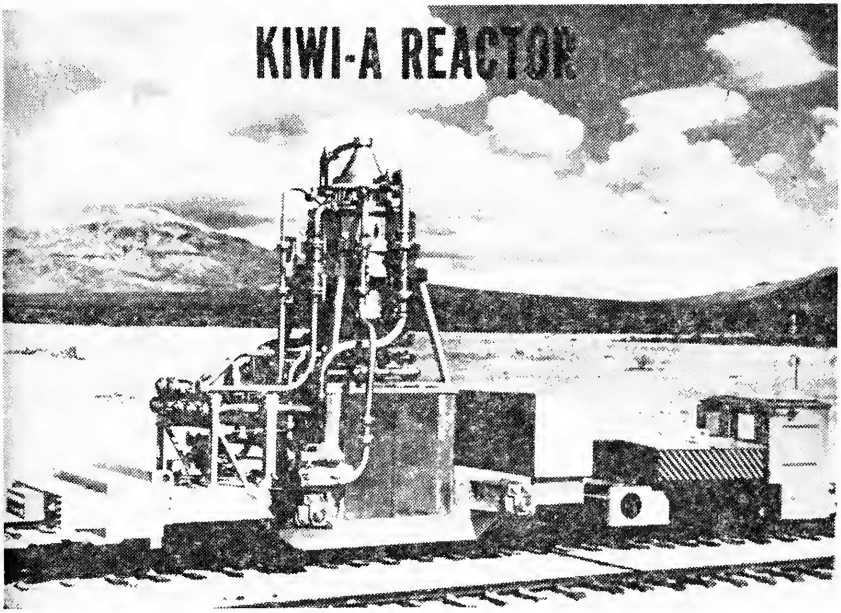

FIGURE 51

Mr. FULTON. Is the board to divide the various elements?

Mr. FINGER. "Breadboard" is really a term given to a system which tries to simulate operation of a true system, but doesn't necessarily put these in their proper relative position.

Mr. FULTON. It is the position of the various elements that are concerned in the word "breadboard" that I am trying to bring out.

Mr. FINGER. I am just not sure I understand your question.

Mr. FULTON. Go ahead.

Mr. FINGER. The KIWI–A project is aimed at developing the breadboard—I almost hesitate to use the term.

Mr. FULTON. Would you please define it?

Mr. FINGER. It is an engine having all the principal components of the engine unit, but not necessarily utilizing flight weight components or necessarily packaging these components as they would be in a flight system. It is a simulated engine.

Mr. FULTON. Go ahead.

The CHAIRMAN. Is that clear to all the members?

Mr. FULTON. Really, you could call it a prototype?

Mr. FINGER. No; a prototype is an early flight engine. A breadboard is earlier than a prototype.

The CHAIRMAN. It is a design engine?

Mr. FINGER. No; it is not even that. A prototype is a design engine.

The CHAIRMAN. A drawing board engine?

Mr. FINGER. Yes; but it includes hardware so that it is more than that.

Mr. FULTON. Actually it is a mockup then that is workable and is not just a drawing board engine with hardware on it?

Mr. FINGER. That is correct.

Mr. FULTON. It has no relation to flight, size, or place in the vehicle?

Mr. FINGER. That is correct.

The CHAIRMAN. Mr. Finger, I question whether all of the members of the committee are hearing you.

Why don't you gentlemen come on down closer? It is not that you are not talking loud enough, Mr. Finger, but the acoustics are so bad it is a little difficult to hear you.

Mr. FULTON. The good doctor wants to know whether breadboard has any Greek mythology background in the naming of it.

Mr. FINGER. I will try to determine that.

The followon steps to this KIWI–A reactor are aimed or will be aimed at a logical development program which will culminate in the mockup engine Mr. Fulton referred to.

Specifically the breadboard engine will include a hydrogen tank. It will be a large sphere actually. It will include a pump and a turbine to pump hydrogen out of the tank into the reactor; it will include a reactor—not necessarily a flight weight reactor—and it will also include a liquid hydrogen jet nozzle (fig. 52).

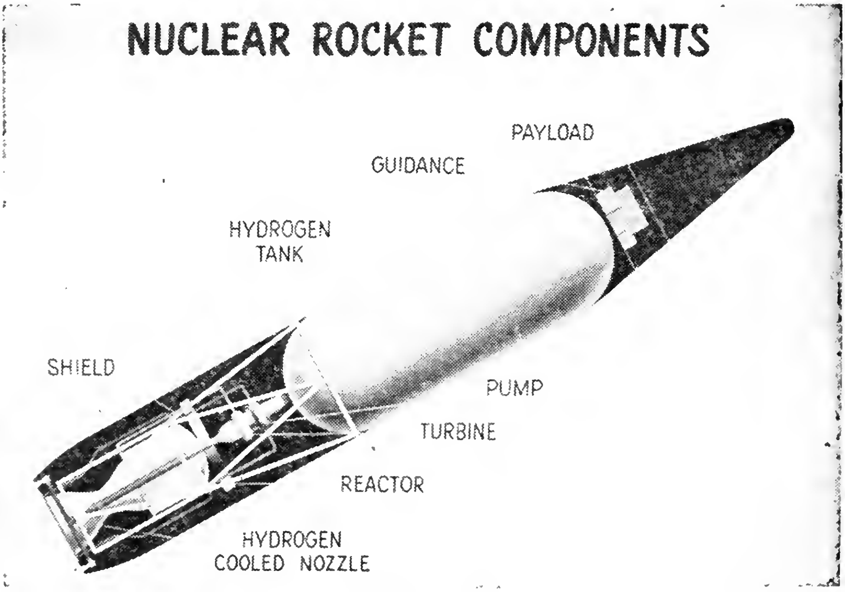

FIGURE 52

The NASA is developing all of these nonnuclear components. Specifically, we are funding the development of the pump and turbine to be used.

This year we will undertake the development of a hydrogen-cooled nozzle, also to be used in the reactor tests.

Not shown on the chart is an automatic control system which will automatically control both the reactor and the flow system. This, too, will be developed and studied by NASA.

Now, in addition to the work in the breadboard engine development we are already initiating work to study the flight test system that may be used for the nuclear rocket program.

This is one of the possible flight test vehicles we might use. In this case I have shown the two-stage Saturn vehicle which will be discussed by Dr. von Braun. This vehicle could be used to boost a nuclear stage rocket into orbit around the Earth. Once it is established in the orbit, this stage will be fired up and it will be tested under conditions that simulate the operation of a nuclear rocket on a useful space mission. This will be an orbital rocket test (fig. 53).

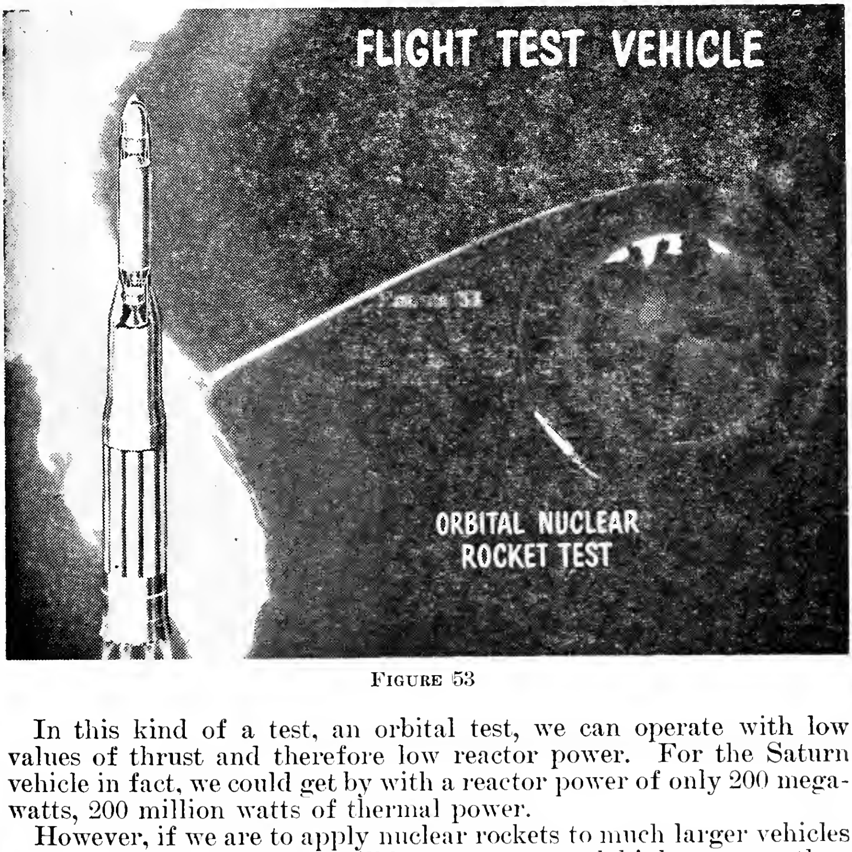

FIGURE 53

In this kind of a test, an orbital test, we can operate with low values of thrust and therefore low reactor power. For the Saturn vehicle in fact, we could get by with a reactor power of only 200 megawatts, 200 million watts of thermal power.

However, if we are to apply nuclear rockets to much larger vehicles or to second stages, then we will have to go to much higher powers than 200 megawatts.

In addition to our work on the nuclear rocket, we are studying various methods of generating electric power in space.

We want power for rocket systems and also on every one of our satellite space probe missions in order to collect data and transmit the data back to Earth. All of these electric power generating systems are made up of some kind of a power source which supplies energy—it might be heat—to systems that convert that energy to electric power output (fig. 54).

We have chemical, solar, or nuclear power sources. The chemical could be a chemical battery, or we may use the heat of the Sun, and we may use the fission of uranium.

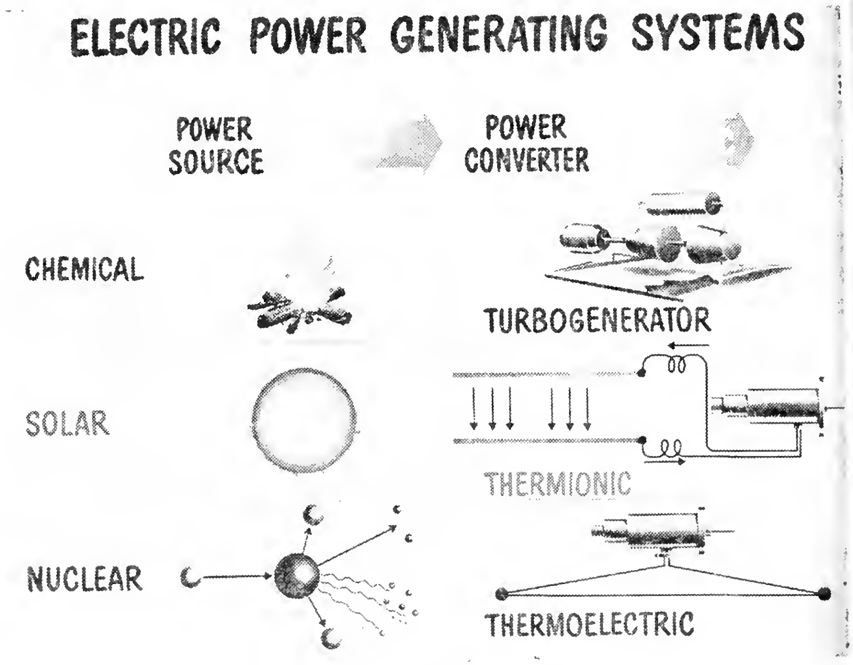

FIGURE 54

The power converter can be a turbogenerator in which a turbine runs a generator like our steam turbines in a ground powerplant.

Or, we may use direct conversion systems, thermionic system or thermoelectric systems. This is much like our radio diode tubes where the electrons are transmitted between electrodes from the hot to the cold plate. Or we may use the thermoelectric system which was the one used on the SNAP–3 power generating system demonstrated by the President and the Atomic Energy Commission about a year ago.

Any one of these power sources can be combined with any one of these power converters to generate electrical power.

Chemical systems give low power or a short duration of power, so we prefer the solar and the nuclear power for longlived systems.

We now have being initiated a solar-powered generating system and a nuclear system.

Mr. FULTON. Before you leave that, are you working on the electromagnetic system to be operated in the Van Allen radiation belt?

Mr. FINGER. Yes, there is study being done on using the motion of charged particles through such a magnetic field to produce an electrical output.

Mr. FULTON. With reference to your word "solar" there, are you working on a solar sail system? Actually, is there a program of research and development underway or is that just an indication that you could use it for electric batteries?

Mr. FINGER. This is specifically aimed at generating electrical power. The solar sail is a propulsion device and requires solar collector areas acres in size. This kind of a system has been reviewed in our NASA research centers. Specifically, our Lewis Research Center has made some analytical studies. There are also other people working on it.

Mr. FULTON. Apart from the ordinary equipment, such as generators and batteries, have you carried on any research in rockets as a separate program?

Mr. FINGER. Yes, sir.

Now, one possible configuration of the solar turboelectric system is the one that Dr. Abbott showed this morning. He had a model of it, with a collector, turbogenerator, and the Sun seeker to keep the collector oriented in space (fig. 55).

In addition, in order to supply power when this solar system goes around to the dark side of the orbit, we have a heat storage unit which would be used on the dark side. This is a boiler which supplies hot vapor to a turbogenerator.

One of the problems here is that, in order to generate electric power with a solar system, we must be able to package this collector into the nose cone of our vehicle and then erect it once we are up in space.

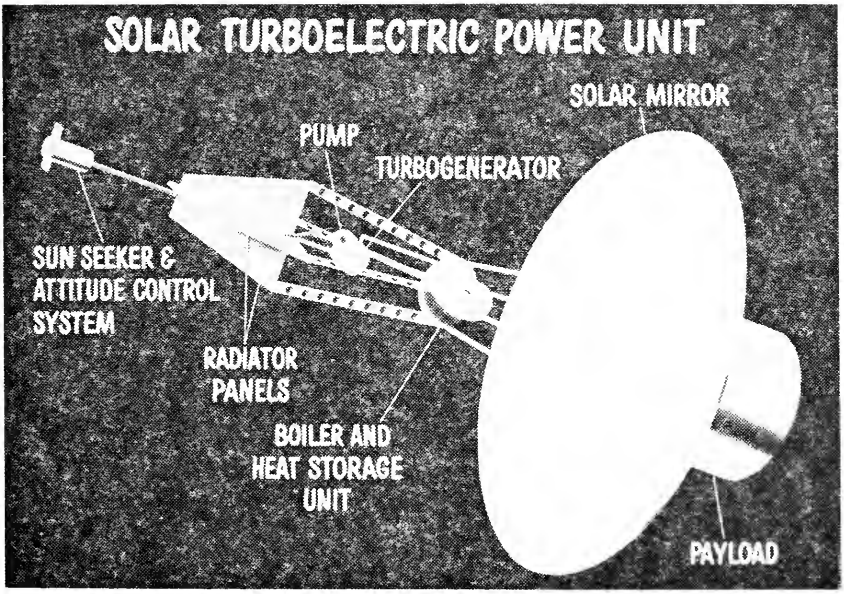

FIGURE 55

For 3 kilowatts of electric power, the diameter of this collector must be 30 feet. If you wanted to generate 30 kilowatts, then we have to go to something in excess of 60 feet in diameter.

This first solar system will be called the Sunflower–1.

If we want more power, we must go to reactor power systems, such as the one shown on this slide.

In this case the heat is supplied by a reactor which transfers the heat to a boiler and a working fluid. The working fluid, rather than being water and steam as in our ground stations, will probably be vaporized metal in these space systems. These vaporized metals drive a turbine which drives a pump and a generator in the system (fig. 56).

This generator electric output may be used for an electric thrust producer or to produce ordinary power.

Now, this system is not 100 percent efficient. In fact, it is only up to 20 percent efficient and therefore it is at least 80 percent of the heat generated in the reactor which must be rejected to space. In our ground power systems we usually reject this waste heat in a condenser set out into a flowing river.

For large powers we need a large area and the radiator may become almost as large as a football field. This radiator will have to be packaged in the launch vehicle and then erected in space.

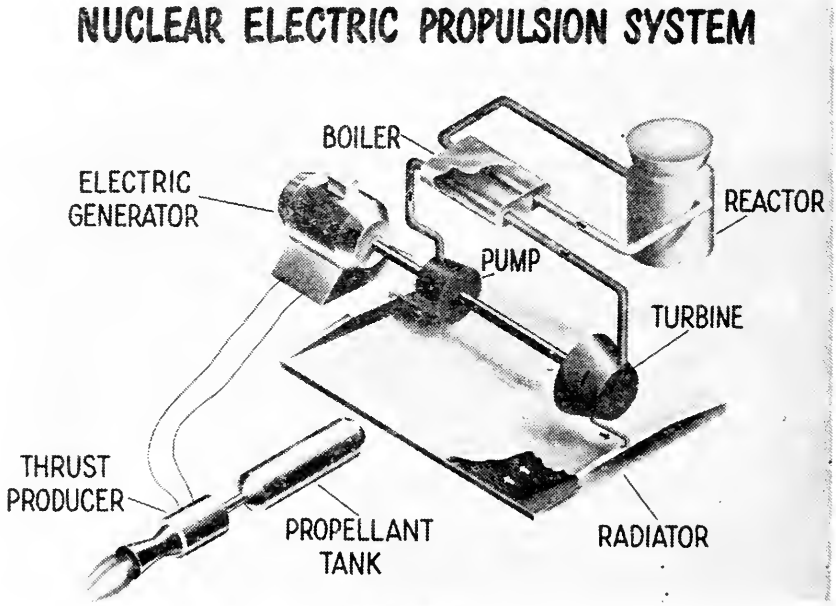

FIGURE 56

We are now initiating the development of a nuclear electric power generator capable of developing 30 kilowatts of electric power and this is called the SNAP-8. This program is being operated jointly with the Atomic Energy Commission. Specifically, the AEC is developing a reactor and the NASA is developing the conversion equipment, the equipment to convert the thermal power to the electrical power.

Mr. FULTON. Could I ask you why have you such a low rate of efficiency on the conversion of the heat into actual power? What is your trouble?

Mr. FINGER. All of these thermodynamic cycles have a maximum efficiency. There are no practical cycles of higher efficiency. You must reject waste heat due to the cycle and component inefficiency. This Carnot maximum cycle efficiency is of the order of 25 percent.

Mr. FULTON. That is just the same as it is in the atmosphere. I thought you could do better in space.

Mr. FINGER. No. This is a closed loop system that keeps working on the same fluid all the time. For example, in this primary loop if you didn't reject heat to the boiler, the temperature would continue to rise. Similarly, if you didn't reject heat through the radiator, the temperature in this loop would continue to rise to higher and higher levels. In order to maintain a stable operation, we must reject the waste heat of the thermodynamic cycle and the inefficiency of all of the components.

The CHAIRMAN. You say you use the same material over and over again?

Mr. FINGER. Yes, sir.

The CHAIRMAN. How do you recapture it then?

Mr. FINGER. It is not released at all. You will notice that this is a closed loop.

The CHAIRMAN. You release your heat and that permanently takes something away from the material, doesn't it?

Mr. FINGER. No, it just drops the temperature of the material.

The CHAIRMAN. Doesn't that take something away from it?

Mr. FINGER. It takes energy away.

The CHAIRMAN. It takes energy out of the material?

Mr. FINGER. Yes, but then the material itself, the mass of material, continues to flow.

The CHAIRMAN. How do you reenergize the material?

Mr. FINGER. Through the reactor energy which supplies heat to the boiler. The reactor keeps producing energy while we are using it here.

The CHAIRMAN. It is a nuclear reactor then?

Mr. FINGER. Yes, sir.

The CHAIRMAN. That is where you get the basic energy?

Mr. FINGER. And it keeps developing energy for a very long life, continually.

Here I have indicated fiscal years 1959, 1960, 1961. In my final chart I have indicated our budget requests for propulsion technology (fig. 57, p. 334).

For liquid propellent rocket we are requesting $40 million plus additional funds just mentioned at the start of this session. Specifically, rather than only $25 million for the million-and-a-half-pound

SPACE PROPULSION TECHNOLOGY BUDGET

	1959	1960	1961
LIQUID PROPELLANT ROCKETS	**15.98**	**30.30**	**40.00**
1500 K ENGINE	10.00	24.20	26.00
165 K LIQUID H_2-O_2 ENGINE		1.70	8.00
ADVANCED TECHNOLOGY	5.98	4.40	6.00
SOLID PROPELLANT ROCKETS	**.62**	**3.79**	**2.80**
NUCLEAR SYSTEMS TECHNOLOGY	**3.80**	**6.00**	**10.00**
NUCLEAR ROCKET	3.00	4.10	5.50
NUCLEAR ELECTRIC GENERATING SYSTEMS	.80	1.90	4.50
SPACE PROPULSION & AUXILIARY POWER UNITS		**4.82**	**8.00**
SPACE PROPULSION		1.60	2.90
AUXILIARY POWER UNITS		3.22	5.10

FIGURE 57

thrust engine, we will now have $41 million with this supplemental money, with the additional request that the President has just announced.

For the 200,000-pound liquid hydrogen-oxygen engine we will now have $16 million. For the other advanced technology work, which is the work aimed at improving the performance of our chemical rocket systems and learning more about advanced systems; $6 million.

In the solid propellent rocket program, we are requesting $2.8 million. For nuclear systems, including the nuclear rocket and the nuclear electric generating systems, we are requesting $10 million.

And finally, for space propulsion and auxiliary power units, including the electrical thrust accelerator and the nonnuclear auxiliary power units such as the Sunflower-1 solar system, we are requesting $8 million.

Thank you.

The CHAIRMAN. Thank you very much, Mr. Finger. We appreciate your very learned explanation.

Now, are there any questions from the committee?

Mr. FULTON. I have one.

The CHAIRMAN. Mr. Fulton has a question.

Mr. FULTON. Why don't you, when you are trying to get rid of your heat—you only have 20-percent efficiency—try to combine some sort of an ion emission system and use your heat and discharge to come up with a positive ion emission and that will give you a propellant? It would be useful in space, but it wouldn't be much here.

I wonder, since your efficiency is so low, why don't you use it?

Mr. FINGER. What you are suggesting is certainly feasible. We could put thermionic emitters on the radiating surface, but it would then turn out that we would lose more through added weight than what we gain in power. We could end up with a lighter system if we build a higher powered system to begin with and just lose this heat. It would be a lighter system.

Mr. FULTON. Well, isn't there some better way than just radiation from an exposed surface in space of dispelling heat in?

Mr. FINGER. This is really something we are looking for. It introduces many problems. We haven't found any other way except to just have tubes and fins connecting the tubes, giving us a hot surface radiating heat away.

Mr. FULTON. Your exposed surface likewise gets solar heat, compounding your own trouble by making exposed surfaces.

Mr. FINGER. That is correct, but we have a net heat loss because of distance from the sun, reflection, and the radiator orientation.

In other words, the sun delivers 125 watts per square foot most of which is reflected and we would radiate more than that at the temperatures at which we would operate.

Mr. FULTON. Would it be possible to have some sort of an electrode set up where you could discharge it in the form of a spark. You would just have a pink-bluish spark emitting out into the vacuum.

Why couldn't you do that?

Mr. FINGER. You really don't use energy that way unless you have something flowing with it. In other words, this spark has to heat something. It has to heat a mass in order to lose the energy.

Mr. FULTON. Doesn't the fact that the spark has a pressure cause a thrust which would then cause a loss of energy?

Mr. FINGER. Yes, sir. If it has a pressure and produces thrust then it will cause loss of energy. This will be the energy of the propellent moving out.

Mr. FULTON. That is all.

The CHAIRMAN. Any further questions? Mr. Hechler?

Mr. HECHLER. Mr. Chairman, on behalf of my eminent colleague, Mr. Fulton, and myself I would like to ask this question: Have you ever done any research on the possible use of derivatives of coal as a propellant?

Mr. FINGER. If you are thinking of hydrocarbons and so on——

Mr. FULTON. Preferably Pennsylvania and West Virginia coal.

Mr. HECHLER. I mean this question quite seriously.

Mr. FINGER. For the systems we are talking about, they wouldn't have high enough energy per pound. We are looking for very high energy systems or low molecular weight systems. For example, in the nuclear rocket we want hydrogen because it is the lowest molecular weight fluid and gives us a high specific impulse.

The CHAIRMAN. Any further questions? Mr. Roush?

Mr. ROUSH. I was wondering if, in your original request for funds the additional amounts the President has authorized for your F–1 engine and your liquid hydrogen engine were included.

Mr. FINGER. Originally?

Mr. ROUSH. Originally.

Mr. FINGER. Yes; I believe they were; on the F–1 engine, I believe so. I am not sure of the hydrogen-oxygen engine.

Mr. HORNER. The numbers shown on the chart did not include the augmentation of the budget announced by the President.

Mr. ROUSH. I realize that and that is the reason for my question. I was wondering whether, when you made your original request for funds, you limited it to the figures I saw on the chart or whether you included that which the President finally has authorized.

Mr. HORNER. This goes back to the discussion we had the day before yesterday concerning the request we had made of the Bureau of the Budget in the budget authorization process.

The answer to your question is that there was additional money in our original request upon the Bureau of the Budget, on the F–1 engine, but at that time we did not have responsibility for Saturn, so this problem wasn't treated as a whole at that time.

Mr. ROUSH. That is all.

The CHAIRMAN. Any further questions?

Mr. FULTON. I have one.

The CHAIRMAN. Mr. Fulton has a question.

Mr. FULTON. From what you say, it appears that the development of plasma propulsion is not a part of your program. Where do you fit that in?

Mr. FINGER. The example I chose was the ion accelerator and it is only one example of the many electrical thrust producers that are possible. We are investigating them all, including plasma.

Mr. FULTON. So you do have a broad program of plasma propulsion?

Mr. FINGER. Plasma propulsion is one and electrically heating a plasma is another.

Mr. FULTON. A Russian scientist has come up with the idea of using the magnetic field as a propellant. For example, you have a positive pole and a negative pole. He would change the emissions and thus get an attraction or a repellant.

Have you done anything on that the way the Russians are saying they are doing?

Mr. FINGER. Do you mean using the Earth's magnetic field?

Mr. FULTON. Yes.

Mr. FINGER. Of course, this would then require that you launch in certain directions and maintain this kind of a direction all the way.

It also means that you have a problem of worrying about the change in the magnetic field intensity, with mission location.

Mr. FULTON. Are you doing anything on that the way the Russians say they are? They are going to have a vehicle that will operate just on magnetic fields as propellants.

Mr. FINGER. No, sir. There may be something going on in our research, but I don't know of it myself.

Mr. FULTON. That is all.

The CHAIRMAN. Thank you, Mr. Finger. We appreciate your fine statement very much.

The next witness we have here is Dr. Homer E. Newell, Jr. Dr. Morris Tepper is here too, isn't he?

Mr. HORNER. Yes, sir.

The CHAIRMAN. And Richard Rhode, is he here too?

Mr. HORNER. They are all here.

The CHAIRMAN. Then they can all be sworn en masse.

Do you, and each of you, solemnly swear the testimony you are about to give on the subject under discussion by this committee is the truth, the whole truth, and nothing but the truth, so help you God?

Mr. NEWELL. I do.

Mr. TEPPER. I do.

Mr. RHODE. I do.

STATEMENT OF DR. HOMER E. NEWELL, JR., ASSISTANT DIRECTOR, SPACE SCIENCES DIVISION, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

The CHAIRMAN. As members of the select committee will remember, Dr. Newell was one of our friends and supporters and advisers on the select committee. We are happy to have you again here, sir, upon this occasion.

Dr. NEWELL. Thank you, Mr. Chairman.

The CHAIRMAN. Do you have a prepared statement, Doctor, or would you just like to give us a verbal statement like Mr. Finger did?

Dr. NEWELL. I have a written text which may be distributed but I would like to talk——

The CHAIRMAN. Fine. If there is no objection, we will place Dr. Newell's statement in the record.

(The statement referred to follows:)

STATEMENT BY DR. HOMER E. NEWELL, JR., ON NASA SPACE SCIENCES PROGRAM

This presentation answers four important questions:

(1) Why must NASA do research in space?

(2) What are the objectives of space-sciences research?

(3) What is this agency's space-sciences research program?

(4) How much will this space sciences research program cost in fiscal year 1961?

Now, why must NASA do research in space? The many reasons can be summarized by the observation that such research contributes materially to each of the eight objectives enumerated by the Congress in the National Aeronautics and Space Act of 1958 and, in fact, constitutes the very first objective: the expansion of human knowledge and phenomena in the atmosphere and space. Furthermore, before man ventures into this new and hostile environment of radiation belts, solar winds, cosmic radiation, and meteorites, we must learn enough about this environment to insure man's safety.

Next, what are the NASA space-sciences research objectives? In the past, man was limited to observations which could be made at or near the surface of the earth. Now, the scientist can send his measuring equipment on sounding rockets and satellites throughout the earth's atmosphere and into space beyond the moon on lunar and planetary probes. Even those regions of the universe which instruments cannot reach have been opened up to more penetrating study; for telescopes and satellites coursing above the earth's atmosphere can observe the radiations in all of the wavelengths which arrive from the vast depths of space. Unobscured and undistorted by the earth's atmosphere, these radiations may be expected to reveal a hitherto inaccessible wealth of information about the universe.

Seizing upon the new opportunities, scientists the world over are busily investigating a wide range of phenomena. The geophysicist is using sounding rockets and earth satellites to study the properties and behavior of the earth's atmosphere, ionosphere, magnetic field, auroras, and other phenomena in space close to the earth. Cosmic rays, radiation belts, and the solar wind are under intensive investigation thousands of miles above the earth. The moon, the sun, and the stars received their due share of attention. Cosmic experiments to study gravity and relative theory, to observe physical processes and materials in the environment of space, and to probe the mysteries of life in space are in preparation. Manned flight away from the earth into the hostile environment of space is imminent. In support of this worldwide quest for knowledge and experience, hundreds of sounding rockets and more than a dozen satellites and space probes are to be fired each year for the foreseeable future.

At first glance, this broad range of activities may seem disconnected and random. But in all this activity there is one simple, coherent pattern. One clear-cut, concise set of objectives ties together and motivates all of this activity. These objectives are:

(1) To understand the nature of the control exerted by the Sun over events on the Earth;

(2) To learn the nature and origin of the universe, including the solar system; and

(3) To search for the origin of life and its presence outside the Earth.

Let us consider the first objective. The Sun affects every aspect of human activity. If its radiation were to increase or decrease by a small fraction of 1 percent, our present mode of existence would undergo marked changes. Knowledge of the Sun and its influence on the Earth has direct bearing on our daily activity and our very existence.

Actually, we know that the total solar energy output does not, and should not be expected to, change appreciably. It is for this reason that the solar energy reaching the Earth's surface per square centimeter per minute is called the solar constant. It is this energy in the visible and infrared regions of the spectrum which furnishes the driving power for our winds, storms, and the other manifestations of weather.

But one small part of the Sun's energy does undergo important fluctuations. This part comprises the gusts of X-rays, ultraviolet light, and charged particles which are emitted from the Sun at times of unusual surface turbulence. The radiations travel at the speed of light, reaching the Earth some 8 minutes after leaving the Sun. They are absorbed in the higher levels of the atmosphere, well above our "weather sphere," and produce heating, chemical reactions, and electrical charging of the very thin area. It may be said that they give rise to a sort of upper atmospheric weather whose storms produce heating, chemical reactions, and radio blackouts. The charged solar particles travel at the more modest speed of some 1,000 miles per second, reaching the earth in 1 or 2 days. Upon arrival, they are seized by the Earth's magnetic field and funneled into the polar latitudes, producing magnetic field storms, modifying the radiation belts, augmenting the auroral displays, and producing longer lived radio and telephonic communications breakdowns.

One of the most exciting chapters in the history of Sun-Earth relationships concerns the discovery by James Van Allen of the radiation belts which bear his name. These belts consist of charged particles which are trapped and guided by magnetic lines of force many thousands of miles above the Earth's surface. Although the possible radiological effects of these particles are well known, their geophysical role in transferring energy from the Sun to the Earth, accompanied by heating, auroras, and communications disturbances, may well prove to be more significant.

Experimental evidence obtained during 1959 shows the importance of the Van Allen belts in Sun-Earth relationships. Pioneer IV, launched in March after 5 days of unusually intense solar and auroral activity, detected a belt population some 10 times greater than that observed by Pioneer III during a period of solar quiet. In October, Explorer VI radioed back counting rates 5,000 times lower than those of Pioneer IV; but several weeks later, after some intervening solar activity, Explorer VI counter showed a return of the particle population nearly to its Pioneer IV level.

These fragmentary measurements have led to strong disagreements between the scientists themselves concerning the interpretation of the results and their geophysical importance. Consequently, it is important to measure the populations of such energetic particles over long periods of time and to many tens of thousands of miles from the Earth. One entire satellite to be launched in 1960 will be devoted to the observation of these trapped particles, using more complex detectors which will separate the particles by type and by energy. Particularly important will be the first measurement of the very low energy protons [hydrogen nuclei] having energies of less than 10,000 electron volts, which is only half the energy of the charged particles in the average home TV picture tube. Due to their potentially large population, such particles may even be dominant in producing geophysical effects.

The second approach to the measurement of charged particle activity is the use of a space probe in orbit around the Moon, to detect the clouds of solar particles as the sweep across the Moon's orbit, and, in cooperation with measurements from an Earth satellite, to measure the velocity of the solar particles. Still another approach to be followed in 1960 is the rocket launching of recoverable film, or nuclear emulsions, into the polar atmosphere during unusual solar activity, so that the responsible particles may be identified by studying their photographic tracks. Such identification is as positive as that of an individual by his fingerprints.

Such effects have a practical aspect. It has been suggested that the arrival of large numbers of solar particles may trigger major weather disturbances. For example, on February 10, 1959, a large solar flare was followed by magnetic storms, radio disturbances, a red aurora visible as far south as Washington, record high temperatures in the Arctic, and freezing snow throughout large areas of the South. Although this one event could have been coincidental, a study of weather statistics for other years has shown a definite correlation between magnetic storms and rising polar temperatures 5 days later. Tree rings and wheat price index both show an 11-year cyclic weather variation, corresponding to the sunspot activity cycle. More knowledge of such phenomena could lead to the future use of data transmitted from a distant satellite observatory to predict the arrival of a cloud of solar particles in time to light the smudge pots in Florida.

The importance of the Sun to man, and the immediate value of the knowledge of Sun-Earth relationships, is clear. But, underlying such relationships is an even more fundamental matter, that of the nature of the entire universe. Science is based on the assumption that all activity is governed by universal laws which apply both near at hand and in the remotest part of the universe. These laws form the basis for the origin and development of living matter.

All the achievements of science in the last century have been applied to the development of a remarkable description of the universe and its elementary constituents. The development begins with the neutron, proton, and electron; these are the fundamental building blocks of the universe. Neutrons and protons are bound together tightly to form the atomic nucleus. Atoms consist of electrons bound to the nucleus and circling around it at some distance, like a planetary system in miniature. Atoms combine to form molecules, which in turn are cemented together to form visible matter as we know it. Our Earth is a collection of such matter, circling around the Sun along with the eight other known planets. The Sun is one of the 100 billion stars of our disc-shaped galaxy whose cross section we know as the Milky Way. In turn, the galaxies tend to collect in huge clusters which together make up the universe. This entire hierarchy is built on three basic forces:

(1) Nuclear force, the most powerful force known, which clamps together the nucleus of the atom so tightly that 1 cubic inch of nuclei (such as is found in white dwarf stars) weights 1 billion tons.

(2) Electromagnetic forces, which bind electrons to nuclei, atoms into molecules, and molecules into gross matter. These forces are some 100 times weaker than nuclear forces.

(3) Gravitational force, which gives many weight and holds the solar system together. This force is 10^{40} times weaker than the nuclear force.

The weakness of the gravitional force can be illustrated by the smallness of an electromagnet which will lift a 1 pound iron bar, compared with the tremendous size of the earth which generates 1 pound of gravitational force on the iron.

Strangely enough, the formation and evolution of stars depend upon the interplay between the weakest and strongest of these forces. Initially, stars are probably formed out of condensation of the interstellar dust in space. Once begun, gravitational attraction accelerates the condensation process until the pressure and temperature at the center are high enough to initiate a thermonuclear reaction whose heat prevents further attraction. The rest of the star's life history depends only on its initial mass and on the relative amount of different elements present; i.e., its chemical abundance. The determination of this chemical abundance of stars is one of the most basic problems in the study of stellar evolution.

Perversely enough, the light which contains the best information on chemical abundance on stars is beyond the visible portion of the spectrum in the ultraviolet; but such wavelengths cannot penetrate the Earth's atmosphere. Thus, for the first time, man can obtain this vital information from an observatory located on an artificial or natural Earth satellite. The very first ultraviolet experiments, flown by scientists of the U.S. Navy in rockets, disclosed many sources of ultraviolet light, some at locations where there is no visible emitter of light. The nature of such ultraviolet sources is still a mystery. Their further study from an orbiting astronomical observatory is an objective of the highest scientific priority which may be expected to produce new information concerning the structure of the universe.

Just as stars may have formed by the condensation of interstellar matter, so planets may have formed by the condensation of smaller pockets of matter left over from the stellar formation. If this condensation theory is the correct one, then planets such as ours must be very commonplace in the universe. On the other hand, it is possible that our planets were born catastrophically, in a rare collision between our Sun and a second star. Since the probability of such a collision is extremely small with the existing stellar population, the catastrophic theory implies a small probability of other planets in the universe, and a correspondingly small chance of life existing outside of our solar system.

If we can determine what the temperatures of the Moon and planets were at the time of their formation, we will have gone far toward discriminating between the condensation and catastrophic theories of the origin of the solar system. For if these planets were formed by the cooling of hot masses of solar gas, they must have passed through a molten phase; while if they were formed by the condensation of relatively cool gas or dust, they may never have existed in the molten stage. This is particularly true of the Moon, which is small enough so that the heat produced by decay of radioactive uranium can be lost to its surface rapidly enough to keep the temperature below the melting point. In this respect, the Moon is of greater interest than either Mars or Venus.

Another reason for concentrating on lunar observations is the uniqueness of the Moon as the only major accessible body whose surface has been unchanged for a major portion of its life, some 3 billion years. This is due to the combined lack of mountain building and lack of erosion by air or water.

Thus, our first need is to come close enough to read nature's handwriting on the lunar surface. Television cameras in orbit about the Moon or en route to a crash landing can radio back detailed information of the lunar surface characteristics, while observations of a lunar satellite orbit can detect whether the Moon has a "raisin bread structure" of iron chunks embedded among lighter rock, which would indicate a process of accretion from small cool masses. Television reconnaissance can also be used to select a location for the first soft lunar landing, and to obtain information concerning the nature of the surface.

Once a soft landing is feasible, instruments such as the seismograph can be placed on the lunar surface to detect Moon quakes produced internally or by meteorite impact. A gravimeter can measure minute changes in the lunar shape produced by the Earth and Sun, thus measuring the elasticity and viscosity of the Moon's interior. Measurement of the surface heat flow and radioactivity would fix the temperature history of the Moon within narrow limits, thereby further defining its mode of initial formation.

Again we find a coherent pattern in our search for the origin of the universe. Experiments on the interaction between radiation and matter, on relativity theory, and on gravity, lead to an understanding of the working of the universe today. Exploration of the Moon and planets, together with observations of the Sun and the rest of the universe, will help determine how the universe began and how its stars and planets were formed. All of these diverse activities and many others contribute to the one great inspiring objective: to understand the universe of which man is such an infinitesimal, but important, part.

One of the most exciting possibilities of space research is the opportunity to search for life outside the Earth and its atmosphere. Were one to discover life forms on another planet like Mars or Venus, the philosophical implications would be tremendous. Working on the earth and in the laboratory, the bioscientist has progressed toward an understanding of how material life may have formed on Earth. Our understanding of the origin of life might make gigantic strides forward if we could discover and study, at the same time, different life forms that have developed and currently exist under different conditions.

The primitive atmospheres of Venus and Mars were doubtlessly similar to ours, but not identical with it, and the development of life on these planets, if it did occur, may be presumed to have proceeded along somewhat different lines.

The practical consequences of this research of planetary biology will require a longer time to develop because the acquisition and interpretation of the basic facts are both very difficult. But in the long run, such research can be expected to have a greater influence on human welfare than any other area of the space sciences program. Most diseases today are regarded as essentially metabolic, that is, as due to aberrations in the normal pattern of molecular interactions. It is precisely these interactions which we hope to understand better through our biological studies of other planets.

Mars and Venus are the solar planets, other than the Earth, which appear to offer the greatest probability of the development of life. The manned landings required for thorough exploration of these planets will not be possible for many years to come. Meanwhile, a progressive program of instrumented planetary explorations will be undertaken as rapidly as the necessarily sophisticated guidance, communications, and soft landing techniques become available.

At present, balloons capable of lifting heavy infrared spectroscopes to altitudes 10 to 20 miles above the Earth can acquire valuable information on Venus and Mars atmospheric constituents and on the nature of some Martian surface compounds. During 1959, an Office of Naval Research sponsored experiment discovered water vapor in the atmosphere of Venus. Early space probes will develop long-range communications techniques, measure the characteristics of the interplanetary environment, and observe those features of the planets, such as their magnetic fields and radiation belts, which may be expected to extend into space many times the planetary diameter.

During the past year, as shown in table 1, a number of important scientific discoveries have already resulted from the NASA space sciences program. With regard to the Van Allen radiation belts, it has been discovered that the extent and intensity, particularly of the outer belt, fluctuates over a very wide range. These fluctuations show a distinct correlation with activity on the Sun, and a complex structure which varies with time. As usually occurs in scientific research, such discoveries raise as many or more questions than they answer.

TABLE 1.—*Recent discoveries in space sciences*

Area	Discovery	Questions raised
Radiation belts	Outer belt extent and intensity fluctuates	Causes.
	Correlation with solar activity	Mechanism.
	Complex structure	Explanation.
Magnetic field	Deviations from expected values	Source.
	Fluctuations with time	Causes.
Upper atmosphere	Very strong wind shears at 70–100 miles	Cause.

The last of the Vanguard satellites has disclosed deviations from their expected values of the Earth's magnetic field, and some fluctuations in the measured magnetic field intensity with time. Again, such results raise questions regarding the sources and causes of these deviations and fluctuations. It should also be recalled that three successful satellites were launched during the latter half of 1959 and, since 6 months to a year is usually required for thorough data analysis, most of these data will be translated into new discoveries in 1960. If all goes as planned, Explorer VII will continue to radio back data for another 9 months.

Several important results also resulted from the NASA sounding rocket programs during 1959, table 2. Perhaps the most notable of these resulted from the Wallops Island launching of rockets carrying sodium, which was visible over a wide area of the east coast. The resultant sodium vapor clouds showed very strong wind shears at altitudes between 70 and 100 miles, and wind velocities at slightly higher altitudes in excess of 400 miles per hour. During 1959, there were also several very successful tests of new satellite instrumentation for direct measurements of the structure of the charged region of the atmosphere which is called the ionosphere.

TABLE 2.—*Scientific sounding rocket launchings, 1959*

Date	Vehicle	Experiment	Comment
August	Nike-Asp	Sodium vapor, dawn	High winds, 400–500 knots, 150 kilometers.
September	Aerobee-150 (2 rockets).	Ionosphere measurements; Instrument development	Successful tests of new satellite instrumentation, new ionospheric data.
November	Nike-Asp	Sodium vapor, twilight	Powerful wind shears around 110 kilometers.

Table 3 summarizes the planned NASA rocket launchings through the end of fiscal year 1961. Since each sounding rocket is generally devoted to only one or two scientific disciplines, it is convenient to divide them according to their scientific purpose. The planned level of activity of approximately 100 sounding rockets per year is only slightly less than that reached during the peak of activity during the 18-month International Geophysical Year, when 200 sounding rockets were launched by this country.

TABLE 3.—*Sounding rockets*

	Fiscal year 1960			Fiscal year 1961		
Quarters	3	4	1	2	3	4
Atmosphere	3	4	4	4	3	3
Synoptic atmosphere	2	2	9	9	6	6
Ionosphere	2	2	2	2	2	2
Energetic particles	2	6	2	1	3	2
Magnetic field		5	1		2	3
Astronomy	6	8	8	8	6	6
Special	10	3	3	1	2	2
Total	25	30	29	25	21	24

During 1959, four scientific satellites were launched successfully (table 4). Two of these utilized the Vanguard launching vehicle, one the Thor-Able combination, and one the Juno II vehicle. These launchings completed our participation in support of the International Geophysical Year by means of scientific satellite research.

TABLE 4.—*Scientific satellites, 1959*

Name	Month	Vehicle	Experiments
Vanguard II	February	Vanguard	Cloud cover.
Explorer VI	August	Thor-Able	Radiation belt, magnetic field, micrometeorite, radio propagation, cloud cover.
Vanguard III	September	Vanguard	Magnetic field, solar X-rays.
Explorer VII	October	Juno II	Composite radiation.

During 1960, the Juno II scientific satellite program will be completed with the planned launching of four additional satellites (table 5). The first and fourth of these missions represent follow-on studies to earlier exploratory experiments. The second and third of these missions are first exploratory experiments.

TABLE 5.—*Juno II scientific satellites*

Fiscal year	Quarter	Mission
1960	3d	Radiation belt studies.
1961	1st	Ionosphere properties.
1961	2d	Gamma and cosmic rays.
1961	2d	Ionosphere beacon.

The five scientific satellites listed in table 6 are planned to be launched with the use of the Thor-Delta vehicle system over the next 2 years. The last three of these missions represent first exploratory satellite experiments in their respective scientific fields, and will be launched in orbits across the polar regions.

TABLE 6.—*Delta scientific satellites*

Fiscal year	Quarter	Mission
1961	2d	Solar spectroscopy.
1961	3d	Radiation belt studies.
1962		Atmospheric structure.
1962		Geodetic flashing light.
1962		Ionosphere topside sounder.

By fiscal year 1962, it is expected that the solid-propellant Scout satellite launching vehicle will have been developed for routine use in the scientific satellite program. This vehicle will be put to frequent use in support of our international cooperative program in space sciences (table 7). Like the Delta satellite system, most of the Scout scientific satellites will be launched in orbits over the Earth's polar regions, with the exception of those satellites primarily devoted to the astronomical program.

TABLE 7.—*Scout scientific satellites*

Fiscal year:	*Mission*
1962	International.
1962	Polar ionosphere studies.
1962	International.
1962	Polar radiation studies.
1963	International.
1963	Polar atmospheric structure.

The satellites which have been discussed thus far are all limited to maximum payload weights of the order of a few hundred pounds. Beginning in 1962, the Atlas-Agena and Thor-Agena vehicle systems will be capable of placing into orbit scientific satellites weighing 1,000 pounds and more. Two such satellites are planned to be launched into orbits over the polar regions of the Earth for various geophysical studies, as shown in table 8. A Thor-Agena satellite will be used in a relatively low altitude orbit of several hundred miles, while an Atlas Agena will be used in a highly eccentric orbit reaching many tens of thousands of miles from the Earth's surface at its highest point. The other two Agena satellites will be launched into orbits of relatively low inclination to the equator, one to correlate relations between solar activity and phenomena in the Earth's atmosphere, and the other to make astronomical observations using a highly precise stabilized astronomical platform. This last satellite will weigh several tons.

TABLE 8.—*Agena scientific satellite*

Fiscal year	Booster	Mission
1962	Thor	Polar geophysics.
1963	Atlas	Geophysical observatory.
1963	Thor	Sun-Earth relations.
1963	Atlas	Astronomical observatory

During 1959, the first U.S. space probe to escape the earth's gravitational control and go into orbit about the Sun was launched on March 3. This payload produced valuable information regarding the radiation belts, and was tracked to a distance of 407,000 miles from the Earth (table 9).

TABLE 9.—*Space probe, 1959*

Pioneer IV.
March 3.
Juno II vehicle.
Energetic particles experiment.
Communications tests.
Tracked for 82 hours to a distance of 407,000 miles.
Now in orbit about the Sun.

During the next 2 years, in addition to their use in the scientific satellite program, four Scout vehicles will be used to launch scientific probes which are intended to reach altitudes of from 5,000 to 10,000 miles. These probes are listed in table 10.

TABLE 10.—*Scout scientific probes*

Fiscal year	Quarter	Mission
1961	2d	Ionosphere structure.
1961	3d	Nuclear emulsion recovery.
1961	3d	Ionosphere structure.
1962		Outer atmosphere winds.

These comparatively short-range scout probes which fall back to the earth should be distinguished from the longer-range lunar and interplanetary probes which are scheduled during the same time period, as shown in table 11. Initially, relatively lightweight space probes will utilize the Thor and Atlas boosters with the Able and Delta upper-stage systems, for preliminary research on the interplanetary environment and for tests of long-range communications. Beginning in 1961, the heavier Atlas-Agena system will also be available for this important program. The first two Atlas-Agenas will be used for the twin purposes of measuring the interplanetary environment and for developing the necessary technology for more advanced missions. The last three of these vehicles will concentrate on the measurement of the surface properties of the moon.

TABLE 11.—*Lunar and interplanetary probes*

Fiscal year	Quarter	Vehicle	Mission
1960	3d	Thor-Able	Interplanetary environment and communications tests.
1961	1st	Atlas-Able	Lunar orbiters.
1961	2d		
1961	2d	Delta	Interplanetary plasma and field.
1961	4th	Atlas-Agena	Interplanetary environment technological development.
1962		do	
1962		do	Lunar surface properties.
1962		do	
1962		do	

In fiscal year 1963, using the Atlas-based Centaur vehicle system, we will be ready for our first attempted orbit toward the planets Venus and Mars. The objectives of technological development for later, more advanced missions and an investigation of both the planetary and interplanetary environment will be served by these missions.

In summary, the space sciences program over the next several years will include approximately 100 sounding rockets per year, some 9 satellites and Scout probes, and approximately 4 deep space probes for lunar and planetary explorations (table 12). Nearly half of the requested funding in the space sciences area will be devoted to lunar and planetary explorations, while the sounding rocket program will require less than 10 percent of the total (table 13).

TABLE 12.—*Space sciences vehicle summary*

	Fiscal year 1960	Fiscal year 1961	Fiscal year 1962	Fiscal year 1963
Sounding rockets	55	102	----------	----------
Scientific satellites and scout probes	[1] 4	9	9	
Lunar and planetary explorations	[2] 2	4	4	

[1] Includes 3 in orbit.
[2] Includes 1 launch failure.

TABLE 13.—*Space sciences budget summary*

[In millions of dollars]

	Fiscal year 1959	Fiscal year 1960	Fiscal year 1961
Sounding rockets	3.9	8.8	8.0
Scientific satellites	21.3	22.8	41.7
Lunar and planetary explorations	30.2	49.0	45.0
Total	55.4	80.6	94.7

The CHAIRMAN. All right, Doctor, now you may proceed in your own manner.

Dr. NEWELL. Mr. Chairman and members of the committee, this afternoon I should like to address myself to four important questions. First, why must NASA do basic research in space?

Second, what are the prime objectives of space science and research?

Third, what is the NASA program designed to meet those basic objectives, and then finally, what is the proposed cost for this program in the fiscal year 1961?

Now, as to the first question—namely, why must NASA do basic research in space—I believe I do not need to dwell long on that subject, since the Congress itself has set forth these reasons in the Space Act itself.

Basic research in space contributes to all eight of the stated objectives of the United States in space activities and in particular the very first objective; namely, the expansion of human knowledge of phenomena in the atmosphere of space.

Moreover, before we send any men out in space we must certainly know as much as we can about the hazards that are to be encountered.

With these few remarks about the first question let me proceed to the second question; namely, what are the prime objectives of space science research?

Last year in these hearings you heard us describe a rather complex series of subjects that were to be studied in space science and during the year you have seen these things written about in newspapers and spoken about in different kinds of discussions. You have heard us talk about the Earth's atmosphere and the complexity and the dynamics of the Earth's atmosphere; the pressures, the temperatures, the density, and winds; and about the Earth's ionosphere. Then you have heard us discuss the possibility of extending these studies to the planets and to the Sun. We spoke of energetic particles, the cosmic rays, auroral particles, the plasmas in space, and so on. We have spoken about the magnetic field of the Earth and the gravitational field of the Earth, and the fields of the planets and of the Sun.

We have spoken about astronomy and the new dimension that satellites and space probes give to astronomy, until I am sure you have come to wonder just what is the pattern here. Is this just a disconnected random series of investigations carried on by scientists who have no coherent objective at all?

Well, the answer is "No," this is not the case. There is a coherent pattern. There are three principal objectives which tie together all of these activities. These are:

1. The study of the Earth and Sun, and the Sun-Earth connections. Here we tie together many of these observations.

Secondly, to look for the fundamental nature of the universe and the origins of the universe, including the origin of the solar system (fig. 58).

FUNDAMENTAL OBJECTIVES

1. UNDERSTAND CONTROL OF THE EARTH BY THE SUN

2. LEARN NATURE OF THE SOLAR SYSTEM AND THE UNIVERSE

3. SEARCH FOR ORIGIN OF LIFE AND ITS PRESENCE OUTSIDE THE EARTH

FIGURE 58

Thirdly, to search out the origins of physical life, and to look for the presence of life beyond the Earth itself.

Now, as to the understanding of the Sun-Earth relationship I should like to point out to you that the Sun has an influence in our everyday life on practically everything we do.

If in the total solar energy that comes to us daily from the Sun, a change of even a fraction of a percent were to occur, then our lives would undergo marked changes. One might say violent changes. Yet we know from experience and past observations that this radiation does not change, and has not changed to any great extent in our history and should not change for millions of years (fig. 59).

The main portions of this solar energy lies in the visible and infrared regions and it is this part of the energy that affects our weather, the growth of plants, our own growth, and provides the basic heating of the lower atmosphere.

But there is a small portion of the total solar energy that does undergo fluctuations, sometimes quite dramatic fluctuations, and these are the energies that are contained in ultraviolet light and X-ray radiations and particles that are emitted by the Sun during times of unusual activity.

The X-rays and the ultraviolet light travel from the Sun to the Earth in about 8⅓ minutes. This is the velocity of light. When

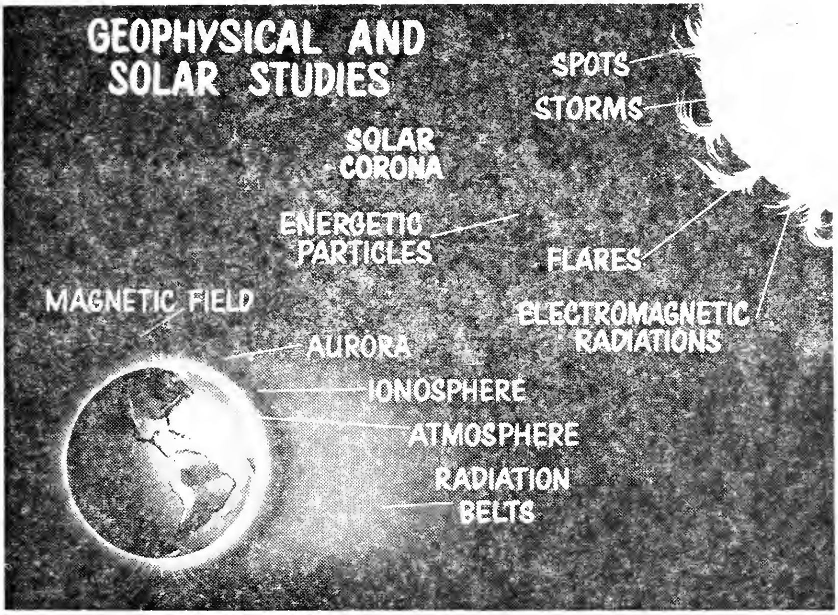

FIGURE 59

they arrive at the Earth, they are absorbed in the Earth's upper atmosphere and they give rise to heating, electrification of the upper atmosphere, affecting communications, providing the basis for our normal shortwave communications and sometimes interfering with that shortwave communication.

Since they are absorbed in the upper atmosphere we don't get to see them in the lower atmosphere.

We might say that these X-rays and ultraviolet radiations cause a weather of the upper atmosphere which is electrical and chemical in nature, in contrast to weather of the lower atmosphere which is based on water vapor.

The particles, the charged particles which are also emitted by the Sun travel at a more modest speed of about a thousand miles per second and they arrive at the Earth a day or 2 days after they are emitted by the Sun. Now, when they get to the Earth they are seized by the magnetic field and funneled into the northern and southern latitudes and give rise to magnetic storms, interfere with radio communications, sometimes even with telephone lines; give rise to aurora, heat up the upper atmosphere and so on.

I may illustrate this subject by a topic which has become familiar to you by now; namely, the Van Allen radiation belts. The discovery of this belt was, as you know, one of the most exciting events of the IGY. At the time of this discovery, people thought of the Van Allen radiation belt mostly in terms of the hazard to space flight. However, it may well turn out that these belts are far more important in the light of their role in transferring energy from the Sun via these belts into the Earth's atmosphere.

The Pioneer IV flight of March 5, 1959, showed quite markedly that the Sun does indeed have a pronounced effect on the outer Van Allen radiation belt. This flight showed an intensity in the radiation belt that was 10 times the intensity observed during the Pioneer III flight.

Inasmuch as the Pioneer III flight occurred during a time of low solar activity, whereas the No. IV flight occurred after 5 days of high solar activity, the conclusion was clear that the Sun must be pouring particles into the outer radiation belt.

In addition, the Explorer VI satellite, in October, at a time of low solar activity, showed intensities in the radiation belt 5,000 times lower than those that had been observed in Pioneer IV.

Yet a few weeks later, after some solar activity, the rates had climbed back again to the rates shown in the Pioneer IV flight.

Well, these facts have given rise to considerable discussion as to just what is going on. You will hear it said that the radiation belt consists of two zones or maybe three zones or more zones. The fact of the matter is that the radiation belt is a very complicated and diffused region just as shown here, in which energy is funneled in from the Sun and then in some way or other, into the Earth's atmosphere.

Just how this happens, what the mechanisms are, are not clear. There are discussions, arguments, and controversy over these mechanisms.

For this reason, it is important for us to continue with observations on the radiation belt, and during the coming year we plan to have a satellite devoted just to this subject, in which the instrumentation is a step beyond that which has been used in the previous satellites, in which the types and energies of the particles will be pinned down in much greater detail.

Furthermore, the satellite will observe in the lower energy regions, electrons and protons, for example, of less than 10,000 electron volts. This is less than half of the energy in the electrons in the normal home television picture tube.

In addition, if we are successful, a satellite about the Moon, a satellite of the Moon, will be used as an anchored space station as it were, to make similar observations. These observations can give us a measure of the solar clouds out at the distance of the Moon. Simultaneous observations at the Earth, on the ground, or in a satellite of the Earth, can be used to study the transit time effects, and the time it takes the solar clouds to sweep across the intervening space between the Moon and the Earth.

Also in the polar regions, nuclear emulsions will be sent aloft at a time of high solar activity to study the particles that arrive at the Earth following this activity. The tracks left by these particles in nuclear emulsions identify these particles just as a fingerprint will identify a man.

Now, these observations planned are of great interest to the scientists. I should point out they have a great practical value, also.

There is a considerable likelihood that the energies brought in by these particles to the radiation belt and then fed into the atmosphere have a great effect on our weather. We certainly know they have an effect on our communications.

Back in February of 1950 at a time of the great solar disturbance, it was noticed on the Earth that we had marked magnetic storms, marked interference with radio communications. There were large auroras, and red auroras seen as far south as Washington.

There was marked and unusual heating of the arctic atmosphere and yet at the same time freezing rain and snows in great portions of our own South.

Now, of course, this might have been an isolated instance, but an analysis of weather statistics over many years shows that there is a relationship between magnetic activity, which is certainly associated with the Sun, and heating of the arctic regions, a heating which almost always occurs 5 days after such magnetic activity.

Moreover, the tree rings, the growth rings in trees, and, of all things, the wheat price index, both show an 11-year cycle. This corresponds with the 11-year sunspot activity.

The CHAIRMAN. Would you amplify that, the wheat price index?

Dr. NEWELL The wheat price index was analyzed statistically over the last 350 years from all the records that were available, and interestingly enough, the only variation in this thing that lasted consistently over 350 years was the 11-year component, the ups and downs that seemed to follow the sunspot cycle ups and downs. Now, this presumably tempts one to think that there must be some connection with weather, one thing that you think of as affecting the wheat price index.

The connection with weather, then, must be in some way connected with solar activity that is associated with the sunspot cycle, and that is magnetic, particle activities.

The CHAIRMAN. So the growing of wheat would be traceable to your reaction that you referred to?

Dr. NEWELL. Yes. The wheat crops and the successes and so on may be traceable to——

Mr. FULTON. Ask the question again. I don't think the witness understood you.

The CHAIRMAN. I said the growing of wheat, I should have said perhaps the production, but growing would cover it, of wheat, then, has a direct relationship with the reactions you referred to, from the sun?

Dr. NEWELL. This is an obvious conclusion one might jump to. However, as all of you know, the wheat price index is a very complicated thing which depends upon economic situations, trade conditions, agricultural situations and so on. But the fact that this

11-year cycle component existed through 350 years would lead you to guess that many of these other factors wash out in this analysis, and there must be some weather and some solar connection.

Now, I would make the immediate point that this is something that requires study. This is something that requires further research, both in the basic physics we are talking about and in the effects that I have mentioned.

The CHAIRMAN. Well, if it isn't the weather that produces more wheat, then would it be that this activity would result in the merchant becoming more active during those 11-year periods? That represents a period of activity on the part of the individual, rather than on the part of the wheat, does it not?

Dr. NEWELL. This is the sort of question that one must look into and in fact, in order to pin down just what the real meaning is behind the fact that I have pointed out, one must ask all the possible questions as to what is the cause of this and look into all sources and until this is done—this will take a long time—one can't state conclusively the variations are caused by the solar radiation.

Yet I suspect that when one has gone through that whole process, one will find that the solar particles do have an effect.

Mr. FULTON. Will you yield?

The CHAIRMAN. I yield to Mr. Fulton.

Mr. FULTON. The thing that caused an abrupt start was when your question and answer changed quickly from price to production. That is what caused me some trouble. I used to be a fellow in economics, studying it. Possibly, rather than spend your time on trying to follow that research out, you might find it might be the effect of the radiation on the human energy that made the farmer plant and harvest more wheat. Or, you might find that, if it is the price, it was the way the particular farmer or the middleman looked at his medium of exchange or his pocketbook.

Or it might also have been that the energy made more wars and, therefore, the human energy went off in a different direction and had an effect on price.

I think it would not be too productive for the taxpayers' dollars to try to go into quite a program on trying to correlate price and electromagnetic radiations.

Could I finish with this? On the electromagnetic storms on the Sun's surface, isn't there about a 30-day lag in the Earth's weather pattern?

Dr. NEWELL. There is a 27-day pattern. Following a solar outburst, there is a magnetic storm or some such terrestrial effect within a few days; then 27 days later, often times another effect; and then 27 days later sometimes another; due to the 27-day rotational period of the Sun which brings the sunspots that caused the thing in the first place, back again.

The CHAIRMAN. Well I can say this, though, and I think it is correct. Dr. Reichelderfer, head of the Weather Bureau, testified before the committee about a year and a half ago that the ability to judge long range weather accurately would save this country $3 billion a year and save the lower Mississippi Valley in which I am particularly interested, of course, about $1 billion a year.

Now, could you go so far in your statements as to say that this radioactivity from the Sun might result in the weather forecasting being set up like Dr. Reichelderfer referred to?

Dr. NEWELL. Yes. The point I was about to make was not that we should investigate the wheat price index. This was only an interesting side point that was quite remarkable, but that all of these facts that I brought out suggest that we have here something that may be of great value in forecasting events on the Earth.

It is not unreasonable to think that some day we will have a satellite away out beyond the Earth that detects the approach of these solar particle clouds, radios this information back to the Earth—to use a homely suggestion—in time to be of value.

In other words, it is an area of research that man must pursue from a scientific point of view in order to lay the groundwork for these future practical applications.

Mr. FULTON. Could I ask you this. Of course, there are these energized particles all around the world in the magnetic field. The first question is, do those energetic particles travel from the Sun or do the rays themselves simply energize particles that are already there in the magnetic field and make them bounce? If they do bounce, how long do they keep bouncing from one of those electromagnetic storms on the Sun?

Dr. NEWELL. The energetic particles we are talking about travel directly from the Sun, and, arriving in the vicinity of the Earth, are caught, as it were, by the magnetic fields.

Mr. FULTON. How long does it take?

Dr. NEWELL. About a day to 2 days, depending on their speed.

Mr. FULTON. They don't come at the speed of light then?

Dr. NEWELL. No; about a thousand miles per second.

The light, the X-rays and ultraviolet radiations come at 8⅓ minutes, so those effects are observed first. Then the particles, the charged particles arrive about a day after the solar activity, sometimes 2 days.

Mr. FULTON. When they energize other things, coming like a bunch of pool balls, how long do they keep bouncing around the outer edge of the Earth's magnetic field?

Dr. NEWELL. This depends upon their energy. Some particles are trapped in orbits that dip away down in the Earth's atmosphere. Those will stay in their orbits a matter of days only. Other particles are trapped in places where they may stay a year or more.

Mr. FULTON. I hope you do work out some correlation for the Earth's weather so we can forecast it better.

Dr. NEWELL. This, then, presents to you a picture of one of the areas in which Sun-Earth relationships may produce some things of very practical value, and certainly of great scientific interest. But underlying all of this is something even more fundamental; namely, the nature of the universe.

It is an assumption we make that the laws we observe to operate on the Earth also operate elsewhere in the universe, to the remotest distances.

The science of the last century has been directed toward developing a remarkable picture of this universe based on the number of fundamental particles and a number of fundamental force laws (fig. 60).

Now, these fundamental particles are the neutron, the proton, and the electron. As you know, the neutron and proton combine together in various numbers and make up the different nuclei of our atoms.

If you have electrons revolving around this nucleus, you get an atom. Atoms join together to form molecules and molecules adhere together to form matter as we observe it; and the Earth, of course, is a large collection of such matter.

As we go up in the scale, we have the solar system. The Sun is one of 100 billion stars in our galaxy; and ours is one of billions of galaxies, as we know, in the universe.

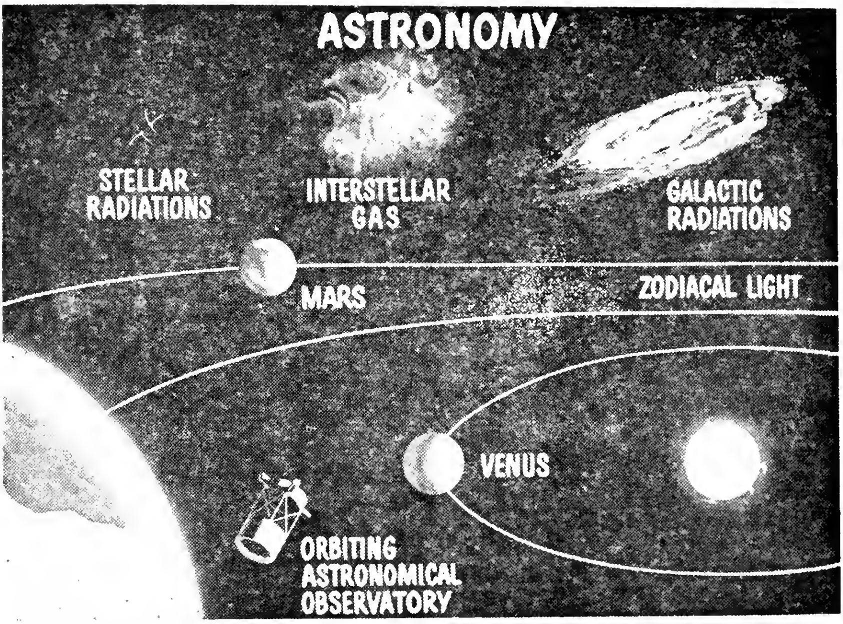

FIGURE 60

Operating with these particles are three fundamental force laws. These three forces are the nuclear forces, the atomic forces, and the gravitational forces.

The nuclear force is the strongest of all. It combines together the neutrons and the protons in the nuclei in such density that 1 cubic inch of this material would weigh 1 million tons. Of course, we have nothing like this on Earth, but matter approaching such a density is observed in what we call the white dwarf stars.

The atomic forces are electromagnetic in nature, and are a hundred times weaker than these nuclear forces. It is these forces that combine together the electrons to the nuclei, and the atoms together to form molecules, and molecules to form ordinary matter.

The gravitational force is the weakest of the three, and it is 10^{40} times weaker than the nuclear forces. That is 10,000 trillion trillion trillion times weaker than the nuclear or atomic forces.

To give you some idea. so you can visualize what this means, consider a pound of iron. When you say you have a pound of iron, you mean the earth pulls on that piece of iron with a force of 1 pound. It takes a whole earth to pull on that iron to make a force of 1 pound; but a very small electromagnet will produce a force to hold that pound of iron. In fact, it doesn't take a large magnet to pick up tons of material.

This gives you an idea of the weakness of the forces of gravity.

There is the interaction between the weak forces and the strong forces that give rise to the birth and life of stars, for example. A star is born presumably by the condensation of interstellar dust. As this accumulation begins, the gravitational forces accelerate the process, the dust accumulates together, and finally pressures are built up in the interior of the star that is being born. These pressures give rise to high temperatures and eventually the temperatures and pressures are high enough that a thermonuclear reaction is started.

Now, this thermonuclear reaction can release additional energy which balances the gravitational force and this collection of material in the star stops and the star has been born.

Now, the life history of the star depends on only two things—the original mass at the time the star was born and the abundance of the chemical elements in the star. In order to study the life history of this star, then, the scientist has to observe, to learn about what these chemical abundances are.

And, perversely enough, the information about the chemical abundances in these stars is contained mostly in the ultraviolet light that doesn't get through to the surface of the Earth.

So if we are going to continue our study of the nature of the universe and the origins of things in the universe, we must get our equipment up into observatories above the Earth's atmosphere.

Now, there is another subject of the origin of the universe that is important to us and rather dear to our heart and that is, how was the Earth born? How was the solar system originated? It may be that planetary systems are born from materials left over from the birth of stars, accumulations left over, we will say, from the birth of our star.

If this is the way planetary systems are born, then it is very, very likely that there are millions and even billions of other planetary systems throughout the universe. This is a very likely process, you see. This means then that there is a great likelihood of finding life elsewhere in the universe.

On the other hand, it may be that the planets were born in a catastrophic sort of process in which one star collided with another—our solar system perhaps was born because of collision of our sun with another star, in which masses of material were pulled out of the sun and left to condense into the planets.

Now, if this is the way planetary systems are formed, this has a low probability of happening and implies a low probability of other planetary systems in our galaxy and hence a low probability of life as we know it elsewhere in our galaxy.

Well, how can we test for this? Well, the Moon gives us a very significant object to study and test for this. The Moon is small enough that if it were accumulated out of the relatively cool gases left over from the formation of the Sun, the Moon itself may never have been molten. If we can get to the Moon and study the surface and learn as much as we can about its past temperature history, and so forth, we may be able to tell whether or not the Moon and hence the Earth and the other planets were formed from the accumulation of cooler gases (fig. 61).

On the other hand, if we find from study of the Moon that it was at one time molten, then we may have to conclude the planetary system was made by the catastrophic process.

Mr. Fulton. Or a third process; formation of new matter.

Dr. Newell. Yes; but this is a slow process compared with the time involved in the formation of the Moon and Earth.

Mr. Fulton. Do you favor a static universe or a different one?

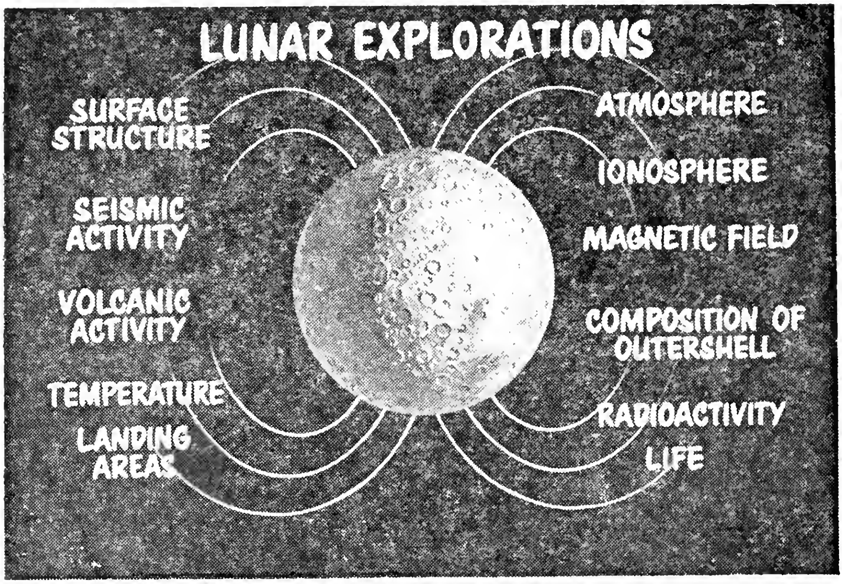

Figure 61

Dr. Newell. I think the expanding universe theory is probably a good one.

Mr. Fulton. How about the dimensions of space? What are they to you?

Dr. Newell. I suspect that Einstein's theory of relativity will turn out to be correct, in which case space time is what we should speak of. In other words, a four dimensional space time rather than space and time.

As you know, the NASA program has in it an experiment to check this theory of relativity.

Well, in the study of the nature of the universe and the origins of the universe, we have come back to our own back door, so to speak, to the nearest object in space, to the Moon. But even closer to us, right here on the surface of the Earth we have the most exciting, the most fundamental thing: physical life.

This brings us to our third objective: the study of the origins of life and possibly its presence beyond the Earth.

In the study of the origins of life——

Mr. FULTON. Before you get into that, while you are just on space, do you have any experiment that proves whether there is ether through which matter moves in space? Aren't you trying to do that, too?

Is there anything there through which all matter moves? Don't you have an experiment on that?

Dr. NEWELL. We have no such experiments specifically planned. Our present thinking runs along the following lines: To check the Einstein theory of relativity; to compare whether gravitational clocks and nuclear clocks—by this I mean whether the motions of large masses around each other like the Moon around the Earth, or satellites around the Earth, follow the same type of time as vibrations of electrons in atoms.

This is a fundamental topic and one that we hope to include in our programs, but beyond this we haven't gone any further at the present time.

Mr. FULTON. You don't favor the theory that neutrons are being formed all the time?

Dr. NEWELL. You are thinking of the continuous creation of matter?

Mr. FULTON. Yes.

Dr. NEWELL. I don't, but no one is in a position to reject that absolutely and it has to be looked into. It has to be checked in the course of our program sometime.

Mr. FULTON. You are one of the believers in the theory that 5 billion years ago there was an explosion through which all these motions of matter and planets and stars can be checked back to? A tremendously compressed mass, and an explosion occurred and we are just 5 billion years after that explosion occurred?

Dr. NEWELL. When I say that I favor the expanding universe theory, that automatically implies that I must then trace back to this explosion. This seems to me, at least at the present time, to be the best theory explaining the facts that we know.

Mr. FULTON. But you don't think that was a progression, coming back in by attraction, getting so dense nuclear forces got into play, exploding, so that we have a 5-billion-year alternating thing—that it goes out for 5 billion years and comes back for 5 billion?

Dr. NEWELL. We really don't know. Many scientists are trying to trace things back through an initial "egg" as you might want to call it, to what happened before; but there is apparently no way through which they can do it. It is something they can't get their hands on. So, for the time being they are content with starting with this initial nucleus, and an ensuing explosion, and seeing what they can develop there.

Mr. FULTON. Do you have any time study on the radioactivity of various matter in the universe?

Dr. NEWELL. We have radioactivity measurements included in our lunar program.

Mr. FULTON. That is all.

The CHAIRMAN. Just proceed, Doctor, with your statement.

Dr. NEWELL. Thank you.

In laboratories on the Earth, it has been shown that certain types of atmospheres which may be called reducing atmospheres, are different from our present atmosphere which is an oxidizing one.

In these, lightning discharges will always give rise to formation of amino acids. Amino acids are building blocks of the self-replicating molecules which are probably precursors of living matter.

Now, we can continue this sort of research in the laboratories on the Earth to seek out the origin of physical life on the Earth. However, if we can get our equipment up to some other regions, Venus and Mars, where the atmospheres are different and presumably were different in their life history, although perhaps similar to that of the Earth, then we may be able to find some life processes and life forms that are similar to, but different from, those on Earth (fig. 62).

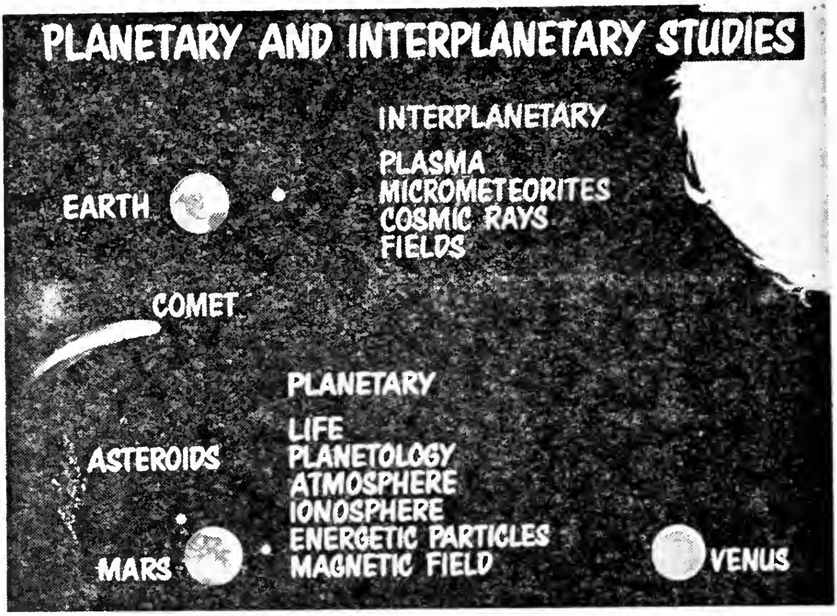

FIGURE 62

If this is the case, then we will have the very powerful way of searching for the origins of life. Whenever you can follow two slightly different processes, that are sufficiently similar to compare them, but sufficiently different to highlight fundamental things that are going on, then you have an extremely powerful tool to work with. Well, in our current researches we will have a planetary program and an interplanetary program leading to the study of Mars and Venus and the medium in between, but looking forward eventually to the search for life on these planets and even beyond that, to the search of the origin of this life.

This may well have by far the greatest impact on our everyday living, although it may be well into the future before we feel this impact.

Now, I have given you the three principal objectives of space sciences.

Let me run through quickly the program that has been developed to support these objectives.

First we have the results in 1959. There were three significant areas that led to important discoveries: Radiation belts. We found, as I mentioned earlier, that the radiation belt is an extremely complex thing, not at all as simple as we first thought and, as always seems to be the case, the discovery of these things raises more questions than it answers. So the program goes on. (See table 1, p. 341.)

In the case of the Earth's magnetic field, work done in Vanguard–3, it shows deviations from expected values. Now, this is always interesting scientifically. If you find what you expected, that is not half as exciting as when you find deviations. Then, of course, you have to find out the course and causes of those deviations.

In the Earth's upper atmosphere many measurements have been made. One significant one has shown that the Earth's upper atmosphere is even more dynamic than we thought. Very strong wind shears exist in the ionospheric regions.

Sounding launchings show that sodium vapor (table 2, p. 342), launched between evening and dawn, show high winds in the upper atmosphere; 400 to 500 knots at 150 kilometers and very powerful wind shears—I mentioned this on the previous slide.

The CHAIRMAN. What is a wind shear?

Dr. NEWELL. A wind shear is one wind going this way and the other going in either the opposite direction or in a cross direction. Remarkable wind shears have been discovered. As much of a change in velocity of 100 kilometers per second in 1 kilometer change in height. It is a tremendous shear and, of course, it raises the question as to how it occurs.

Mr. FULTON. Is there a general correlation to the turning of the Earth or the movement around the Sun, or heat? Much more around the Equator and less around the poles?

Dr. NEWELL. There appears to be such a correlation. The winds appear to be strong and from the west in winter—west and winter both beginning with "w."

Mr. ANFUSO. And weak in the summer.

We extend these to higher altitudes and this will be part of our program to follow.

Mr. FULTON. Do they have any effect on weather?

Dr. NEWELL. Probably not. The atmosphere at this point is only one one-millionth of the density of the atmosphere on the Earth.

Now there may be a connection. There may be things that happen simultaneously, or perhaps things happening in the upper atmosphere that precede things happening in weather, in which case it would be important to know about these because then they would be signs of things to come.

Mr. FULTON. Do the jetstream winds have an effect on weather?

Dr. NEWELL. Yes, indeed, but these, of course, are fairly low down compared with the altitudes we are mentioning here.

Mr. FULTON. Thank you.

Dr. NEWELL. This is the sounding rockets program, and you will note about 100 rockets per year is the program and that there is a fairly good distribution among the different subjects that might be studied. (See table 3, p. 342.)

This "special" here means things like those sodium vapor experiments.

In the next chart we have the satellites in 1959. Vanguard II, Explorer VI, Vanguard III, and Explorer VII. These launchings were all successful. The data from these three will continue to be analyzed and we expect discoveries announced in 1960 that will be based on these satellites. In addition, Explorer VII will continue if it is successful, to transmit for another two-thirds of a year, so we will have additional data coming from that. (See table 4, p. 342.)

Mr. FULTON. Do you have in those programs exploration of the oxygen radical belt that is about 60 miles up?

Dr. NEWELL. Not in these particular satellites, but in the sounding rocket program, yes.

The measurements of the atomic oxygen is one of the most important items in the atmospheric composition studies.

Mr. FULTON. Thank you.

Dr. NEWELL. I might point out with the launching of those satellites in 1959, this country performed every experiment that it planned to perform for the IGY. There was one slight variation. Our upper air densities were not measured by the 30-inch sphere, but they were measured by other techniques.

So there was no measurement planned for IGY that we did not make.

Following on with this chart, we have the Juno II scientific satellites, at the times indicated. The radiation belt studies and the Ionosphere Beacon, which carries several transmitters radiating frequencies back to the earth for observing the ionosphere, are follow-ons of previous work. The other two will be firsts, exploratory, opening new fields. (See table 5, p. 342.)

The Thor-Delta vehicle will be used for a series of experiments, at the times shown here [indicating]. (See table 6, p. 343.)

The last three here will again open up new fields. The geodetic flashing light satellite will open up an important field, previously touched on by the Vanguard I.

The ionosphere top side sounder was described last year, and we have agreement with Canada for a joint effort in this experiment.

Mr. FULTON. When will you be able to put a telescope in space?

Dr. NEWELL. This will come up in the chart after this.

The Scout vehicle should be ready for use in the near future. We plan to use it as the principal vehicle for our international program and to use it in our solar studies. (See table 7, p. 343.)

With this we will be able to put up the heavier payloads, the previous payloads being a hundred to several hundred pounds. With the Agena, based on the Thor or Atlas, we will pursue geophysics studied and with these Thor and Atlas vehicles, Sun-Earth relations and the Precision Astronomical Observatory, which I personally regard as one of the most exciting prospects. (See table 8, p. 343.)

Mr. FULTON. So do I.

The CHAIRMAN. Doctor, where do you pick up that word "Agena"?

Dr. NEWELL. I got it from the Department of Defense. I don't know where they picked it up.

Mr. FULTON. I can answer that. It is a star in the constellation Centaur near the Southern Cross and, I think, one of the 6 or 10 brightest stars in the heavens.

The CHAIRMAN. The gentleman might be correct. I am going to ask the Department of Defense though, when they come down here, and not rely entirely on the gentleman from Pennsylvania.

Mr. FULTON. Isn't there anyone here from the Air Force? Weren't they going to have a polar orbit from Vandenberg Field and they picked out the brightest star toward the South Pole and said, "That is what we are aiming at." How about that, Mr. Horner?

Mr. HORNER. I think that is correct.

The CHAIRMAN. Is that correct? That is what the Agena is?

Mr. HORNER. I believe so.

Dr. NEWELL. You will recall Pioneer IV was launched in March of this year. We discussed the results of this in detail earlier. (See table 9, p. 344.)

The Scout will be used for near-Earth probes; namely, probes reaching out 5,000 to 10,000 miles. (See table 10, p. 344.)

Following the Scouts, other vehicles will be used for probes reaching to greater distances with relatively small payloads.

We will make communications tests with the Thor-Able, Atlas-Able, and the Delta. (See table 11, p. 344.)

Then, the heavier payload vehicles, the Atlas-Agena for interplanetary environment, technological developments, and a study of the Moon.

This is what is planned for 1962. This is for technological developments of payloads in interplanetary space and preliminary planetary measurements (fig. 63).

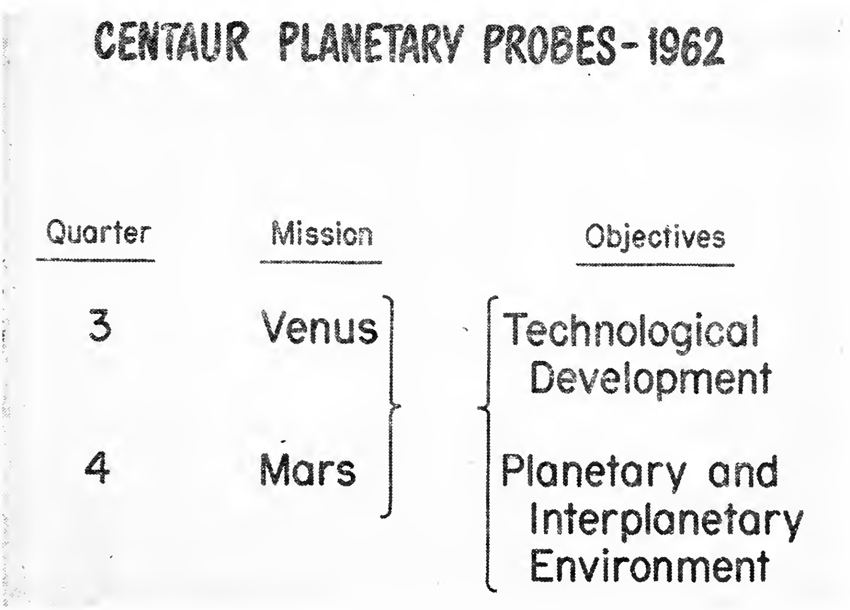

FIGURE 63

In summary, the program goes through about 100 sounding rockets per year. The scientific satellites, about eight or nine a year. These figures here are incomplete. When we develop our program next year, the 1963 figure will probably go up to eight or nine. The lunar and planetary explorations will be about four per year. (See table 12, p. 345.)

This will be divided as follows: Slightly less than half for lunar and planetary explorations. Less than 10 percent for sounding rockets. The remainder for scientific satellites. All total $94.7 million. (See table 13, p. 345.) Thank you.

Mr. FULTON. Mr. Chairman, could we have these charts all put in the record?

The CHAIRMAN. If there is no objection, it is so ordered. All of these charts are more or less a part of the statement. I want to take this opportunity to commend Dr. Newell on the exhaustive statement he has presented to this committee. The charts are most interesting.

Dr. NEWELL. All of the charts except the pictorial ones are in the material handed out.

Mr. FULTON. May I add, it is interesting and not exhausting.

Dr. NEWELL. Thank you.

Mr. FULTON. Could we have a statement from you as to what the Russians are doing in this field? If you don't want to give it now, put it in the record.

Dr. NEWELL. I will be glad to put it in the record. You may have seen an analysis that NASA drew up recently which I think is still up to date.

Mr. FULTON. I would like to have that in the record.

(The information appears on p. 256.)

The CHAIRMAN. Thank you very much, Doctor.

We appreciate your statement. It was a brilliant one. Now, we have Dr. Morris Tepper, in charge of the satellite applications program. Dr. Tepper.

May I say, before we proceed with Dr. Tepper's statement, that tomorrow we will have Dr. von Braun and tomorrow afternoon we will take up House Joint Resolution 567 that we previously agreed to take testimony on.

After that, the following day, February 3, we have Secretary Sharp of the Air Force, and on February 4, we have Gen. T. D. White, Chief of Staff, Air Force.

On February 5, we have General Schriever, from the Research and Development Command. We have a very tight schedule. I think we should try to hear these witnesses, rather than postpone them, because if we do they will fall out of order very much in their appearance in the record.

Mr. FULTON. Could I ask Mr. Horner a general question before we start with the witness?

You have lying around a payload of an Explorer VI. Perhaps we could give it to the United Nations the way the Russians gave their sputnik. I refer to the paddle wheel.

Mr. HORNER. There was a model of the Explorer VI payload that was used by USIA in various exhibits in foreign countries.

Mr. FULTON. Where is that?

Mr. HORNER. I just don't know at the moment. The last I knew about it was in Italy, but I will find out where it is.

Mr. FULTON. That is all.

The CHAIRMAN. Thank you. We will proceed, Doctor.

STATEMENT OF DR. MORRIS TEPPER, CHIEF, METEOROLOGICAL SATELLITE PROGRAM, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Dr. TEPPER. After having heard the presentations so far, you may be wondering somewhat whether the exploration of space does not have a more practical side, something closer to our activities as individuals.

The CHAIRMAN. Doctor, may I interrupt you. Would you like to give us a verbal statement like Dr. Newell's? If so, we will place your written statement in the record.

Dr. TEPPER. Just as you prefer.

The CHAIRMAN. I believe the committee would be more attentive than if you read the statement.

Dr. TEPPER. Surely.

(The prepared statement is at the end of the day's hearing.)

Dr. TEPPER. There are three general fields of application which I would like to discuss today, those of meteorology, communications, and navigation.

The objectives are: In the meteorological field, to develop a satellite capability for providing worldwide meteorological information; in the communications field, to develop a satellite capability for making possible worldwide communications; in the navigational field, to develop a satellite capability for making possible all-weather navigation at low cost (fig. 64).

SATELLITE APPLICATIONS

OBJECTIVES

METEOROLOGICAL:	TO DEVELOP A SATELLITE CAPABILITY FOR PROVIDING WORLD WIDE METEOROLOGICAL INFORMATION.
COMMUNICATIONS:	TO DEVELOP A SATELLITE CAPABILITY FOR MAKING POSSIBLE WORLD WIDE COMMUNICATIONS.
NAVIGATION:	TO DEVELOP A SATELLITE CAPABILITY FOR MAKING POSSIBLE ALL-WEATHER NAVIGATION AT LOW COST.

FIGURE 64

I will discuss these three fields in turn.

First, the meteorological satellite: The meteorologist requires certain information in the performance of his duties. The objective of the meteorological satellite program is to provide this information for the meteorologist. How this will be done, I will show in the next slide.

In the upper right-hand corner we see that photocells and television will provide cloud cover information, storm location, description of the various clouds, their amounts and general types (fig. 65).

The scanning infrared detectors are being designed to measure temperatures—average surface temperatures and temperatures of the atmosphere; and temperatures of the cloud tops.

There are nonscanning infrared detectors which will give information on the gross heat budget of the Earth's atmosphere. This is

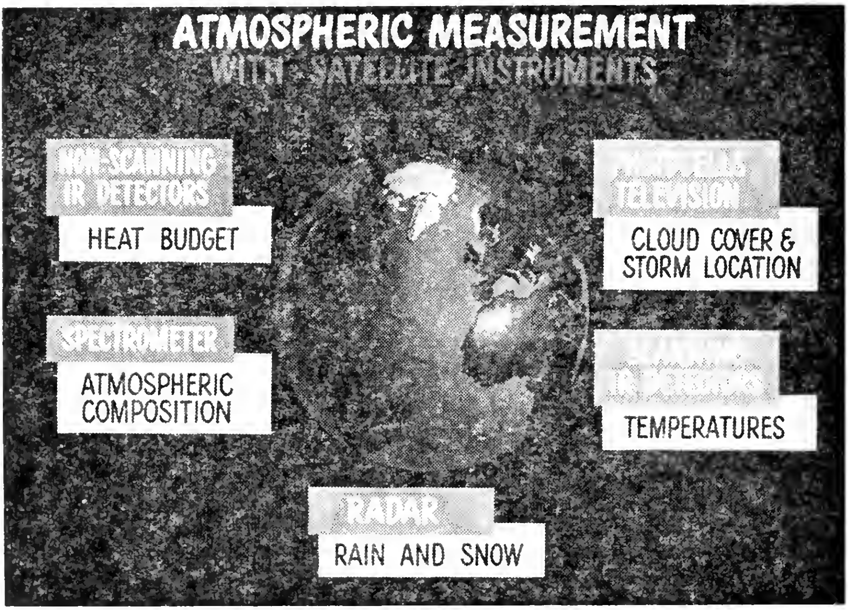

FIGURE 65

a very important quantity because it gives an accounting of what happens to the solar radiation after it enters the earth-atmosphere complex and how much is available for producing atmospheric motions.

We are thinking of developing a spectrometer in order to give atmospheric composition of a kind, useful to meterologists, like water vapor, carbon dioxide, and ozone.

We also have suggestions as to how to use a spectrometer to perhaps measure stratospheric temperatures.

We are investigating the possibility of flying a radar in a satellite in order to determine areas of rain and snow and the heights of the precipitation layers. These, then, are the varions types of instrumentation that we are thinking about and the types of information they will give us.

Mr. FULTON. Are you not going to have any of those nuclear explosion detectors?

Dr. TEPPER. Not in this program. Their relationship to meteorology has not been demonstrated as yet. Our experiments are designed more to provide the meteorologist with the type of information he is using currently.

This is our progress, past, present, and future. During the past we launched two satellites which had significant meteorological instrumentation. Vanguard II, contained a photocell, and I believe the committee is well acquainted with the history of that satellite. We have not abandoned the possibility of reducing that data, however. We hope that we will be able to get useful information from this satellite (fig. 66).

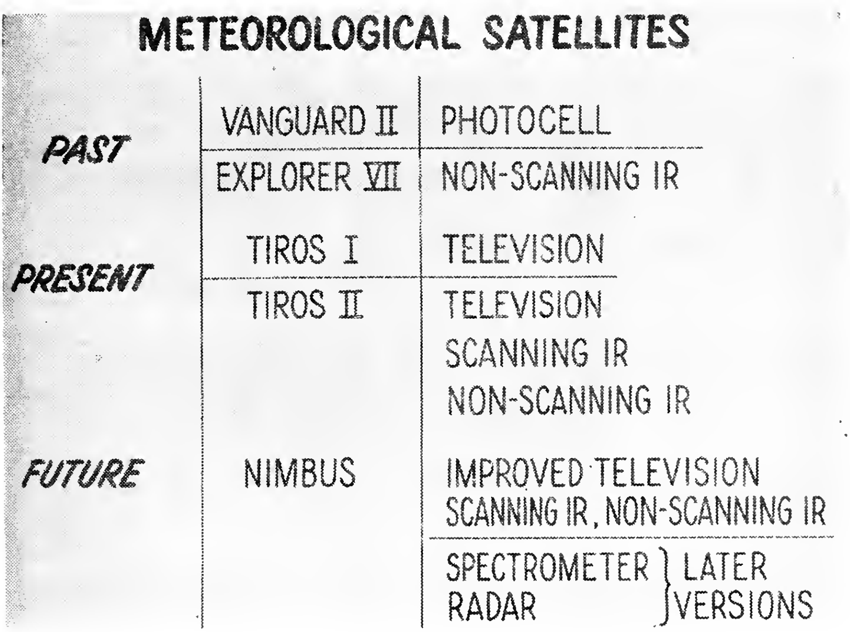

FIGURE 66

Explorer VII, which is still in orbit, contains a nonscanning infrared radiation detector and is giving us information on gross heat. This data is not completely reduced but is being worked up. The information that I have is that the data looks very good.

Currently—and I want to talk about this at greater length later—our current program relates to Tiros I and Tiros II. These are two satellites to be launched this calendar year. Tiros I will contain a television system containing two cameras to photograph cloud cover.

Tiros II will contain a television system also and will contain a scanning infrared radiation system and a nonscanning infrared detection system.

In the future, is a series of satellites which we have designated Nimbus, and these will contain instrumentation of the kind we have been working with and in addition the spectrometer and the radar developments.

I will mention a little bit later, when I discuss Nimbus, some of its important improvements over Tiros I and II.

This chart shows an artist's drawing of the Tiros satellite. Tiros will be spin stabilized. In other words, it will rotate and maintain its aspect fixed in space throughout its life history. It will be covered with solar cells to provide energy for its operation (fig. 67).

In addition, it will have batteries in order to run the satellite whenever it is in darkness.

This shows one of its cameras, the wide angle camera and the narrow angle camera is back here. I show this to show the complicated equipment that the satellite has.

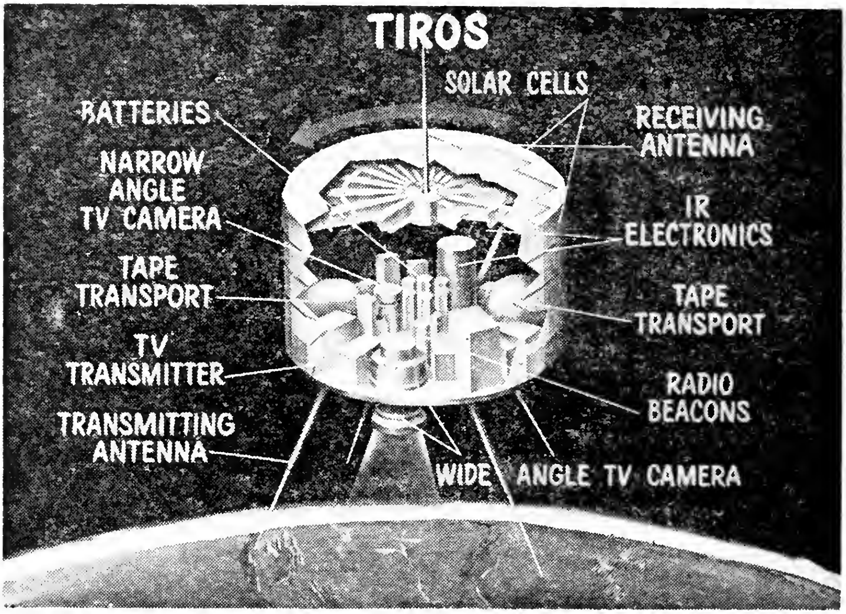

FIGURE 67

It will be launched in an inclined orbit and will reach approximately 50° north and 50° south during its transit around the Earth. It will be at approximately 380 miles elevation. Insofar as its shape, weight, and size are concerned, it weighs about 270 pounds; it is 42 inches across here and 19 inches tall.

Mr. FULTON. Why do you have a 50° inclination? Why don't you have it equatorial?

Dr. TEPPER. The meteorologist would like to have as much coverage over the entire Earth as possible so that the optimum orbit would be one that would go pole to pole. As the Earth rotates around it would see everywhere during its orbit.

Mr. FULTON. Why don't you then make a polar obit?

Dr. TEPPER. We couldn't start with a polar orbit and this will be one of the differences between the Tiros launch and the Nimbus launch we will talk about a bit later.

Energy considerations prevented us from launching the Tiros directly northward and also the fact that we have been launching from the Atlantic Missile Range rather than the Pacific Missile Range.

Mr. FULTON. When you get a 50° orbit and then get your scanners, how much of the Earth's surface can you then cover? How much of a slope do you get?

Dr. TEPPER. There are several things that are involved. Picture taking is essentially restricted to daylight. Another factor is whether the satellite looks at the Earth. Sometimes it looks out in space or has a glancing view of the Earth.

These are the two essential features. Percentagewise, I don't have this information.

Mr. FULTON. Put it in the record later.

Dr. TEPPER. All right.

(The information referred to is as follows:)

The portion of any orbit useful for photographing the Earth's cloud cover is variable, ranging from 0 percent under the worst conditions to about 33 percent under the most favorable. An overall average figure is perhaps 17 percent per orbit.

Areawise, it is possible to photograph up to 40 percent of the Earth's surface per day under the most favorable conditions.

Dr. TEPPER. Tiros originally began in the Department of Defense and was transferred to NASA during the spring of the past year (fig. 68).

In Tiros, NASA has responsibility for overall direction and coordination. The U.S. Army—specifically the U.S. Signal and Research Laboratories at Fort Monmouth, and contractors from industry, particularly the Radio Corp. of America, had responsibility for the development of payload and selected ground equipment, data acquisition, and data transmission.

PARTICIPATION IN TIROS

NASA	OVERALL DIRECTION AND COORDINATION
U.S. ARMY AND CONTRACTORS FROM INDUSTRY	DEVELOPMENT OF PAYLOAD AND SELECTED GROUND EQUIPMENT, DATA ACQUISITION, DATA TRANSMISSION
U.S. AIR FORCE AND CONTRACTORS FROM INDUSTRY	DEVELOPMENT OF LAUNCH VEHICLE, MATING OF VEHICLE AND PAYLOAD, LAUNCH, DATA ACQUISITION. ASSISTANCE IN DATA ANALYSIS AND INTERPRETATION
U.S. NAVY :	ASSISTANCE IN PHOTO ANALYSIS
U.S. WEATHER BUREAU	DATA ANALYSIS AND INTERPRETATION, DATA DISSEMINATION, HISTORICAL STORAGE

FIGURE 68

The U.S. Air Force, BMD, and contractors Douglas and Lockheed, had the responsibility for the launch vehicle itself—the mating of vehicle and payload, launch, data acquisition. AFCRC is assisting in data analysis and interpretation. The U.S. Navy, particularly the Navy Photographic Interpretation Center, is assisting in the photoanalysis.

The U.S. Weather Bureau has a very major role in the Tiros program and that is in the data analysis, data interpretation, and dissemination.

Mr. FULTON. Is this program one done with international cooperation and under the extension of the International Geophysical Year? What are you doing in connection with other countries?

Dr. TEPPER. As of now this particular Tiros program and the follow-on program of Nimbus are restricted to activities within the United States. The cooperation with other countries in the meteorological satellite field has not really begun.

Mr. FULTON. When do you expect to begin that? I think that is one of the things the Space Act points out. These programs are to be done when they are for the benefit of mankind and extensions of practical programs for peaceful purposes with these other countries and in conjunction with them.

It was apparent to me from your statement that it seemed to be limited to just the United States.

Now, the second thing is, our statutes of 1958 require the dissemination of this information so I would rather not have it now, but put in the record what your plans are on that. It is to be made public and disseminated.

Mr. HORNER. Mr. Fulton, we have had activity in that area.

Mr. FULTON. Put in a statement on that.

Mr. HORNER. We will provide it for the record.

(The information requested is as follows:)

A cooperative program with other nations for the use of application satellites is an objective of the National Aeronautics and Space Administration. When the technology of meteorological satellites has advanced sufficiently, a detailed plan for such cooperation can be prepared. The Tiros satellite is an initial experiment to develop the technology. Experiments with Tiros and the second generation satellites, Nimbus, will provide us with much of the information needed to make engineering selections of the type of data to be collected, the methods for storing and coding the data, the type of ground receiving and data recovery systems, and the methods for processing the data.

Although a detailed plan for international cooperation in a weather satellite system cannot be prepared now, it will be desirable to call upon other countries to aid in some of the experiments. Our first task, however, is to produce a successful satellite for conducting the experiments.

Dr. TEPPER. In our program we have established a Joint Meteorological-Satellite Advisory Committee, jointly with the Department of Defense and the Weather Bureau, where the military requirement in the field of weather is being coordinated with ours so that we can develop a national program responsive to the needs of the military and the civilian as well.

This meteorological data will be quite different from anything the meteorologist has had before (fig. 69).

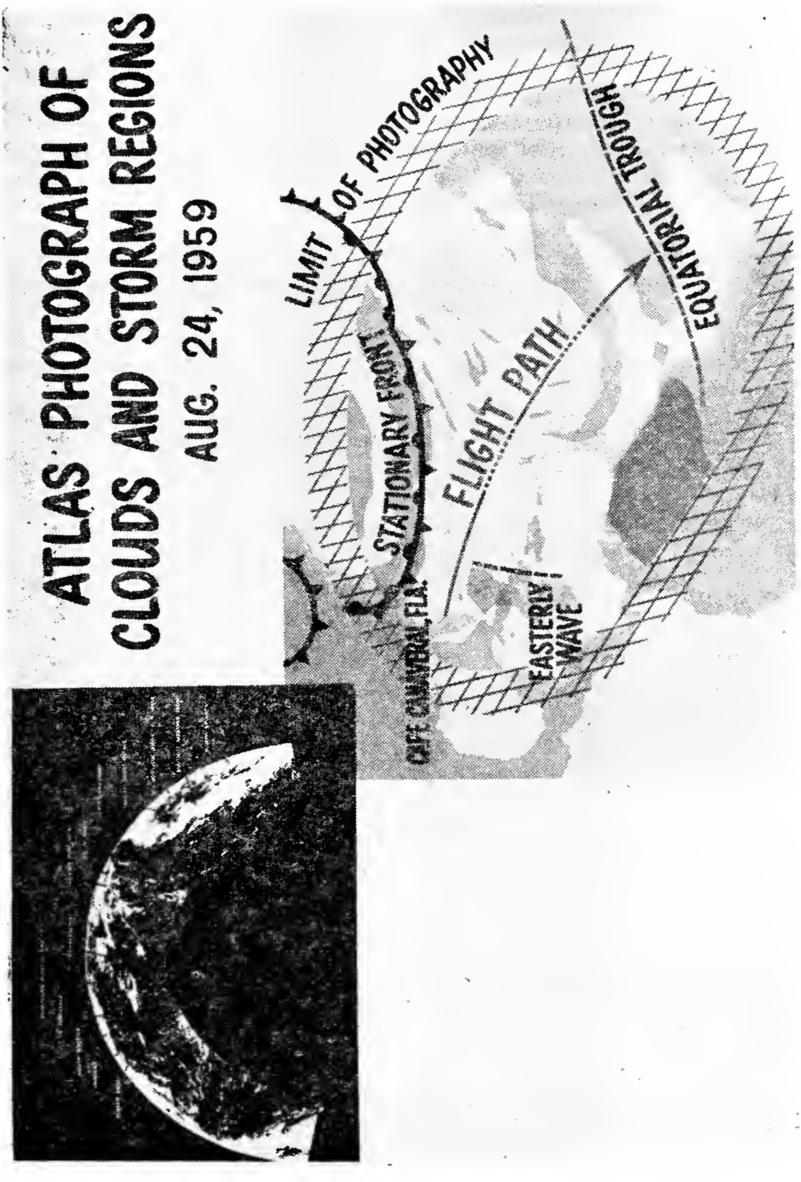
ATLAS PHOTOGRAPH OF
CLOUDS AND STORM REGIONS
AUG. 24, 1959
LIMIT OF PHOTOGRAPHY
STATIONARY FRONT
FLIGHT PATH
EQUATORIAL TROUGH
EASTERLY WAVE
CAPE CANAVERAL, FLA.

FIGURE 69

It is necessary before launching to develop techniques and procedures so that when the data becomes available it can be used on an operational basis, and perhaps I can refer to your previous question, Mr. Fulton, by stating that at each of the Tiros read out stations—there will be two in our Tiros program—there will be a meteorological team. It will be abstracting useful meteorological data and putting it on the weather teletype service so that the information will be made available to weather users as soon as possible if any is identified in the meteorological satellite data.

Mr. Fulton. How small an area will be your area of reception? For example, on a storm or a burst of a nuclear explosion? What height and what focal area will you have?

Dr. Tepper. I think we are in privileged regions here. There are two cameras aboard the Tiros. The low resolution camera will view an area of roughly 700 miles—a square of 700 miles on a side with a line resolution of about 1½ miles.

The high resolution camera is——

Mr. Fulton. You could pick up the ordinary atomic or nuclear explosion with that type of resolution.

Dr. Tepper. I am not familiar with the resolution required to identify such explosions, but I imagine it would be.

Mr. Fulton. Of what type would you expect the orbit to be? Is it going to be an annular orbit or elliptical?

Dr. Tepper. A circular orbit of 380 miles elevation.

Mr. Fulton. Why do you pick that particular level?

Dr. Tepper. This was chosen in order to be high enough to be outside the influence of the atmosphere and low enough to be compatible with the energy of the launch vehicle.

Mr. Fulton. Go ahead.

Dr. Tepper. I was mentioning the type of data that we expect to get from Tiros, and its newness. And, in order to prepare for the utilization of these data, the meteorologists have been studying high-level photographs as they have been available from other sources, such as the nose cone photographs and so on.

There is a mosaic of a series of nose cone photographs taken by an Atlas shot, launched October 24, 1959. It shows a considerable amount of detail on the photograph.

Of interest to us here is the transposition of the cloud data onto this map as shown in the blue here, and its correspondence with the weather data of that date. You will notice the correspondence between the stationary front and cloud data here; the equatorial trough and the convergence of the circulation from the Northern and Southern Hemispheres and the easterly wave, and the cloud cover picked up by the photograph itself.

This analysis was made by the scientists at the General Electric Co. who were associated with this particular experiment.

However, the meteorologists at the Weather Bureau are studying some of the detail of this structure that do not correspond directly with the gross analysis made previously in order to see whether there is any additional information to be gleaned from data of this kind.

In addition to analysis of cloud photographs, they have studies of radiation and data transmission and dissemination, in order that when the data become available, a minimum amount of time would lapse between the getting of data and its usefulness.

Mr. FULTON. With respect to that photograph there, obviously, if you have an Atlas missile you have a ballistic trajectory at a certain point. How do you cure the distortion that would occur in order to get the picture that you have there, that is perfectly balanced?

Dr. TEPPER. I don't know how long the entire picture sequence took, but this particular picture was taken in the neighborhood of 300 miles. This is not the entire trajectory.

I mentioned before following the Tiros experiment will come the Nimbus program. This is to correct two of the major difficulties, two of the major faults of the Tiros program (fig. 70).

Tiros, which is represented to the left, has these two features: An inclined orbit, roughly going to 50° north, 50° south, which does not

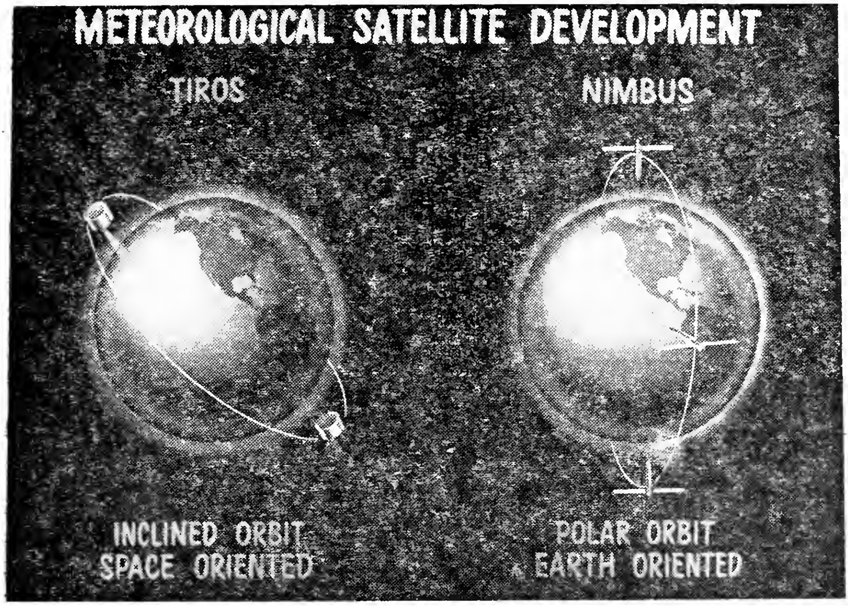

FIGURE 70

permit us to view the events poleward. Sometimes it looks at the Earth and sometimes it looks out into space.

In order to correct that, the Nimbus program represented here will be in polar orbit and will then be able to cover all latitudes and it will be Earth-oriented so it will be facing the Earth at all times and giving us maximum possible acquisition of data during its travel around the Earth.

Of course, it will still be dependent upon the illumination by the Sun, but this, too, we hope to be able to get around eventually by using other techniques.

Mr. FULTON. Why, if you are going to orient it, for example, on the Sun, why then can't you have it move in an orbit which will have it reflected toward the Earth's surface?

If you have a particular set point that you are able to have it revert to, why can't you have a mechanism that can move it on some sort of a pivot. You could have it set on the Sun at some fixed point. Then, as it goes around the Earth, have it revolve so that it aims toward the Earth's surface rather than out into space, sometimes. Why couldn't you do that?

Dr. TEPPER. Are you referring to Nimbus or to the Tiros?

Mr. FULTON. The Tiros.

Dr. TEPPER. In order to stabilize it on launch, it has to spin around and keeps this orientation throughout its history.

Mr. FULTON. Yes, but I think it would be fairly simple if you could have a point it would have a reference to when it is in orbit, that you could then have it aiming toward the earth's surface all the time.

What percentage of the orbital equipment will be facing right out into space and doing you no good?

Dr. TEPPER. I think you are referring to a stabilization technique, or an orientation technique. Well, this is what we are going to try to do in Nimbus: orient it so it is facing the earth at all times.

Our first experiment is—well, it is a first experiment and it is launched in the simplest manner, spin stabilizing it and keeping a fixed orientation.

Mr. FULTON. You are doing that with Nimbus?

Dr. TEPPER. Yes, Nimbus will always look at the earth.

This is an artist's conception of Nimbus and it will be launched by a Thor Agena–B vehicle. It will be about 650 pounds; it will be in a 600-mile orbit and it will have these wings which will have solar cells on them to provide the energy (fig. 71).

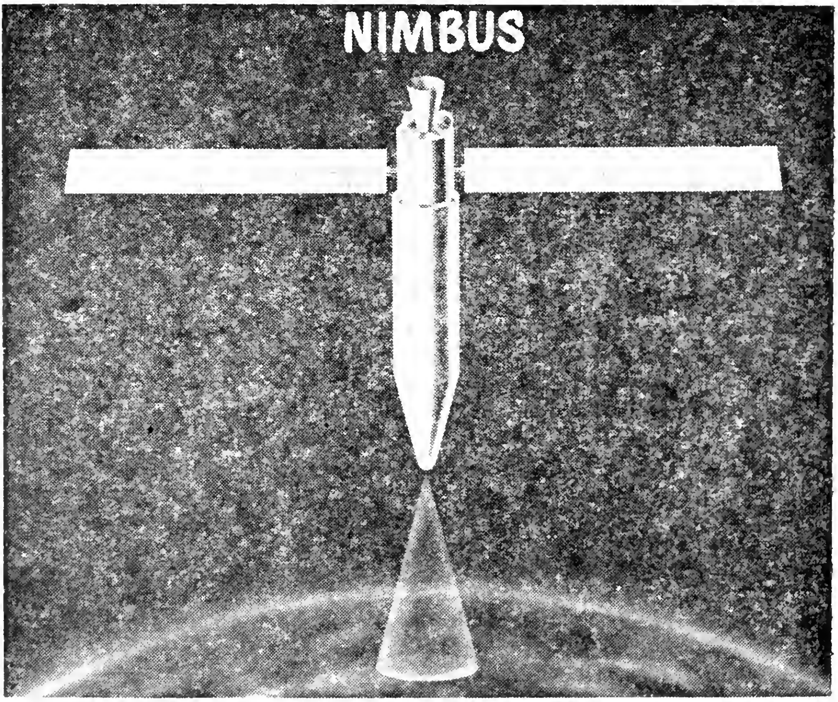

FIGURE 71

It will have advanced instrumentation, but similar to the kind on Tiros. Later versions of Nimbus might have the spectrometer, or the radar.

As I mentioned, the two major features that indicate improvement of Nimbus over Tiros, are its pole-to-pole transit and that it will be earth oriented, looking at the earth all the time.

This then briefly is the meteorological satellite program.

Now, in the communications satellite program, just to review the presentation of last year, there are two types of communications satellite. One is an active repeater, one that contains electronics aboard, receives information from the ground and retransmits it. The other is the passive satellite from which signals are merely reflected back toward the Earth.

The Department of Defense is engaged in the active satellite field and NASA is looking during these early stages to the Department of Defense for the first developments in this field; NASA is primarily concerned now with the passive communications satellite.

The project which I will discuss is Project Echo.

The reflector to be used in this experiment is a hundred-foot sphere which will be launched in about a 900-mile circular orbit around the Earth. It will consist of mylar about a half a thousandth of an inch thick with a weight of 136 pounds (fig. 72).

In order to test this sphere, as a communications satellite, there will be a signal transmitted from Goldstone, Calif., and reflected to the receiver at Holmdel, N.J. Experiments will also be done in the other direction from the transmitter on the east coast to the receiver on the west coast.

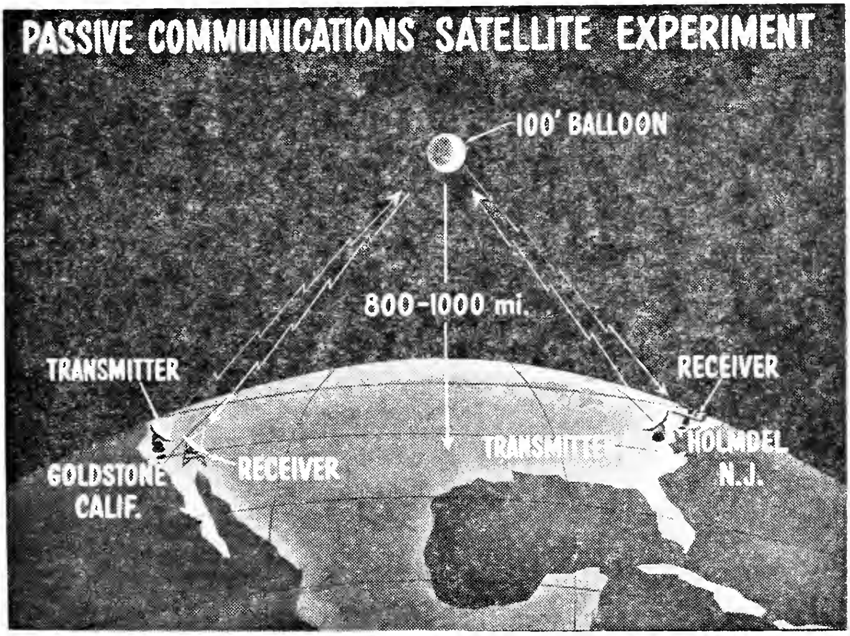

FIGURE 72

Mr. FULTON. Actually, any nation could use that then and there is no way we could prevent it?

Dr. TEPPER. That is right.

Mr. FULTON. Secondly, could another nation jam what you are doing?

Dr. TEPPER. This is a completely passive satellite, like the Moon. Anybody can use it.

Mr. FULTON. On your reflected signal, what could the other nation do to jam what you are doing? Do they have to interfere with line-of-sight communication?

Dr. TEPPER. There isn't anything that I can think of that they could do in order to interfere with any signal sent from one receiver to the other side.

Mr. FULTON. How many signals then could be received or transferred?

Dr. TEPPER. There is no limit to the use of this.

Mr. FULTON. The transmitters' radio wave bands would be the only limiting feature?

Dr. TEPPER. That is right. To clarify this point on intentional interference or jamming of communications via such spheres, this would be extremely difficult to do. To effectively interfere one would have to use an excessive amount of power spread out over the frequencies on which communications were taking place. The unlimited range of frequencies which is afforded the communicator using such spherical satellites makes it virtually impossible for anyone to muster up enough power to cause interference.

Mr. FULTON. Your transmitter is on a certain band. It is the number of bands that limit it and not the transfer to the sphere.

Any number of signals can bounce off that sphere.

Dr. TEPPER. That is right. But I say in this experiment what we are going to do is send it from one part of the country to the other, in order to test this type of a configuration.

The CHAIRMAN. Any interference would not affect the sphere, but it would affect the means of bringing the signal from the sphere back to the Earth, or taking the signal up to the sphere.

Mr. FULTON. That is what I said. There can't be interference. Only if you are on a narrow band, it can then only be through cutting that almost line-of-sight projection.

The CHAIRMAN. Is that right? Is it true nothing could be done there to interfere with the use of the sphere, because it is passive, as you say?

Dr. TEPPER. That is my understanding.

The CHAIRMAN. All the interference that could be set up in the case of communications would be on the wavelength being used to reach the sphere and then reflect back. That is correct, isn't it?

Dr. TEPPER. That is correct.

Mr. FULTON. And that, almost, has to be cutting it in line-of-sight, does it not? You are using a narrow band to go from your transmitter up to the reflector and down to the receiver. In order to cut off that particular message, as the chairman says, you would have to cut that particular message as it travels.

Dr. TEPPER. That is right.

Mr. FULTON. So it would be really a very narrow line-of-sight cutting and it would be very hard to do. Is that right?

Dr. TEPPER. Yes.

In all satellite experiments, we try to test out the satellite under space conditions, as much as possible.

Obviously it is not very feasible to try to test out a 100-foot sphere in space conditions, on Earth. We have arranged for a series of vertical launchings of this sphere in order to test the configuration of the payload passage and the inflation technique.

We have a short film——

Mr. FULTON. Before you leave that, you could really have any number of receivers and any number of transmitters within the United States that could send messages back and forth, or really make a zigzag pattern up and down and relay it?

Dr. TEPPER. The only limit would be in the amount of energy you could transmit and how much would come back eventually after going through all these transits.

The CHAIRMAN. There is nothing exclusive, though, in the use of that sphere. Anyone could use it, either friend or foe.

Dr. TEPPER. That is correct.

Mr. FULTON. Practically, we could use it for both military and civilian purposes and carry thousands of messages per second on a 100-foot sphere.

Dr. TEPPER. Hopefully, yes.

Mr. FULTON. So if you put up various hundred-foot spheres in orbit and have them all so they were within a line of sight to a certain tangent, air to surface, three of them would pretty well cover the Earth.

Dr. TEPPER. I will show you a slide a little bit later, and indicate that it will require 25 to 26 at 3,000 miles altitude, if they were distributed in a random manner, and we would have to consider that they would be. It would require that many in order to have a 99-percent probability of having a satellite available for communication at any given time.

The CHAIRMAN. Would that sphere stay in the same relative position?

Dr. TEPPER. Oh, no.

The CHAIRMAN. It would vary?

Dr. TEPPER. It would be in orbit. This is a 900-mile orbit. You have to get it up to about 23,000 miles or so, in order to keep it in stationary position over the Earth.

The CHAIRMAN. If you send a signal based on reflection from that sphere you would have to catch the sphere in the right position?

Dr. TEPPER. Relative to the station, yes.

Mr. FULTON. Actually, what you are doing then on the orbit that you are proposing, with some variation, is putting one of these hundred-foot spheres about every 1,000 to 1,200 miles.

Dr. TEPPER. That is roughly correct.

Mr. FULTON. Every thousand miles you get one of these, right around the Earth.

Dr. TEPPER. Yes, sir.

I would like to show you now the preparation for and the launch of the vertical test shot for Project Echo.

[Whereupon, a moving picture was shown.]

Dr. TEPPER. This is the inflated sphere. The hangar is somewhere in North Carolina.

Here we see the satellite folding table, some 150 feet long and the sphere being folded into about 400 pleats. This is the 26-inch-diameter container that contains the sphere. Here the sphere is being folded into the container. The top part of the container is now being put over it.

This is the telemetry that will be included in order to report back the events of the experiment.

Next you will see the second stage which will launch the sphere. It is the same rocket that will be used in the final shot.

The sphere is now placed on top of the second stage.

Here we have the launch site at Wallops Island, with the first stage in place and the second stage being placed on top of it.

The sphere is protected by fairing during flight.

The first launch was in October of last year and the second in January of this year. They were launched in the evening so that the sun's light could be reflected off the sphere for visual observation.

Here we see the first stage ignition. The vehicle is spinning for stabilization.

In a minute you will see the balloon being ejected.

Here it is being ejected.

[End of film.]

Dr. TEPPER. Here we have some models of the sphere. This is the container into which it will be placed and this is a transparent plastic container showing you how the sphere is folded. You will note it is folded inside this container. This is the satellite that will be launched and then it will be inflated.

The CHAIRMAN. That is the original that is going to be launched?

Dr. TEPPER. Oh, no.

The CHAIRMAN. That is just a sample?

Dr. TEPPER. It is one of several which were fabricated for the development of this payload. Of course, the plastic container is for display so that we can look inside.

This is being built by the Bell Telephone Laboratory at the east coast (figs. 73 and 74).

NASA provides direction, payload, development, tracking, and orbit calculation (fig. 75, p. 376).

We have the Jet Propulsion Laboratory for the west coast site. The Bell Telephone Laboratories for the east coast site.

The Lincoln Laboratory provides the Millstone radar for tracking. Industry provides the mylar spheres, radio beacons and so forth.

The military services' research and development organizations are participating in individual experiments of their own with this sphere, and the radio industry at large is also setting up experiments so that when the sphere is launched, they can utilize the sphere for their independent experiments.

This slide illustrates the very thing Mr. Fulton was talking about before. At any time the sphere can be seen only in a certain radius, a region on Earth. As it moves, this area where it can be seen by any

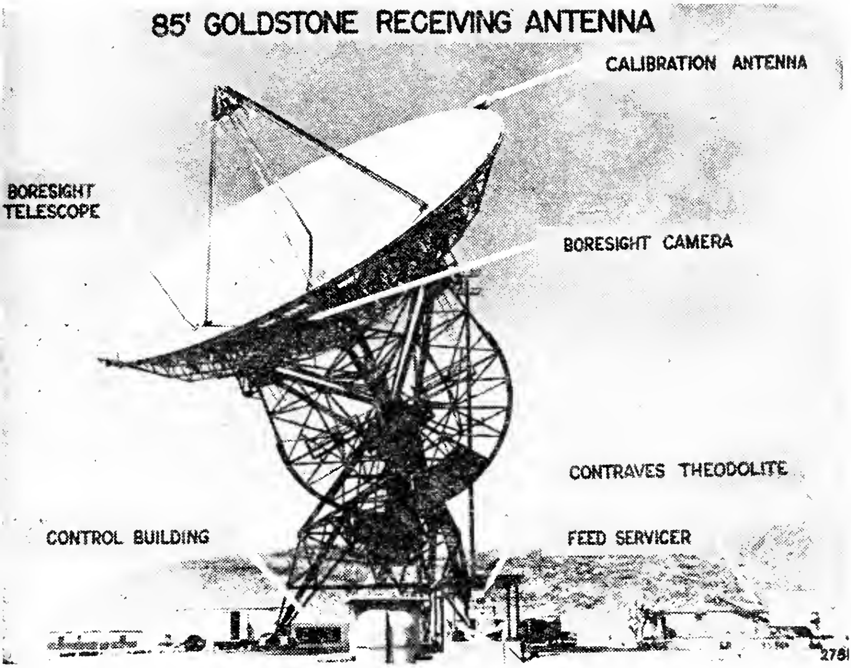

FIGURE 73

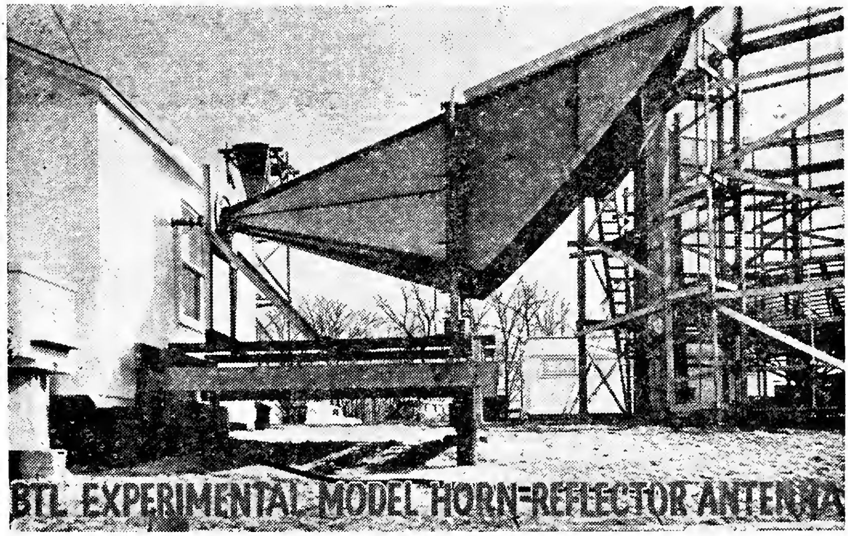

FIGURE 74

PROJECT ECHO PARTICIPANTS

NASA	DIRECTION, PAYLOAD DEVELOPMENT, TRACKING & ORBIT CALCULATION
JET PROPULSION LABORATORY	WEST COAST COMMUNICATIONS SITE
BELL TELEPHONE LABORATORIES	EAST COAST COMMUNICATIONS SITE
LINCOLN LABORATORY	MILLSTONE RADAR TRACKING
INDUSTRY	MYLAR SPHERES, RADIO BEACONS ETC.
INDEPENDENT EXPERIMENTERS	NAVAL RESEARCH LABORATORY ROME AIR DEVELOPMENT CENTER ARMY SIGNAL RES. & DEV. LABORATORIES RADIO INDUSTRY-AT-LARGE

FIGURE 75

two stations also moves, so that in an operational system you have to have a number of such satellites in space. This brings us to the problem of the possibility of launching multiple satellites from one launch vehicle and having them separate in space once they get up there (fig. 76).

Mr. FULTON. Why are all the spheres silver and one is red.

Dr. TEPPER. This is to have a place to point to, to talk to.

You talk to this one and its red area of visibility is out here.

Mr. FULTON. But you aren't launching red ones, you are launching silver.

Dr. TEPPER. They will all be the same color. They will all be silver.

This is briefly the communications satellite program.

Mr. FULTON. Let me ask you this. It looks like those are egg-shaped at the outer reaches of where they will reach. Why are they egg-shaped rather than circular? The pattern on the Earth's surface is a——

The CHAIRMAN. It is just the way you look at it. If you project that right, they are circles. If you look at it flat, it is egg-shaped.

Mr. HORNER. That is because of the projection of the map.

The CHAIRMAN. Well, Doctor, you have certainly given us a fine statement. I wish that the whole membership of the committee could have heard you, but they will have an opportunity to read your statement. It will be printed, so if they are interested, they will really have full opportunity to take advantage of that.

Mr. FULTON. Why do you have to have so many?

Dr. TEPPER. Why do you have to have so many of these?

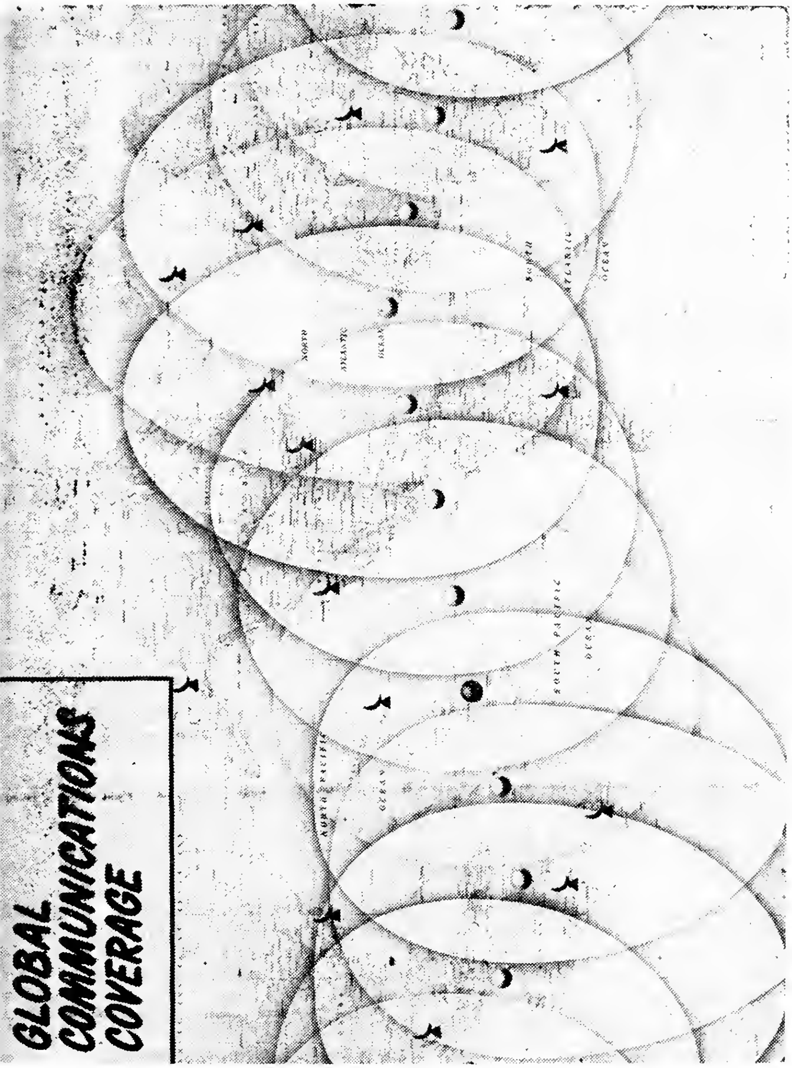

FIGURE 76

Mr. FULTON. Yes. You will have 25 or 30 going around the earth in orbit.

The CHAIRMAN. There are only 12 there.

Dr. TEPPER. This is in order that any two stations can communicate with each other 99 percent of the time. If you didn't have this many, then at some time, these two stations would not have a satellite available to them by which they could communicate.

Mr. FULTON. The next question is, Why don't you have intersecting orbits with various inclinations? Wouldn't that give you a better coverage, going every which way around the Earth?

Dr. TEPPER. The computation of 26 was made for random distribution.

Mr. FULTON. At one time then, if you look at it, there would be six. Any one station can pick up six at a time.

Dr. TEPPER. In this particular distribution that we have here. This is a very even distribution. In a random distribution, they might be bunched differently.

Mr. FULTON. How many would you expect each station to be able to pick up?

Dr. TEPPER. This would represent an average picture.

The CHAIRMAN. This is more or less an ideal distribution, but from a practical viewpoint, you wouldn't get that evenness.

Dr. TEPPER. Yes. This represents a distribution, if they were equally spaced.

Mr. FULTON. Should they all be going in one direction or could some be going the other way around? Should the orbits all have the same path and direction, or should some of the orbits be shifted so that you get a different overlapping?

Dr. TEPPER. Probably the best arrangement would be to have all the orbits polar orbits so that if we launched them in equally spaced meridians in polar orbits, then you eliminate some of the randomness this way.

Mr. FULTON. Once this system is set up, how many messages would it be possible, or digits per second, for this kind of a system to carry and at what cost?

Dr. TEPPER. I will have to put that in the record.

Mr. FULTON. Put that in the record, and then how long it will take to reach such a practical result.

(The information requested is as follows:)

This question cannot be answered with a simple number. The spherical satellite is theoretically unlimited in its ability to reflect different frequencies. Thus many transmitter-receiver combinations can make use of the same satellite simultaneously, so we would have to say that, in theory, a spherical passive satellite has an unlimited message capacity. However, every time one doubles the capacity of the ground equipment, the cost of this ground equipment virtually doubles.

Cost estimates for such systems must wait for the completion of initial phases of the research and development. We must first determine just what is required to place such a structure in orbit and to keep it there for long periods of time.

The CHAIRMAN. Why do you work on this type system that requires so many spheres? Why would it not be better to work on a system where you would have stationary satellites at 18,000, 20,000, or 22,000 miles and have much fewer, too, and more dependable ones? Wouldn't that be a better arrangement?

Dr. TEPPER. I think we ought to consider that at this stage it is only an experiment as yet. In experiments you try to keep at a minimum the number of difficulties you have to contend with. This type of a launch at this altitude is much more simple to accomplish than the one that is a stationary orbit at 22,000 miles.

The CHAIRMAN. The altitude is really the governing factor then?

Dr. TEPPER. Partially. The altitude. The equatorial launch itself presents a difficulty. Another reason is that the power required to communicate via a 24-hour satellite is 100 times that required if the satellites were placed in a 2,000-mile-high orbit.

The CHAIRMAN. Is that going to be equatorially launched or is that a polar launching?

Mr. FULTON. That is 50° up from the Equator.

Dr. TEPPER. It will be an inclined orbit.

The CHAIRMAN. 50° above and 50° below?

Dr. TEPPER. Yes.

The CHAIRMAN. Rather than what you suggested which would be around the pole?

Dr. TEPPER. Again, this is a first experiment of this kind, and subsequent experiments will be pole to pole.

Mr. FULTON. If the polar orbit is better, why don't you try it first?

Dr. TEPPER. The pole to pole launch facility was not available to us.

Mr. FULTON. Vandenburg Air Force Base was not——

Dr. TEPPER. At the time these programs originated, you planned them and developed them, with what was available and what you had. In other words, there is a leadtime concept involved here.

The CHAIRMAN. You couldn't adapt it now to use at Vandenberg?

Dr. TEPPER. It is problematical whether the amount of complication you are introducing here would compensate for what you are gaining just for this particular item, this one thing.

In other words, this can be a very useful experiment and very helpful the way it is.

The CHAIRMAN. You know this is a preliminary experiment and what you want to do is launch the experiment and then provide for the future, on the basis of the findings from the experiment.

Dr. TEPPER. Yes. Subsequent Echo shots will be pole to pole.

I think the third one—there are three in this series, the third one will be a polar launching.

The CHAIRMAN. Are there any further questions?

Mr. FULTON. One more. Do you see any need for Christmas Island, that we should purchase Christmas Island as a satellite and sphere launching area? Have you heard of that?

Dr. TEPPER. Yes.

Mr. FULTON. Put that in the record.

The CHAIRMAN. Yes, I think so.

(The information requested is as follows:)

We can only say that ultimately it will be desirable to put some communications satellites in equatorial orbits. An equatorial launching site would for this mission minimize the requirements on the vehicle performance. As vehicles become more reliable and their controls more sophisticated it will certainly be possible to launch satellites into an equatorial orbit from a nonequatorial launch site at some cost in vehicle performance.

The CHAIRMAN. The reporter is worn out. He has been working all day.

Mr. FULTON. Look at the money he is making.

The CHAIRMAN. For the benefit of all the members of the committee who are present, we will meet tomorrow in our regular committee room.

Mr. FULTON. I want to say from the Republican side that we unanimously thank you for your good chairmanship today.

The CHAIRMAN. Thank you very much.

The committee will adjourn until 10 o'clock tomorrow morning.

(Whereupon, at 5:10 p.m., the committee adjourned to reconvene at 10 a.m., Tuesday, February 2, 1960.)

THE NASA SATELLITE APPLICATIONS PROGRAM

Gentlemen, after having heard the presentations so far, you may be wondering somewhat whether the exploration of space does not have a more practical side—something closer to our activities as individuals. This is indeed the case, as I expect to show during the next half hour, as I present the NASA satellite applications program—a program involving satellites that will have an impact on the day-to-day living of all of us.

Last year, we presented the general aspects of the program on which we had embarked.

Today, I would like to acquaint you with our progress during the past year, our activity of the present, and our plans for the immediate future.

The three primary fields of satellite applications to which I shall refer are the meteorological, the communications, and the navigation satellites (fig. 64, p. 361).

The first chart states very briefly our objectives in these fields. They are:

Meteorological: To develop a satellite capability for providing worldwide meteorological information.

Communications: To develop a satellite capability for making worldwide communications.

Navigation: To develop a satellite capability for making possible all-weather navigation at low cost.

I shall now discuss each of these programs in turn.

METEOROLOGICAL SATELLITE

Our meteorological satellite program has been designed to acquire certain information needed by meteorologists in order to adequately describe and understand atmospheric processes and to predict the weather. This information includes:

(*a*) Cloud observations, both day and night, on a global basis.

(*b*) The heat budget of the earth and atmosphere.

(*c*) Indirect measurements of the temperature structure and composition of the atmosphere.

(*d*) Radar coverage, giving worldwide precipitation information.

The next chart (fig. 65, p. 362) shows the kinds of instruments being considered for inclusion on board satellites which will provide this information:

(*a*) Photocells and television—storm location, cloud cover, cloud type, and cloud motion.

(*b*) Scanning infrared radiation detectors—average temperature of the earth's surface and lower atmosphere, temperature of cloud tops.

(*c*) Nonscanning infrared radiation detectors—gross heat budget measurements; i.e., reflected solar radiation and radiation from earth and atmosphere.

(*d*) Spectrometer: Composition of atmosphere, water vapor, ozone, carbon dioxide, and stratospheric temperatures.

(*e*) Radar: Rain and snow areas, heights and intensity of their layers.

The next chart (fig. 66, p. 363) shows the rate with which we are accomplishing our program.

During the past year, we had two successful launches of satellites containing major meteorological instrumentation.

Vanguard II contained a scanning photocell for mapping areas of high reflectivity (essentially cloud cover). As has already been explained, a wobble developed upon launch and we are experiencing some difficulty in reducing the data.

Explorer VII, which is still providing useful data, contains, among its other scientific instrumentation, a nonscanning IR radiation detector system for heat budget measurements.

Currently, we are actively preparing for the launch this calendar year of Tiros I and II. Tiros I contains two television camera systems for cloud cover photography and Tiros II, the later version, will have in addition both scanning and nonscanning infrared radiation detector systems.

Our future program, the series of satellites designated Nimbus, will contain improved instrumentation growing out of our experience with previous satellites. Hopefully, later versions of Nimbus will carry new instrumentation such as a spectrometer or a radar on board.

On the next chart (fig. 67, p. 364), we have an artist's drawing of the Tiros satellite. The following are its characteristics:

1. Launch vehicle: Thor-Able II (Tiros I), Thor-Delta (Tiros II);
2. Stabilization: Spin stabilized;
3. Weight: 270 pounds;
4. Size: 42-inch diameter, 19 inches high;
5. Orbit: 380 nautical miles, circular;
6. Inclination: About 50° to Equator;
7. Lifetime: 90 days;
8. Instrumentation: Two television systems, scanning and nonscanning IR and associated electronics;
9. Power: Solar cells and storage batteries;
10. Launch: From AMR;
11. Tracking: Minitrack and Millstone radar; and
12. Data acquisition: U.S. Army Signal Corps Station at Fort Monmouth, USAF station at Kaena Point, Hawaii.

Participation in Tiros has been extensive (fig. 68, p. 365). Tiros was initially begun in the Department of Defense. On April 13, 1959, overall project direction and coordination was transferred to NASA.

U.S. Army (USASDRL and contractors from industry—primarily RCA): Development of payload and selected ground equipment, data acquisition, and data transmission.

U.S. Air Force (BMD and contractors from industry—STL, Douglas, and Lockheed): Development of launch vehicle, mating of vehicle and payload, launch, data acquisition. AFCRC will assist with data analysis and interpretation.

U.S. Navy (NPIC): Will assist in the photoanalysis.

U.S. Weather Bureau: Data analysis and interpretation, data dissemination, and historical storage.

In addition, NASA has organized the Joint Meteorological Satellite Advisory Committee (JMSAC) with membership from ARPA, Army, Navy, Air Force, Weather Bureau, and NASA with the following objectives:

(*a*) To consider the requirements of the DOD and NASA in the meteorological satellite program;

(*b*) To serve as a medium of interchange of information among NASA and DOD members; and

(*c*) To assist wherever possible and appropriate in operating programs.

It is our intent that through the coordination of requirements in this committee, we shall be able to develop a true nàtional meteorological satellite program, responsive to the needs of both the military and civilian users.

Meteorological satellite data, particularly the photographs of cloud cover, will present a new kind of data previously unavailable, to the meteorologists. In order to develop techniques of analysis and photointerpretation by means of which it will be possible to extract significant meteorological information from such photographs, meterologists are carefully studying all available photographs taken from high altitudes.

For example, during the past year, there have been several instances where a camera containing film was placed in a recoverable nose cone of an Atlas or Thor launch vehicles. Although the initial and primary purpose for the camera was nonmeteorological, it turned out that some very good pictures of the Earth's cloud cover emerged as a byproduct. On the next chart (fig. 69, p. 367) in the upper left-hand corner is a mosaic of several photographs taken at about 300 nautical miles elevation during the flight. The clouds were transcribed onto a map and are shown in tinted blue on the accompanying map.

Superimposed on the chart is the weather situation for the day. We see how remarkable is the correspondence between the major cloud areas and the major weather storm regions—as shown by the stationary front, the equatorial trough and the easterly wave.

This very preliminary analysis was performed by the scientists of the General Electric Co.—the company directly concerned with the nose cone experiments. However, as you can see, there is a considerable amount of additional detail on this photograph. The Weather Bureau is studying these details in terms of meteorological significance.

The Weather Bureau is also conducting similar kinds of studies, though necessarily more theoretical in nature, in the field of radiation, data handling, data processing, and operational utilization of satellite data in order to be better prepared to interpret and use the data when they are available.

So much for Tiros and preparing for its data. What is beyond Tiros?

In order to understand better the direction which we are following in the follow-on to Tiros—it is important to understand two of the basic limitations of Tiros. The next chart (fig. 70, p. 369) illustrates these weaknesses. Tiros will be launched in an inclined orbit and will be space oriented. The former means that Tiros will reach a maximum northern and southern latitude (about 50°). It will view events primarily between these latitudes so that poleward from these latitudes we shall have little or no data from this satellite. Secondly, by being space oriented, Tiros views the earth only part of the time during its orbit. The rest of the time it looks glancingly at the earth or out into space. Our follow-on satellite, Nimbus, will correct this. It will be in a polar orbit and so will cover all latitudes from pole to pole; it will always face the earth.

The other characteristics of Nimbus are (fig. 71, p. 370)—

1. Launch vehicle: Thor Agena B;
2. Stabilization: Earth oriented, pneumatic and inertia wheel technique;
3. Weight: 650 pounds;
4. Orbit: 600 nautical miles, circular;
5. Inclination: Polar orbit;
6. Lifetime: 6 months;
7. Instrumentation: Advanced TV, scanning and nonscanning IR; spectrometer and radar on later versions;
8. Power: Solar cell and storage batteries; and
9. Launch: From PMR.

Maximum data acquisition from a satellite in a polar orbit would be from a station located at the pole or as close to it as feasible. Thus, we are looking into the possibility of establishing a station in high latitudes at which the Nimbus data might be acquired.

COMMUNICATIONS SATELLITES

To refresh your memory: Satellites which can be used to provide communications over large areas of the Earth can be placed into two broad categories—the active repeater satellites and the passive satellites. The active repeater satellites contain electronics and an appropriate power source which permit a radio signal, sent from one point on the Earth, to be received on board the satellite, amplified, and then to be retransmitted to a distant receiver. The other category, the passive satellite, is comprised of satellites which merely reflect back toward the Earth radio signals originating on the Earth (fig. 72, p. 371).

Because of some rather immediate tactical needs, the DOD has embarked on a program to develop certain forms of the active repeater communications satellite. NASA, as was implied earlier in the introduction, is interested in establishing the technology necessary to the design of the more general communications satellites for civilian and commercial use.

In the area of active repeater communications satellites, NASA is watching with interest and relying on the DOD programs to provide the early stages of development. NASA has established a research and development program in the area of passive communications satellites.

Our initial effort calls for the development of large spherical satellites and the investigation of this form of satellite as a communications medium. This program has been named Project Echo.

A 100-foot diameter inflatable spherical satellite, developed by our Langley Research Center will be placed in a circular orbit about the Earth at an altitude of approximately 900 nautical miles. The satellite is made of mylar, one-half thousandth of an inch thick, with a vapor-deposited coating of aluminum to provide reflectivity. It weighs approximately 136 pounds and has 31,416 square feet of surface area.

The satellite is evacuated and folded into a 26-inch diameter container such as this [model]. Here, we see a folded sphere in a transparent container as it appears prior to launching [model]. These mylar spheres were fabricated under contract by General Mills Co. and Schjeldahl Co. This entire package will be placed in orbit using a Delta vehicle, and then the container will be opened to release the sphere. Approximately 20 pounds of a sublimating powder, placed inside the sphere, will cause the satellite to inflate in the vacuum of space.

To investigate the characteristics of this satellite as a communications medium and to determine the condition of the sphere in orbit. Project Echo calls for a series of communications experiments between JPL, Goldstone, Calif., and BTL, Holmdel, N.J. Signals originating at Goldstone will be reflected by the satellite and received at Holmdel. Signals from Holmdel to Goldstone via the satellite will make use of a different frequency. These communications facilities are now under construction.

The satellite has undergone considerable ground testing; but the real test is to inflate the payload in space, for we do not have vacuum facilities large enough to inflate this structure on the ground as part of this development. The Langley Research Center has programed several ballistic launches of the 100-foot diameter sphere from Wallops Island. Two such tests have been performed: the first on October 28, 1959, and the second on January 16 of this year. We have prepared a short film showing the preparation for and the launching of the first of the two tests mentioned. I should like to show this film now.

[Film.]

This first scene shows the 100-foot diameter sphere inflated in a large hangar at Weeksville, N.C., to determine the quality of construction.

Here, we see the folding table. The sphere is first folded into a long thin shape, 153 feet long with over 400 accordian-type pleats.

Here, we see the payload container.

The sphere is then carefully folded into one-half of the container.

The other half of the container is put in place.

Here, we see being assembled the telemetry equipment which will radio back events during the flight.

Next, we shall see the second stage rocket. This, incidentally, is the same rocket we shall use to finally eject the payload into orbit on the Delta vehicle; thus, we are testing as nearly as possible the final configuration for the orbital experiment.

The payload is now being fitted onto the second stage rocket of the launching vehicle.

Here, the ballistic launching vehicle is being assembled at Wallops Island. The first stage is a Sergeant rocket.

The second stage and the payload are now being added. A protective nose cone has been added which will be jettisoned after the vehicle leaves most of the atmosphere.

The test was made just after sunset so that the sphere would be visible by reflected sunlight against a dark sky.

The rocket is fired. The vehicle is spinning to provide stability.

The sphere is ejected and inflated at an altitude of approximately 80 miles.

[End of film.]

This first test showed a fault in the payload, for the sphere ruptured on inflation. The second test suffered from a vehicle fault. However, the sphere was ejected and the data (which is still being analyzed) indicate that the payload fault observed in the first test may have been successfully corrected.

(Fig. 73, p. 375). Rather large ground facilities are required for the communications experiment and here we see one of two 85-foot diameter antennas which will be employed in Project Echo.

(Fig. 74, p. 375). A specially designed antenna is under construction for the experiment at Bell Telephone Laboratories in Holmdel. This antenna is designed to eliminate noises which are a result of the surroundings. The use of such techniques will permit the detection of extremely small signals.

(Fig. 75, p. 376). The participants in Project Echo are shown here. NASA is providing the management and the payload development, tracking, etc. Jet Propulsion Laboratory, west coast communications site and Bell Telephone Laboratories, the east coast communications site. Industry is providing many of the components; the mylar spheres, radiobeacons, antennas, transmitters, etc.

Last, but by no means least, are the independent experimenters. We have indicated that the military services will perform their own experiments but many other organizations will take advantage of the existence of this satellite and will perform additional radio propagation experiments. NASA is cooperating with these experimenters and their efforts, in turn, will augment the sum total of extremely valuable information to be gained from Project Echo.

NASA plans three launches of the 100-foot diameter sphere (the first, an inclined orbit and the last two, polar orbits) to determine the usefulness of such spheres as communications satellites and to determine the technology required to place and sustain such large structures in the space environment.

A single satellite of this type cannot comprise a satellite communications system, for as shown here (fig. 76, p. 377).

Even though with a single satellite, communications can be established between any two stations within a rather large area, as the satellite moves relative to the Earth its area of coverage moves with it. If continuous communication is to be maintained, a number of satellites will have to be in orbit so that at least one is always in sight of the two stations desiring to communicate. It would take on the order of 26 spheres in a 3,000- to 4,000-mile orbit to provide 99 percent availability, if the spheres were randomly spaced. Because of this requirement and the advent of larger boosters in the coming years, the follow-on program to Project Echo calls for the development of the ability to place a number of spherical satellites in orbit with a single booster vehicle.

Feasibility studies of larger structures and other, perhaps more efficient, reflectors will continue but the experience and technology to be gained in Project Echo will provide an invaluable foundation on which to build the required technology.

NAVIGATION SATELLITE

At the present, NASA does not have an active development program in navigation satellites. As you know, a navigation satellite system is being developed by DOD. We are keeping in close touch with these developments so as to be in a position to evaluate the usefulness of the system for civilian application.

The total funds required to carry out the satellite applications program, as I have presented it, are \$26,300,000; of this, \$20,700,000 is for the meteorological satellite program and \$5,600,000 for the communications satellite program.

REVIEW OF THE SPACE PROGRAM

TUESDAY, FEBRUARY 2, 1960

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

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

The CHAIRMAN. The committee will come to order. I want to apologize this morning on behalf of the committee for having to meet in our own room rather than have a larger place in which to meet. The committee's staff made every effort to get a larger meeting room. We tried to obtain the caucus room, the Ways and Means Committee room, Armed Services Committee room, and several other committee rooms, but they were all taken.

We are fortunate in having Dr. von Braun here this morning. We have looked forward to his reappearance before the committee. At the last moment he told us that he has pictures that he wants to present to the committee. That presented another problem to us in our limited space here, but we have arranged to have a camera in this position here. The staff of NASA has been very ingenuous in arranging it this way.

When the pictures start, some of the members will have to move over in order to see them. But if you will bear with us, I think we will get along very well.

Mr. FULTON. I would like to welcome Dr. von Braun on behalf of this side and likewise to say I hope he has not too much complaint against this room as a launching pad. Thank you.

The CHAIRMAN. Well, Doctor, do you have a prepared statement this time?

Dr. VON BRAUN. No, sir; I have not. I have brought a motion picture along.

The CHAIRMAN. Whom do you have with you, Doctor, this morning?

Dr. VON BRAUN. This is Mr. Horner, the Associate Director of National Aeronautics and Space Administration.

The CHAIRMAN. Mr. Holaday is here, too. Do you want him up there with you?

Dr. VON BRAUN. No, not as far as I am concerned.

The CHAIRMAN. Doctor, we have adopted the procedure of swearing in all the witnesses. Please stand up and hold up your hand. Do you solemnly swear that the testimony you give this committee in the matters under discussion by the committee will be the truth, the whole truth, and nothing but the truth, so help you God?

Dr. VON BRAUN. I do.

The CHAIRMAN. Thank you, sir. Have a seat, Doctor, and we will be glad for you to proceed.

STATEMENT OF DR. WERNHER VON BROUN, DIRECTOR, DEVELOPMENT OPERATIONS DIVISION, ARMY BALLISTIC MISSILE AGENCY

Dr. von Braun. We have a 13-minute motion picture which gives a technical report on the status of the Saturn project. After this picture I have two more charts of an unclassified nature which show the effect of the additional funds on the schedule and the program of the Saturn development.

In addition, I have approximately 15 other charts of a classified nature in which I could explain to the committee, in closed session, all the details on where that money would go and what its effect on the program elements will be.

The Chairman. Do you want to use your motion picture first?

Dr. von Braun. Yes, sir. The motion picture is unclassified.

The Chairman. When you get ready to use your motion picture, let us know and we will ask the committee members to move to this side so they can see it.

Dr. von Braun. I should like to suggest that we begin with the motion picture right now.

The Chairman. You would like to begin with the motion picture?

Dr. von Braun. Yes, sir.

(A motion picture of 13 minutes in length, entitled "Technical Status of the Saturn Development," was shown to the committee at this point.)

(The sound track of the motion picture is reproduced as follows:)

Screen Play—the Saturn Rocket

Description of scenes	Narration
1. Opening scene: Solar system with planets revolving around the sun.	
2. Camera zooms to planet Saturn for closeup.	
3. Film title superimposed over planet closeup.	
4. Title removed and scene of planet remains while narrator explains.	The next step into space has begun. Development has started on a gigantic booster that will give the United States an advanced space capability. The Saturn space rocket will be capable of reaching the planets. It can orbit very heavy satellites—15 tons or more.
5. Fade to CU of model of man, with camera slowly panning up full length of rocket, with upper stages.	When assembly of the first rocket is completed, man will be dwarfed by the immense rocket. It will tower almost 200 feet from its base—as high as a 20-story building.
6. Aerial view of ABMA area________	Development of the Saturn is underway at Huntsville, Ala., under the direction of the National Aeronautics and Space Administration.
7. Von Braun and others walk out of building.	Dr. Wernher von Braun and his experienced development team started the project in September 1958.
8. Fabrication Laboratory scenes_____	To save time, the experts decided to cluster eight rocket engines of a proven type. Basic engineering problems had been solved in the development of military rockets by the Army Ordnance Missile Command. Work began on the booster, an assembly of nine tanks to carry fuel and oxygen, to provide 1,500,000 pounds of thrust.

SCREEN PLAY—THE SATURN ROCKET—Continued

DESCRIPTION OF SCENES	NARRATION
9. A chart comparing Saturn with Redstone and Jupiter.	The 22-foot-diameter Saturn will tower far above its predecessors, the Redstone and Jupiter ballistic missiles.
10. Forming of a tank bulkhead	Fabricating all parts of the rocket, from the largest to the smallest, personnel of the 10 laboratories are working with a sense of great accomplishment.
11. Welding	Scientists and technicians brought here from all sections of the country were sure they could produce the challenging objective—a space transportation system.
12. Saturn balance wheel fixture, outside Fabrication Laboratory.	First they built rings that would embrace the tanks. The gigantic size of the first stage could now be envisioned.
13. Fixture in Fabrication Laboratory	Assembly and checking began within the enormous hangar-type buildings.
14. Sloshing	Hundreds of tests were conducted in other laboratories. One major problem to be solved was to prevent sloshing of the fuel during flight. Model tanks helped to find the answer.
15. Wind tunnel	Wind tunnel tests of models verified the flight stability of the shape of the booster.
16. H–L motor, still	An improved and simplified version of the rocket motor used for U.S. ballistic missiles was to be grouped in a cluster of eight engines.
17. Single motor on test tower	These motors have already been tested singly, and have withstood the rigorous firings.
18. Saturn model placed in static tower	Facilities had to be altered to handle and test this new giant. Major alterations changed a Jupiter missile tests tower so it could accommodate the Saturn. Models were used for planning purposes.
19. Modification work on test tower	Modifications have been completed on the 178-foot test tower. Complex instrumentation has been installed. The tower must withstand the powerful blast of eight rocket motors generating more thrust than has ever been released. This will be the largest booster yet tested by the free world.
20 and 21. Full size motor cluster in tower.	Awaiting the first firing, the motor cluster section has been fitted to the test tower.
22. Small cluster firing	Small scale motors, generating a thrust of 500 pounds each, have performed as expected in testing the concept. The scientists are now confident that the full-sized Saturn can accomplish the planned space missions.
23a. Group of scientists with globe	Studies have long been underway to select space tasks of more immediate value. One may be a communications system capable of instantaneous transmission of television, telephone, or telegraph signals to any point on earth.

SCREEN PLAY—THE SATURN ROCKET—Continued

DESCRIPTION OF SCENES	NARRATION
23b. Chart of earth with three satellites.	An ideal communications system would include three suitably equipped satellites orbiting around the earth. At 22,300 miles altitude the satellites would remain over the same spot on earth. Messages would be relayed to one satellite, to another, and then back to earth.
23c. Animation of firing sequence____	The Saturn can place these instrumentation packages in the correct position over the equator.
23d. Animation—separation of 1st stage, booster falling toward earth.	At an altitude where the atmosphere thins out, the burned out first stage will separate—and start falling back toward the ocean below.
23e. Animation—parachute opens______	Parachutes will open to lower the booster into.
23f. Landing in ocean________________	Waiting ships will follow radio signals to the landing spot to recover the spent booster for later study.
23g. Second stage firing________________	Soon after the first stage is dropped, the second stage motors ignite, increasing the speed tremendously.
23h. Third stage firing. Comm satellite.	The third stage builds up the velocity and pushes the payload to the proper altitude and speed. A protective cone is ejected, the sides opened, and the satellite pushed forward to open to its full size.
24. Model of communications satellite_	How the satellite emerges can be seen from this 1 to 12 scale model.
25. Men walk over to model__________	The nose cone containing the payload is many times larger than an average sized man.
26. Man lifts shroud, shows side kick action.	As the last stage nears the planned location over the earth, the nose cone is pushed ahead of the payload. A small side-kick rocket moves the cone out of the path.
27 and 28. Container walls open; satellite lifted out of container	The container walls are opened by spring action, and the satellite is ejected. The container is discarded.
29. Satellite open to full size________	By automatic action, the communications equipment is opened to its full size, extending 27 feet from one side to the other. Two antennas face the Earth and two may be directed toward the other communications satellites. Power is generated by the solar deck, the oblong white objects. These always follow the Sun from which they draw energy.
30. Full Moon, close up, changing to scene of Moon landscape.	There are many potential uses for the Saturn. One of the first experiments may be to learn more about the Moon, let us follow an artist's conception of the sequence by which instruments could be soft landed on the Moon. Another Saturn could send two or three men around the Moon and return them safely to Earth.

SCREEN PLAY—THE SATURN ROCKET—Continued

DESCRIPTION OF SCENES	NARRATION
31. Trajectory of Eath to Moon flight (arrow) 7F.	To place instruments on the Moon in a soft landing will be one of the more important steps of the national space program.
32. 3d stage of Saturn, animation 4F__	The same firing sequence will lift the third stage, containing the instruments, to the vicinity of the Moon.
33. 3d stage cover ejected, wheels inflate. 10F.	After the necessary speed of more than 24,000 miles per hour is reached, the cover of the payload is ejected. The wheels of a roving Moon vehicle will then inflate.
34. 3d stage reverses, retro-rockets fire (Moon close) 9F.	Small pressure chambers within the third stage will turn the rocket so that the motors will face the Moon. A burst from the rockets will slow the instruments for a soft landing.
35. Chart of wheeled vehicle on Moon 3F.	The scientific package can include a traveling TV broadcasting station—
36. Stationary package on Moon. 2F__	or a stationary information gathering package.
37. Trajectory of manned cone around Moon. 3F.	Another immediate use of Saturn may be a manned trip around the Moon.
38. Cutaway drawing showing men in cone. 5F.	Two passengers can ride within the rocket nose cone, enabling them to observe the dark side of the Moon and to gather scientific information about the natural satellite.
39. Cone dropping to Earth. 14F____	As the passenger-carrying nose cone starts back toward earth, it must be slowed down so that it will not burn by friction in the Earth's atmosphere. Parachutes will slow the cone in the same way that the Army recovered several missiles.
40. Cone in ocean, radio signals flash. 5F.	Flashing lights, radio signals, water-dissolved dye, and a buoy will direct waiting ships to the floating space ship.
41. Fade—Transporter chart—rocket moved on road.	When the rocket is completed in Alabama, it must be moved to Cape Canaveral, Fla. It will be transported on a trailer from the assembly building to a loading dock.
42. Drawing of loading on barge. 10F__	A river barge will probably carry the giant rocket to Florida. It will begin the 17-day journey on the Tennessee River.
43. Drawing of a river tug. 4F______	A tug will pull the unusual cargo on its long trip.
44. Animation showing river and gulf route. 8F.	First, down the Tennessee to the Ohio River—then down the Mississippi—across the Gulf of Mexico, around the Florida peninsula—to Cape Canaveral.
45. Model of service tower and blockhouse. 16F.	At the specially constructed launching site, the booster and upper stages will be erected. A 305-foot superstructure will be used for prelaunch work and for checking the fueling. Before firing time, the tower will be moved by rail to a safe distance from the powerful space rocket.

SCREEN PLAY—THE SATURN ROCKET—Continued

DESCRIPTION OF SCENES	NARRATION
46. Blockhouse model. 15F	When fully fueled the rocket will weigh close to 580 tons, of which 500 tons are fuel and oxidizer. The blockhouse—containing checking, firing, and tracking instrumentation, has been planned to provide the necessary equipment and to assure the safety of those who must remain during the fueling and firing operations.
47. Construction work at the cape. 8F	Before the firing, all buildings and equipment must be ready, inspected, and in working order. Construction is now well within the planned time schedules.
48. Chart showing erection of all stages of Saturn. 5F.	The erection of Saturn at the firing site will mean the end of development work on the first test vehicle.
49. Rocket firing. Chart of launch pad with flames coming from rocket.	As the rocket starts its journey to the Moon or the planets, man will truly have entered the age of space. This space workhorse can be the means of improving our life on Earth—by more accurate weather predictions and worldwide communications—but, beyond this—
50. Animation of Saturn going through the clouds.	Who knows what fantastic changes will come?
51. Radar within dome, turning	Each bit of knowledge will bring man closer to the stars.

The CHAIRMAN. Very fine, Doctor, very fine.

Now, will the members resume their normal seating. Dr. von Braun, I think we can proceed with your testimony.

Dr. VON BRAUN. Mr. Chairman, we brought a model along of the Saturn. With your permission, I would like to explain how we propose to phase the Saturn program with respect to the upper stages and then show two charts to give you an account of the impact of the additional funds on the schedule.

The CHAIRMAN. Do you wish to have your model returned to the table?

Dr. VON BRAUN. No; I think we can leave it right there. That gentleman there will demonstrate while I am talking.

The CHAIRMAN. All right, fine.

Dr. VON BRAUN. May I proceed?

The CHAIRMAN. You may proceed, sir.

Dr. VON BRAUN. What you see there is the first version of the Saturn, the so-called C–1 configuration. It will have a booster powered by eight engines of 188,000-pound thrust each as the first stage. This booster carries its propellants in a cluster of eight outer tanks, four of which will be filled with kerosene fuel and four with liquid oxygen, and one central tank which will also carry liquid oxygen.

On top of this booster rides the second stage. Would you lift it off please? This second stage will be powered by four engines of 20,000 pounds thrust each. It will use liquid hydrogen and liquid oxygen as a propellant.

Whereas the first stage is under development as an inhouse project in Huntsville, Ala., the second stage will be contracted to industry.

Just recently we had a bidders' conference in Huntsville which was attended by 35 major corporations. These companies have been given a certain time to make their proposals for this second stage and we expect to have a contractor selected by the 1st of April.

It will take this long to get the proposals worked out by the companies and evaluated by us. On top of this hydrogen-oxygen powered second stage will ride a third stage, which is powered by two liquid hydrogen-liquid oxygen engines which are almost identical with the engines used in the second stage.

This third stage also serves as the so-called Centaur vehicle in the Atlas-Centaur project. Therefore, it will have quite a few flights on record by the time we begin using it as a third stage of the Saturn.

In these earlier Atlas-Centaur flights the Saturn's third stage will serve as a second stage riding on top of an Atlas ICBM which serves as first stage.

On top of Saturn's third stage, of course, is the payload. What you see here then is our first objective in the Saturn program, the Saturn C–1. It gives us an orbital payload capability in the order of 23,000 pounds or 25,000 pounds, depending on the altitude of the orbit, which is far more than anything available today.

But we consider the C–1 only as the first phase of the Saturn program. We propose to develop, parallel to the C–1, a new second stage which will be powered by several engines of 200,000 pound thrust each, in all likelihood four of them. The propellants for this new second stage will also be liquid hydrogen and liquid oxygen.

A contract for the development of the 200,000 pound thrust engine for this new second stage has not yet been let, but it can be expected that it will be let in the very near future. Money for the development of this engine is in the NASA budget and the amount available has also been increased by the recommended additional funding.

The CHAIRMAN. What effect is the recommended additional funding going to have on your program?

Dr. VON BRAUN. Sir, I have a chart that will show that after I have explained the concept.

The CHAIRMAN. All right. Go ahead.

Dr. VON BRAUN. The plan is to switch this new second stage at some later time between the C–1's second stage, and the first stage. In other words, what is the second stage in the C–1 will now become the third stage. This longer configuration we call the Saturn C–2.

For low orbital flights, the C–2 does not need a fourth stage at all, but for high velocity flights, such as transfers to the Moon or the planets, we will use the Centaur rocket which served as a third stage in the C–1 configuration, as the fourth stage of the C–2.

Due to the much greater efficiency of this C–2 rocket, its payload will be more than double that of the C–1. In low orbital flights, where we would fly a three-stage C–2 configuration, the entire slender upper portion will be payload, and the orbital net payload in this case will be in the order of 45,000 pounds.

For high-speed missions, the lower part of this slender upper portion will be made up by the Centaur rocket serving as fourth stage. The payload, of course, will be somewhat less in this case because of the higher speeds required. But it will still be adequate to carry, say, two men around the Moon and back, or to land a very substantial payload in a soft landing on the Moon. It will also be adequate to carry a rather sizable automatic radio relay station down to the surfaces of Mars or Venus and radio back some scientific information on these planets.

The CHAIRMAN. Will you be able to salvage any of the stages?

Dr. VON BRAUN. The first stage will be recovered in all flight missions. The second or third stage will not be salvaged, but the third stage, of course, may land in an orbit. In certain flight missions where orbital refueling is used, it can be used again for deep-space missions after refueling in orbit.

Mr. FULTON. Will the two men who go around the Moon have any control over the direction of the rocket or is there a ground command control?

Dr. VON BRAUN. No, sir; they will have the possibility of changing the flight path, but they will depend very greatly on ground tracking. The most accurate tracking data we can furnish these men will still be gained by tracking from the ground.

So the men will be told by radio: You are this far off and in order to correct your flightpath, you have to do thus and so. All this information will be developed on the ground but the space pilots can disregard or override the instructions from the ground, if they so desire.

Mr. FULTON. Will it be done by small vernier rockets attached or retro rockets or will there be a swivel action of the large engines?

Dr. VON BRAUN. Sir, for major path corrections, it is planned to turn on the hydrozen-oxygen engines again. Of course, in order to apply the velocity correction in the right direction, it will be necessary to first put the space vehicle in the proper spatial attitude so that the thrust works in the right direction.

For fine control, that is, when we are talking about velocity corrections of a few feet per second, vernier rockets will be used instead of the main engines.

Mr. FULTON. On the fourth stage of a lunar shot, there has been ground command of a retro rocket. Would you have that on this sort of thing?

Dr. VON BRAUN. The final approach for a lunar soft landing will be done by a combination of ground control from the Earth and sensors in the rocket itself; yes, sir.

The CHAIRMAN. Did you finish your statement, Doctor?

Dr. VON BRAUN. No, sir. I am through with explaining the Saturn vehicle but I still have two charts that show the impact of additional funding on the schedule.

Mr. ANFUSO. I have a question.

The CHAIRMAN. Mr. Anfuso would like to ask a question.

Mr. ANFUSO. Dr. von Braun, when this is operational, could you bury it underground and operate it from underground?

Dr. VON BRAUN. No, sir; this is not intended. All our present plans envision Saturn firings from Cape Canaveral.

Mr. ANFUSO. I see. Of course, you have plans to bury the Atlas throughout the country?

Dr. VON BRAUN. Well, sir, the Atlas, of course, is a weapons system and there is some military interest in hardening the sites so that a hostile surprise attack would not eliminate all our ICBM sites.

Saturn is a vehicle for space exploration with no military applications, at least not for the time being.

The CHAIRMAN. Just proceed with your statement now, Doctor.

Dr. VON BRAUN. This first chart here, Mr. Chairman, shows the new funding level on which we shall operate if the Congress accepts the recommendations made yesterday by the President (fig. 77).

It shows that our original funding level of $70 million will be upped, in 1960, by $1.5 million, which is just adequate to put the most critical elements of our operation in Huntsville on overtime.

SATURN FUNDING
(IN MILLIONS)

	1960	1961
S & E	27.9	37.5
C & E	6.2	46.5
R & D	37.4	146.0
	71.5	230.0

FIGURE 77

We still have a few months to go and this $1.5 million will permit us to work 20 percent overtime in the most critical shops and laboratories.

The sign, S. & E., means salaries and expenses. C. & E. is construction and equipment. R. & D. is research and development, and covers outside contracts and procurement for our inhouse operations.

The CHAIRMAN. What is your total increase for 1960, then?

Dr. VON BRAUN. Only $1.5 million.

The CHAIRMAN. On all of this?

Dr. VON BRAUN. Yes, sir. The total increase for 1960 is $1.5 million. In other words, we had $70 and now it is $71.5. In fiscal year 1961 the old figure was $140 million and this has now been upped to $230 million, or $90 million more.

Now, actually there is an additional $8 million increase over and above the $230 million for additional funds for the development of the 200,000 pound thrust hydrogen-oxygen engine for the C–2.

That is the longer configuration of the phase 2 Saturn. Therefore this engine can be rightfully considered an integral part of the Saturn project.

But all our previous funding exercises had been carried out with this engine considered as a separate project. So for better comparison of the old and the new funding levels we have listed only $230 million versus the old figure of $140 million for 1961.

Mr. FULTON. How much did you ask for originally on each of these?

Dr. VON BRAUN. We asked for $240 million in the original estimate and——

Mr. FULTON. For 1961?

Dr. VON BRAUN. For 1961. And we shall now receive 230 under this new increase.

Mr. FULTON. What do you want now? What would you like to have?

Dr. VON BRAUN. Sir, I believe this present figure for 1961 offers a soundly funded program.

To put very much more into fiscal year 1961 would, in my opinion, mean operating beyond the point of diminishing returns. You can always spend more money, but to spend it wisely is a more difficult problem.

Mr. FULTON. How about at the end of 1960 fiscal year, June 30?

Dr. VON BRAUN. Well, sir, of course, had we had more money in fiscal year 1960, at some earlier time, that would have helped, there is no question about it, but most of that fiscal year 1960 is now over.

Mr. FULTON. That is enough though now, this figure here?

Dr. VON BRAUN. Yes, sir.

The CHAIRMAN. I want to suggest this, that we either stop now and question the doctor, or let him finish. I think it would be wiser to finish because when we call upon our members for questioning it is going to take some time.

Dr. VON BRAUN. Could I have the next chart?

This chart shows the impact of that new funding level on the schedule (fig. 78).

Now, this black bar indicates the Saturn research and development firings. In both cases, old funding level and new funding level, we have assumed that 10 research and development firings are necessary before we would be ready to call the C–1 configuration (which is not the long configuration, but the short interim one) operational. "Operational" means that we can now entrust major scientific missions to it.

You will see that under the old funding program (which provided $70 million in fiscal 1960 and $140 million in fiscal 1961), there was to be one experimental firing in 1961, two more in 1962, three more in 1963, four more in 1964, so that by the end of 1964, all 10 experimental R. & D. vehicles would have been fired and in 1965, we could have fired No. 11, the first operational firing.

Now, the increase of funds from $70 million to $71.5 million in fiscal 1960 and from $140 million to $230 million in fiscal 1961 will permit us to telescope our 10 research and development firings into 3 years.

In other words, there will now be one firing in 1961, which we cannot speed up very much. There will be three in 1962, as compared to two: five in 1963 as compared to three; one in 1964 instead of four; and

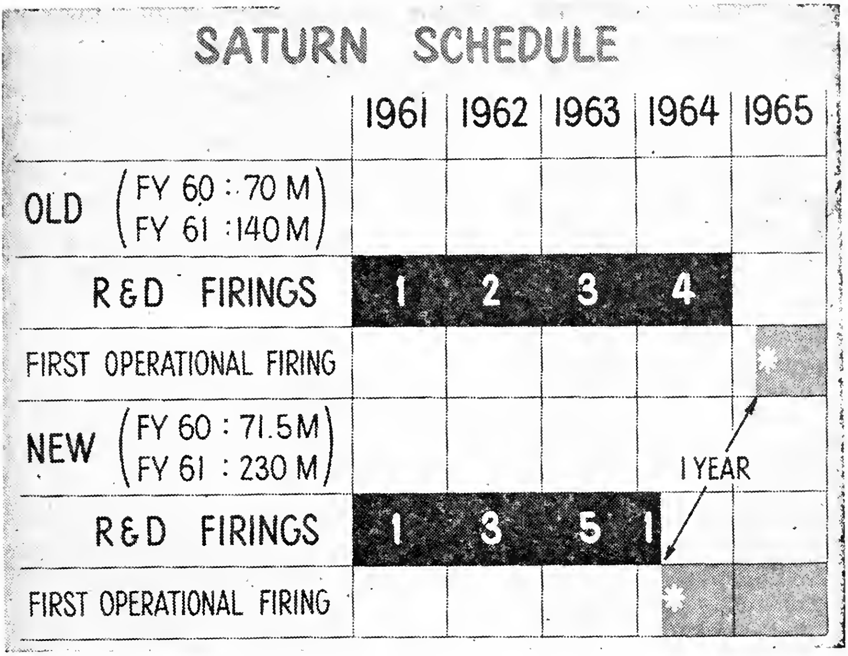

FIGURE 78

in the second quarter of 1964, we will now have the first operational firing with No. 11.

So there is a flat gain of 1 year with respect to the end of the R. & D. period. This is the point I would like to put across.

The CHAIRMAN. It is much better.

Dr. VON BAUN. The new funding plan offers a gain of 1 year; yes, sir. This ends my presentation.

The CHAIRMAN. Thank you, Doctor. Thank you very much for your statement.

Now, the additional sums given you by the President will put you in good shape on the Saturn program to go ahead at your most rapid optimum speed. Is that right?

Dr. VON BRAUN. Yes, sir. I feel that to speed the program up much beyond the present funding rate would be very difficult, if not impossible.

The CHAIRMAN. It would be wasting money?

Dr. VON BRAUN. Yes, sir.

The CHAIRMAN. Now, Doctor, about a year and a half ago, possibly 2 years ago, you told our committee that we were behind Russia in space development. At that time a great many people throughout the country doubted the correctness of your statement. Now, I believe that almost everybody will fully agree with you that we were behind Russia and we didn't realize it.

The idea of this program now is to catch up with Russia in development. Can you tell us now, with the additional amount of money which the President has recommended to Congress be appropriated, how will we be in this effort to reassume first place in scientific space development?

Dr. von Braun. Well, sir, my impression is, and I think the facts have borne it out, that the Russians are several years ahead of us in weight-lifting capability of space rockets. These things, as my schedule chart indicated, take time. To make an estimate as to when we will be even with the Russians and able to forge ahead of them depends, of course, very much on the difference between their working speed and ours.

They are definitely several years ahead of us in the field of very large rockets, and I do not think that we should expect wonders.

Mr. Anfuso. Did he say several?

The Chairman. Yes; several.

Dr. von Braun. Several.

The Chairman. Put up that last chart, will you, please? I want to ask this now. In that last chart in which you show a gain of 1 full year, you say that in 1963 you will have five firings of this Saturn rocket. Will that bring us closer to the position of being preeminent in this field?

Dr. von Braun. Sir, I consider it quite likely that the Russians have a large new rocket under development, too, a rocket larger than anything they have flown so far. When they will have that larger rocket ready for firing tests remains to be seen. I do not know.

The Chairman. In other words, while we are walking a little faster in our program, they also are moving ahead in their program.

(Dr. von Braun nods.)

The Chairman. And you feel that they have got a larger rocket than the Saturn rocket?

Dr. von Braun. This I cannot state with definitude. All I was saying is that it is quite likely that they have a rocket under development which is larger than anything they have fired so far. Whether that new rocket will be as large as Saturn or even larger, I am——

The Chairman. Well, is it a rocket they have tested? Could you say whether they have tested it or not?

Dr. von Braun. I have no information to that effect. No, sir. I would only consider this a logical step for them to take.

The Chairman. Now, you feel with this additional recommendation of money then, our Saturn program will be all right?

Dr. von Braun. I think a speedup of the Saturn program is the wisest move we can take at this time.

The Chairman. You have been ordered transferred, since you were here last, from the Army Ballistic Missile Agency to NASA. Would you want to make a comment on that, in open session?

I think in fairness to the public and the press, they would like to know whether, Doctor, you are satisfied with the change that you and your team are undergoing now in the space development program? Are you thoroughly satisfied with it?

Dr. von Braun. Yes, sir, I am.

The official transfer, of course, has not taken place yet. So while we are not in a position yet to say exactly how the transfer will speed things up, one can see already many highly satisfying signs in our relationship.

For example, a few weeks after the President's transfer decision, Dr. Glennan appointed a joint NASA–ABMA committee which within a few weeks resolved the question of the configuration for the Saturn upper stages. Up to that time this question had been entirely open.

We had been unable to make our own recommendations stick, because there were conflicting opinions and conflicting interests of the several potential users of Saturn. Now, NASA stepped in, appointed a fact-finding committee which within a few weeks buttoned this up. On the basis of its recommendation, Dr. Glennan made a firm decision on what kind of upper stages Saturn should have.

Also, apparently NASA was very successful in getting us the funds we have been trying to get all along, so those two facts alone, I think——

The CHAIRMAN. When we were down in Huntsville, you were having difficulties, we remember, in obtaining funds for the development of your program, weren't you?

Dr. VON BRAUN. Yes, sir.

The CHAIRMAN. Now, you are getting the money and NASA seems to have the knowhow on getting the money. That is something to think about.

This committee has a resolution before it which might actually speed up the transfer of you and your team to NASA. In the event we can work out with committee approval a program to actually speed up the transfer, would you or your team have any objection to that?

Dr. VON BRAUN. No, sir, we would greatly favor it. Much work has been going on between NASA and the Army about the details of the transfer. The cooperation has been quite cordial and efficient, but we are, of course, hampered by the fact that up to this stage, there is no firm decision yet whether or not the transfer will take place. As a result, we cannot commit ourselves to any definite actions.

The CHAIRMAN. Well, thank you, Doctor. I have many more questions to ask you, but this committee operates under the 5-minute rule and I don't want to transgress on that rule. We have a big clock here where we time them all, Doctor. So I am going to yield to my colleague, Mr. Martin, who has just come in here. Would you care to ask Dr. von Braun any questions about this now, or would you rather wait?

Mr. MARTIN. I would rather wait until I hear something.

The CHAIRMAN. Glad to have you anyway.

Mr. Miller?

Mr. MILLER. I will join Mr. Martin and wait.

The CHAIRMAN. Mr. Fulton?

Mr. FULTON. We are glad to have you here, Dr. von Braun. I would like to ask you something with regard to the resolution of Mr. Sisk of California, House Joint Resolution 567, to transfer immediately the Development Operations Division of the Army Ballistic Missile Agency to the National Aeronautics and Space Administration. A good many of us on this committee, including myself, think that is a fine idea. Do you agree with it?

Dr. VON BRAUN. Yes, sir, I do.

Mr. FULTON. And it would help you on efficiency and it would likewise be able to set your policy of administration much quicker and better, would it not?

Dr. VON BRAUN. Yes, sir. In particular, it would enable us to commit ourselves definitely to new people that we want to hire, which we cannot do right now.

Mr. FULTON. So you would recommend prompt action on such a resolution?

Dr. VON BRAUN. Yes, sir.

Mr. FULTON. Then the next problem is this: you are sure that you have enough on the funding, both in the fiscal year 1960, ending June 30 of this year, as well as in fiscal 1961, ending on June 30 of next year, to give you the best and the optimum approach to the Saturn schedule and program?

Mr. HORNER. May I respond to that question. There is, in order to meet this schedule, a requirement for some of the added funds that are shown in 1961 to be applied during the latter months of this fiscal year.

The actual mechanics—our recommendations for the actual mechanics of taking care of that problem aren't quite firm yet. We are looking at several different possibilities. When the request for authorization is transmitted to Congress, we have considered inserting language making possible use of the money early, making the money available to us early, at the time of the appropriation.

We are also investigating the possibility of doing some reprograming to make money available early and then reprograming back again after the appropriation is available. Whatever the final solution, the final recommendations, we will make them known to the committee immediately, but we do still have to take care of that problem in order to start the acceleration of the program earlier than the next fiscal year.

Mr. FULTON. I am glad to have that statement of Mr. Horner. Now, on the operational end, I want to ask Dr. von Braun, as the head of this team, is that perfectly satisfactory to you and are you getting enough money? Because if you aren't, regardless of party or politics, some of us on this committee are going to give it to you as a result of some of your briefings down at Redstone Arsenal.

Dr. VON BRAUN. Sir, as Mr. Horner just pointed out, there is a temporary problem with regard to fiscal year 1960. We cannot touch the $230 million before the 1st of July and any time lost between now and the 1st of July would, of course, retard the program somewhat. But NASA has assured me that ways and means will be found to bridge this gap somehow.

Mr. FULTON. They certainly ought to be able to switch funds from other programs, because they have pretty broad leeway.

Mr. HORNER. We would want to keep the committee advised if we do that.

The CHAIRMAN. I think you should.

Mr. FULTON. You will then bring up to us whatever is necessary, Mr. Horner, to give that proper authority?

Mr. HORNER. Yes, we will.

Mr. FULTON. The next problem is this. Dr. von Braun, when you were before the select committee, of which some of us were members previously, you said there should be emphasis in the space program on research and development much beyond military weapons programs and you felt that that was an essential to the defense of this country and to the keeping abreast of Russia in the scientific field. Do you still feel that way?

Dr. VON BRAUN. Yes, sir. What I was referring to—and I still hold that belief very strongly—is that there is always the tendency that weapons systems—or even space transportation systems like Saturn—which you can describe in detail will receive a higher priority and more funds than the kind of research and exploratory work that is necessary to lay the scientific and engineering groundwork to do all these things.

Mr. FULTON. I had said to you on page 25 of the select committee hearings, I guess it was April 15, 1958, "then you would really recommend"—this is myself speaking—"then you would really recommend a body in the administrative branch that is a civilian body for the space agency, having cognizance a good bit like the Atomic Energy Commission would, is that about your view?" You answered, "Yes."

"You have recommended a change in program that the United States should not continue research and development that serves only an immediate military use. I believe that is good. I think you feel that we should broaden the space of the program and look at it not only in the missiles and weapons system area but likewise in the vehicle and spaceship fields, is that right?" And you said, "Yes, sir."

Now, do you still feel that way?

Dr. VON BRAUN. Yes, sir. We find that within the National Aeronautics and Space Administration there is a very great awareness of the necessity for research. The former NACA around which NASA was built, has a research background of many years——

Mr. FULTON. I only have one more minute so I want to get a point in. The problem comes up when you have once had an experimental making of a vehicle; then the second vehicle is really a carbon copy or some revision of the first—a modification of the first. Why isn't it possible for you to speed your schedule when you come into more or less a department store operation, or a modification operation of your main vehicle program? Why can't you do it faster than 1, 3, 5 years? Why couldn't you move it up so that we could have a manned space platform, for example, in 1961?

Dr. VON BRAUN. Sir, the mechanism of developing such space rocket vehicles works goes something like this. You build a vehicle, you test fire it and then something may happen. Even if the flight was apparently successful you may discover some discrepancies as you evaluate the results. It takes time to first get the raw data reduced, to analyze the results and to diagnose the deficiencies. Then you have to go into reengineering of the faulty component. Then you have to build it. Then you have to test it on the ground again and only after all this has been accomplished can you proceed with the next firing.

Mr. FULTON. You think this, in conclusion, that the Mercury program, which is the man in space project, the Atlas booster, the Centaur, as well as the particular project we are talking about here, the Saturn, are necessary and essential steps that must be quickly taken in space in order to catch up with Russia and, secondly, for the security and safety of the United States as well as our scientific advance, do you not?

Dr. VON BRAUN. Yes, sir.

Mr. FULTON. That is all.

The CHAIRMAN. Mr. Anfuso?

Mr. ANFUSO. Dr. von Braun, I want to thank you profusely for the great job you are doing, but I am not going to do it because I want to save time.

By 1964 you will have the first operational Saturn, the earliest. Is that correct? 1964?

Dr. VON BRAUN. Yes, sir.

Mr. ANFUSO. Now, have you any idea where the Russians will be at that time, considering their research, the amount of money they are spending, and the amount of money we are spending?

Dr. VON BRAUN. I suspect that they will not let off and even with this speedup in our own Saturn program it is quite doubtful whether in 1964 we will be ahead of them. We are just trying to do our best.

Mr. ANFUSO. They may be on Mars by that time.

Dr. VON BRAUN. They may definitely be on Mars.

Mr. ANFUSO. Do you think that we will ever catch up unless we do something much more drastic?

Dr. VON BRAUN. We will just have to keep running. That is——

Mr. ANFUSO. Doctor, wasn't General Medaris supposed to join your team under the new setup under NASA?

Dr. VON BRAUN. No, sir. I think this was never contemplated.

Mr. ANFUSO. Do you find that we are not making it attractive enough for keeping good men, such as yourself, for example, in the Government? I know at one time I read somewhere where you were considering resigning. Do you find that we, as a democracy, lack the means of keeping good men in this field?

Dr. VON BRAUN. Sir, I think the great difficulty in a field like the development of a space transportation system lies in the fact that you cannot simply contract the whole package job to one industrial corporation. There simply is no single industrial corporation in this country that can competently tackle all problems involved in a vehicle like the Saturn, from guidance and control to radio equipment, from liquid hydrogen to rocket engines, from celestial mechanics to launching operations, from human factors research to airframe building, and so forth. So Uncle Sam has to go to a great many contractors, if he wants to utilize his national resources and have American industry make an optimum contribution. But this puts the burden of coordinating such a program on the back of Government agencies. On the other hand, experience has shown time and again that in Government agencies you cannot build up and retain competency over any length of time unless you give Government personnel the possibility to keep in intimate touch with the hardware and its problems. This is the great cause for and the real reason behind a Government inhouse rocket development operation, such as we have it in Huntsville. If we would convert Huntsville to an all-out contracting operation without any continued inhouse work, our best people would soon run away and say: "Here I get rusty. I go to where the contracts go, because that is where the interesting work is done." Soon we would have no capability left to coordinate the overall Saturn effort.

Mr. ANFUSO. Can you recommend to this committee certain methods of improving our negotiations with private industry and bettering our own Government setup in order to speed up this work?

Not now, but can you do that maybe in writing for the committee?

Dr. VON BRAUN. I think one of the problems, maybe the biggest problem with Saturn is that any large inhouse Government operation in this country is unpopular. The belief that all you have to do to get a job done is to give it to industry is as widespread as it is fallacious. Of course, we expect American industry to do most of the work on Saturn. Of course we want to keep our inhouse operation down to the minimum necessary. But of any $10 spent in this field it is a good idea to keep $1 in the coordinating Government agency in order to be able to determine how to spend the nine others wisely in industry. It is that $1 that we are having most of our difficulties with.

Mr. ANFUSO. Dr. von Braun, when did you first come to the United States, and when did you join the U.S. Government?

Dr. VON BRAUN. In 1945, sir—September 1945.

Mr. ANFUSO. Dr. von Braun, Secretary of Defense Gates has testified before this committee that in 1953 our Government had the decision to make whether to develop the large thrust that you are now trying to develop or the warhead. We chose, said Secretary Gates, to develop the warhead. In your opinion, would it have been more advantageous to the security and well-being of the United States to have done both?

Dr. VON BRAUN. Sir, you are referring to the decision to wait with the ICBM development until warheads became smaller?

(Mr. Anfuso nods.)

Dr. VON BRAUN. Looking backward, it may have been better had we not waited that long and had we gone into active ICBM development while our warheads were still heavier. This is obviously what the Russians did. But, then, the Russians didn't have a potent Strategic Air Command. I think the decision to delay the ICBM development in this country was made because it was felt that the Strategic Air Command provided an adequate deterrent power. So looking at the overall picture it really didn't look so bad at that time.

Mr. ANFUSO. We relied on the Strategic Air Command. Is that correct?

Dr. VON BRAUN. The overall military posture, particularly in the deterrent area, was considered adequate at that time because of our airpower.

Mr. ANFUSO. Isn't it a fact, Dr. von Braun, that both this country and Russia have developed methods of detecting bombers coming over their land, whereas we don't have any detection or defense as far as ICBM's are concerned, at least not at the present time?

Dr. VON BRAUN. Not at the present time, sir. That is correct.

Mr. ANFUSO. And we won't have any for maybe 4 or 5 years?

Dr. VON BRAUN. That is correct.

Mr. ANFUSO. So that has placed us at a disadvantage? They have an ICBM that can strike us from any part of the Earth and touch any part of the United States, any base they want, and we cannot solely rely on air bombers, can we?

Mr. VON BRAUN. No, but in the meantime, of course, we have ICBM's also.

Mr. ANFUSO. We have. But they will have by 1962 about a thousand operational, while we won't have anywhere near that number, will we?

Dr. VON BRAUN. Sir, I am not familiar with the Russian production figures.

Mr. ANFUSO. That has been testified here, that by 1962 they will have about a thousand ICBM's, and at the most we will have 150. That would place us in an inequality of defense, would it not?

Dr. VON BRAUN. Well, I think, as I say I do not know anything about relative production figures, but I have the feeling the Russians just—they started earlier, have a larger ICBM, you might say they have an older model.

Mr. ANFUSO. If that is so, considering bombers and everything else, they will have by 1962 a greater striking power against the United States than we will have against them. Isn't that so? If that is so?

Dr. VON BRAUN. If the figures that you just quoted are correct, it seems this is the case; yes, sir.

Mr. ANFUSO. Thank you.

The CHAIRMAN. Let me suggest this to the members of the committee. Dr. von Braun is available to us today, but he has to leave this afternoon. This afternoon we have two rollcalls on the floor of the House. Dr. von Braun wants to talk to us in executive session before he leaves. Now, we can continue this open session questioning and take a chance on meeting again this afternoon in between rollcalls, or go into executive session at say, 20 minutes to 12 o'clock and give him 20 minutes in executive session.

Mr. FULTON. I think the other members want to question him. I suggest we just go ahead with it at the present time.

The CHAIRMAN. I know they do.

Mr. FULTON. I think it is going well.

The CHAIRMAN. We will go ahead and just before closing time we will go into the problem again. Mr. Osmers?

Mr. OSMERS. Mr. Chairman.

I would like to ask Dr. von Braun about the little bit of information about the chart. Dr. von Braun, it is only for fiscal year 1961 that you have listed any expenditures of money.

Now, you have, however, in 1962, 1963, and 1964 listed the number of research and development firings. What level of spending are those estimates based on?

Dr. VON BRAUN. Sir, we have exact figures on which this research and development firing schedule has been based.

Mr. OSMERS. Is it approximately a continuation of the $230 million level?

Dr. VON BRAUN. Yes. It is approximately a constant level for the next 2 years.

Mr. OSMERS. Then, logically the next question would be this. I agree that you do reach a point of diminishing return, particularly early in the program. But, as the program matures and becomes more sophisticated, I was wondering whether in future fiscal years—not in 1962, or should I say not in 1961, but in 1962, 1963, and 1964, whether a sizable increase in the amount of money for those fiscal years would produce a noticeable quickening in the program?

Dr. VON BRAUN. Sir, my appraisal of the situation is as follows: Right now we are at the beginning of the program and, as I said, much more money would not necessarily speed it up. It would, of course, enable us to try parallel approaches. Further increases in funding would permit us to play it safer, to buy assurance to the program, but it would not necessarily speed it up. In the wartime atomic energy program there was a time when nobody knew whether uranium 235 or plutonium was the better answer, but there was enough money available to try both approaches. This is the kind of thing you can do when you have unlimited funds available. But I have no doubts that this Saturn rocket can be designed and built the way we are planning it now, that there is very little fundamental risk involved. We think it is just a question of getting a difficult job done. Now, by the end of calendar year 1960, after we have gathered extensive captive firing experience, and again by the end of calendar year 1961, when we will have free-flight tested the first of these Saturns, we may be able to appraise our situation much better than now. If the program is moving along smoothly, it may very well be that we would come and say: "Now, an additional $200 million over what we had estimated in January 1960 may help a great deal." It is for this reason that it would be unwise for us to commit ourselves at this time to a definite Saturn funding level for the fiscal years 1962, 1963, and 1964. After all, we may be reminded of the figures we have quoted, and it would be kind of embarrassing to come back and say: "Now, if you give us more we could speed it up further."

Mr. OSMERS. Of course, Mr. Chairman, I think Dr. von Braun could also be correct. We might run up against obstacles in connection with the program that would not allow us to proceed at the speed indicated on the chart. Now, if I may, I would like to go from the chart and ask Dr. von Braun a question which, while not directly related to his duties, is very close in its application. That is the question of the basic system of scientific education in the United States. Do you feel, Dr. von Braun, that this Nation is carrying on a program of education at the elementary, secondary, and college levels that is required in connection with the scientific problems which the Nation faces?

Dr. VON BRAUN. My answer is that, by and large, the engineers we hire from American schools have an adequate training for their jobs, but the question remains whether that training could be more intensified.

I believe we should realize that for the Russians, who are our main competitors in this field, a professional education has now become the main requirement for a successful career in the Soviet Union. Under Stalin, the way up for an ambitious young man in the Soviet Union led through the Communist Party machine, but I think there are many indications that today a good professional education and a degree from, say, the University of Moscow may be a more popular and more effective approach.

Mr. OSMERS. May I inject a question there? As I gather it, you feel that the quality of the engineers produced today in this country is good. May I ask you about the quantity? Are we training enough scientists and engineers? When you, sir, seek assistants in Huntsville, or industry seeks help, are there qualified people available to do all that needs to be done for the defense and the civil advancement of the Nation?

Dr. VON BRAUN. Well, sir, in this respect rocketry is pretty well off because it is a highly popular field. So far we haven't had very great difficulties in finding adequately trained people in our field. If you look at the total numbers of engineers and scientists that Russia is producing every year, and compare these with the figures in the United States, I think the aspect is really frightening.

Mr. OSMERS. That is the point I wanted to emphasize, Mr. Chairman.

The CHAIRMAN. Mr. Sisk?

Mr. OSMERS. Could I ask one more question?

The CHAIRMAN. Yes; although the gentleman has consumed his allotted time.

Mr. OSMERS. Yes, I realize I have. But there has been a great numbers game in the United States conducted with regard to the number of missiles which the Russians have and the number of missiles which we have. Would you agree with this statement of mine: That we will have no major war unless an aggressor has a reliable antimissile missile?

Dr. VON BRAUN. This is hard to tell.

With antimissile missiles one can defend only limited areas of high priority. Any country could ruin its economy if it tried to protect every square foot of its real estate against enemy ballistic missiles.

Mr. OSMERS. May I ask this question, then? Isn't it unlikely that a nation unable to defend itself from the ICBM's of another nation will take aggressive action with an ICBM attack?

The CHAIRMAN. Mr. Sisk, I am going to recognize you next.

Mr. SISK. Following Dr. von Braun——

The CHAIRMAN. Did you finish your answer, Doctor?

Mr. OSMERS. No.

Dr. VON BRAUN. I wish I had a crystal ball.

The CHAIRMAN. Mr. Sisk?

Mr. SISK. Dr. von Braun, I want to express my appreciation to you for your statement in support of my resolution a little while ago. The resolution represents an effort to speed up this transfer, because I think that certainly anything that would speed up this situation would be helpful.

Following the questions asked by my colleague, Mr. Osmers, on the educational situation, are you, Doctor, getting all the qualified people you need on your team in Huntsville?

Dr. VON BRAUN. Sir, our difficulties are not caused by the fact that there may not be enough capable engineers in this country, but there is the very mundane question of Government pay versus industrial pay, and that problem, of course, limits our ability to attract the right people.

Mr. SISK. All right. One further question, then, on the subject. Would your work be substantially aided and your program substantially expedited if you were able to pay a little better salary to some of these people on your team?

Dr. VON BRAUN. Yes, sir. This problem is closely connected with the number of excepted positions available to NASA. NASA had a total of, I believe, 250 excepted positions approved by Congress when the Space Act was passed, but at that time, of course, there was no plan to transfer our team to NASA. Now, that we are being transferred, the problem is that most of these excepted positions have already been committed to people and there are very, very few left for us even to fulfill the tentative and long ovedue promises of higher pay that the Army made to many of our personnel a long time ago. As a result, our immediate difficulty is that we are not only unable to hire new first-rate people. We even have difficulties persuading some people to stay with us. These men have been hoping for a long time to get a super grade or an excepted position and the number that NASA now has available for us is, as I said, very, very limited.

Mr. SISK. In other words, this is something definitely that the Congress could do to substantially aid the situation?

Dr. VON BRAUN. Yes, sir; very much so.

Mr. SISK. This, actually, is of some urgency, then, is it not?

Dr. VON BRAUN. Of very great urgency, sir, yes. If you look at the numbers involved here, the Development Operations Division in Huntsville will make up approximately 30 percent of the total personnel strength of the National Aeronautics and Space Administration. To put it another way, the transfer results in a 50 percent total increase of NASA's strength. But of the 250 excepted positions in NASA we may get only 20, which is less than 10 percent. Those would be in addition to 18 existing supergrades or Public Law 313 positions which would be transferred from the Army to NASA along with the individuals in those jobs.

Mr. SISK. I would like to have you or Mr. Horner furnish for the record, as quickly as possible, a definite statement on this situation, because, in the transfer of this great number of people, I realize the problem you are concerned with. Mr. Chairman, I feel it is something this committee has a very grave responsibility in meeting, because, if we seek, as I feel certain we do in all sincerity, to give Dr. von Braun all the tools with which to work, he must have the right people. People are, I think, still the most important single element in the program. Isn't that true?

Dr. VON BRAUN. This would be the most important single area that I could think of where you could help us effectively.

The CHAIRMAN. Doctor, will you supplement the record with that statement?

Dr. VON BRAUN. Yes, sir.

(The information requested is as follows:)

ADDITIONAL STATEMENT OF DR. WERNHER VON BRAUN IN JUSTIFICATION OF ADDITIONAL NASA-EXCEPTED POSITIONS

In response to requests during my February 2 testimony before the House Committee on Science and Astronautics, I agreed to furnish the committee more details on the need for additional excepted positions to assure that the Huntsville leadership continues to make a contribution to the Nation's space program. The following information bears on this subject.

1. Previous history of supergrade positions for the Development Operations Division, ABMA

When the President's decision to transfer the Development Operations Division to NASA was made on October 21, 1959, 19 members of the Huntsville team were in positions at rates of pay in excess of the GS–15 level: In addition to my own position, 12 of my colleagues are in Public Law 313 jobs at rates of pay ranging from $17,500 to $19,000, the maximum payment under this law. Six others are in so-called supergrade positions allocated by the Civil Service Commission (one a GS–18 and the other five at GS–17). Eighteen of this total of nineteen incumbents will transfer to NASA and the President's plan would transfer their job allocation to NASA as well: the remaining one position is held for Dr. Arthur Rudolph, the Pershing Missile Project Director, who remains with the Army until his weapons system assignment is completed.

These 19 positions had come from an overall Department of Defense allocation as a part of the Army's share in competition with the rest of the armed services. Although the number is far less than the need, this represents substantial progress in the brief 4-year history of the ABMA. At the time ABMA was created in February 1956 one GS–17 position (mine) had been allocated to the Development Operations Division. By the end of 1956 we had succeeded in obtaining a total of 17 such positions including the conversion of my position to Public Law 313. Since then, only two additional supergrades have been obtained; there have been several efforts, however, to obtain additional supergrades. Since September 1958, eight other incumbents and two vacant positions have been awaiting allocation at the Civil Service Commission. These 10 positions have survived all the priority contests within the Army and the Department of Defense. Apparently only the lack of sufficient spaces in the congressional allocation to the Commission has precluded final approval.

In June 1959 the Development Operations Division submitted a new list of 53 additional positions. This included the 10 pending at the Civil Service Commission plus 33 new requests for incumbents, and 10 supergrade vacancies for which we have been seeking the right man for the job. Out of this request for 53 more slots, General Medaris, then the AOMC Commander, had approved and forwarded to the Chief of Ordnance for his consideration a total of 28. These recommendations were submitted to Washington on October 12, 1959 (just prior to the NASA transfer decision).

To date, the 19 superpositions actually available have been assigned to the Director, my deputy, Mr. Rees, our 10 laboratory heads, 3 deputy directors of the major laboratories, the head of our high-frequency branch, and 3 of our major project directors. Thus far, with one exception it has been impossible to recognize any of the major technical branch chiefs even though a number of these rank among this country's finest experts in their particular field of specialty.

The 10 positions pending at the Commission, and the remaining 18, which make up the total of 28 positions recommended by AOMC before the President's transfer decision, in general, would have extended recognition to the deputy directors of the other laboratories, and would elevate 20 branch chiefs out of the 51 technical laboratory branch chiefs (or what might be called the key "research team leaders") in the Development Operations Division.

2. Losses of key personnel

We have endeavored to analyze for the committee what our losses of key personnel have been since the original group of German scientists came to the United States. In any analysis of resignations of people in the research and development field, the problem is who you lose rather than how many you lose. For example, the attractions of higher pay in industry have been such that since 1949 our Guidance and Control Laboratory has had three directors; our Structures and Mechanics Laboratory has had four directors; and our main Test Laboratory has had two. These were all losses to higher paying industrial positions. In addition, we similarly have lost individual outstanding scientists such as the three who went to the Convair Co. alone: Dr. Krafft A. Ehricke, Dr. Walter Schwiedetzky, and Dr. Hans Friedrich who was one of the key Convair people in the development of the Atlas guidance system.

The original group of German scientists who had actual rocket development experience at Peenemuende included 136 individuals of which 116 came in 1945 and 20 in 1948. Out of these 136 in the last 11 years we have lost 49 or one-third of the total. The most striking fact to us was that 22 of these individuals had doctor of philosophy degrees. Practically all of these cases were related to financial considerations which led the men to seek other work in industry. More often as not, when I appealed to such a man to reconsider his plan to leave, he would tell me that he was fully aware of the fact that that new job would be less attractive from the point of view of scientific or technological challenge, but that it offered a substantially higher salary and that he just could not deny his growing children a college education, etc. The resulting losses by years are as follows:

1948	2	1954	4	1958	1
1949	15	1955	3	1959	1
1952	9	1956	3		—
1953	7	1957	4	Total	49

Most important to us is that a high percentage of those individuals who left the Government to enter industry had advanced doctorate training in fields of science and engineering. It has been practically impossible under prevailing rates of Government pay to attract into the Huntsville organization American-trained Ph. D.'s as replacements of those we had lost. At the present time there are some 43 Ph. D.'s on our staff of which 10 are American born. One or two have been recruited through our ability to use Army enlisted specialists during their period of obligated service and to offer the more exceptionally trained individuals a civil service career opportunity. To obtain the balance of the 10 we have had to expend extreme effort on a continuous recruiting campaign covering the entire United States.

In the higher levels of professional employees our total losses in number have fortunately remained in check. In grades GS–14 and 15 we have lost 21 individuals, 7 of which were among the original German group. By years these losses are:

1956	5	1958	7
1957	5	1959	4

As I indicated in my earlier testimony, however, we have been relying on the "persuasion of promises" to keep many of our best people with us until they see the outcome of the Army's and now NASA's efforts to improve their salaries. If we find ourselves unable to make any great change in the situation our losses through resignation may indeed become much greater.

Upon a careful review of the total situation, I feel that it is certainly in the Government's best interest to develop some method of pay recognition which will assure our retaining a substantial portion of our best qualified, mature scientists and engineers. In addition, we need to be able to offer an attractive career prospect to the very bright young scientist who immediately after his schooling must choose whether he will do research and development in a Government laboratory or seek a technical or managerial post in industry. The discrepancy in prevailing salaries today between Government and industry seems to me too great to make this anything like an equal competition for the Nation's top talent.

3. The availability of excepted positions under the NASA Space Act

The National Aeronautics and Space Administration under section 203(b) currently authorizes a total of 260 positions for which the Administrator may fix a rate of pay in excess of that provided under the Classification Act. Ten of these may be paid rates up to $21,000, and 250 at rates up to $19,000. In its first year of operation the NASA has worked diligently to identify the key positions in its organization which required salary rates within the so-called excepted position category. These plans were made long before the Huntsville transfer became a probability. NASA had proceeded rapidly to identify the individuals who could most appropriately fill such positions. As of today, I understand that 208 such excepted positions have been filled and commitments to individuals are pending on 10 others. A total of 137 of the filled positions are located in the various NASA field research centers and 81 are used for the major areas of policy determination and program direction within the headquarters office. The NASA planning for the remaining 42 positions calls for a reserve of 10 positions for the creation of a NASA capability in the field of space biomedical activities, and for other program contingencies. Twelve others are programed for the completion of the NASA Headquarters staffing.

This means that NASA can give Huntsville 20 additional excepted positions within its existing allocation of 260. These 20 jobs, in addition to the 18 which would be transferred from the Army under the President's plan would provide the Huntsville group a total of 38 jobs.

Under questioning by Congressmen Sisk, Fulton, and Miller, I agreed that additional excepted positions would certainly help to assure that the Huntsville group attracts and retains high-caliber people regardless of the still higher salaries industry offers for similar work.

A comparison of the Huntsville staffing with the other NASA research centers indicates that a total allocation of 60 to 70 positions would place this new center on reasonable parity. A study of the current excepted positions at each center in proportion to the total number of scientists and engineers at each installation shows the following:

Location	Number of scientists and engineers	Number of excepted positions	Percent of scientists and engineers in excepted positions
Langley	1,200	37	3
Ames	450	20	5
Lewis	1,000	30	3
Goddard	450	30	7
Huntsville	1,353	[1] 38	3
		[2] 65	5

[1] Current allocation.
[2] Proposed.

It should be noted from the above that the proportion of professional staff in excepted positions varies between 3 and 5 percent for the established research centers which became a part of NASA when the National Advisory Committee for Aeronautics was abolished.

The 7 percent figure for the Goddard Space Flight Center is higher than the average because this center is still in the early process of organization and is gathering at this initial stage a number of its senior staff members. When the Goddard Space Flight Center approaches its full staffing of about 800 scientists and engineers, the excepted positions will fall within the 3- to 5-percent range outlined for the other centers.

For this reason, a comparable figure for the Huntsville staffing would bring the excepted position requirement alongside the upper level of the existing research centers; namely, 5 percent. This would make a total present requirement of approximately 65 positions, or a minimum increase of 25 to 30 over those which can currently be provided within the existing NASA authority. I choose the word "minimum" with care because these requirements are based upon our present level of scientists and engineers, whereas our new and expedited program assignment under NASA may require changes in the types and proportion of scientists, engineers, and research managers we will need. Undoubtedly, additional future growth requirements will develop both in Huntsville and the other NASA research centers. Provision should be made now for extra spaces in the NASA authority, perhaps as many as 30 to 50, so that we can recognize with appropriately higher pay some of the other, and often younger, staff members as quickly as they develop exceptional competence in this new and growing space program.

Mr. HORNER. This is one of the more difficult areas we have had to deal with in effecting the transfer. We will be glad to provide the committee a statement on the situation.

Mr. FULTON. Why don't you include that in your resolution that we are going to act on this afternoon?

Mr. SISK. I will yield to Mr. Miller.

Mr. MILLER. I have just asked Mr. Ducander to draw up a resolution for me to provide 100 excepted positions in NASA.

Mr. FULTON. Will the gentleman yield?

The CHAIRMAN. I think that is a matter we are going to have to take up in executive session.

Mr. FULTON. You already have House Joint Resolution 567 on which we are going to act on this afternoon. Why not get a temporary recommendation for Dr. von Braun now for that resolution?

The CHAIRMAN. Well, we will take that up in executive session this afternoon. I think all the ideas advanced have been excellent. We will ask Dr. von Braun in executive session on that. Are there any further questions?

Mr. SISK. I will suspend there.

The CHAIRMAN. Mr. Van Pelt?

Mr. VAN PELT. No questions.

The CHAIRMAN. Mr. Wolf?

We welcome Mr. Wolf back. He has been halfway around the world there. I don't know, he may have been watching that Russian rocket land in the Pacific.

Mr. WOLF. Mr. Chairman, may I say that it was a little terrifying to realize that they can launch a missile 8,000 miles, land it in a garden patch, do it twice, do it quickly, and do it exactly as they said they would, and have our own people there to observe it.

I would like to develop that idea a little later if I may, Mr. Chairman. But right now, Dr. von Braun, if I have gotten this picture correctly this morning, our job is not to catch up with the Russians. Our immediate job is to hold our position somewhere behind them. Is that correct?

(Dr. von Braun nods.)

Mr. WOLF. Right now we are not trying to catch up, even. We are trying to hold a position behind them and try not to get any further behind.

Dr. VON BRAUN. They are way ahead of us and still moving faster than we are. So at first we have to build up the working speed that they have and only then we can talk about closing the gap.

Mr. WOLF. That is right. That is why I think our questions here on catching up are just a little premature.

Dr. VON BRAUN. Yes.

Mr. WOLF. The question I would like to develop, if I can, is this: I would like to know what, in your opinion, is the difference in their system and ours that has permitted this to happen? The Russian system of science and technology?

Dr. VON BRAUN. I think this question has quite a few aspects. In the first place, of course, in a totalitarian system it is much simpler for the government to marshal its resources behind one objective which the government decides is important in the national interest. So if somebody in the Kremlin pushes the button, he can get action much more effectively than in a democracy. Then there is the fact that fewer people have to give their consent as to where the money goes. The totalitarian government can send people around much easier, it can assign them to out-of-the-way places without too much consideration of whether they or their families like it or whether they would quit the job. In other words, it is like in a military organization, where you just tell a fellow "You go to Timbuctoo," and he goes.

Mr. WOLF. But scientists, as I understand it, like to be pretty free to develop their own ideas. It would seem as though this would inhibit that. If they can do this, if they can say, "You go here and go there," wouldn't this inhibit their natural ability to develop their thoughts?

Dr. VON BRAUN. I do not think that the Russian scientist always compares his position with that of a scientist in the free world. He compares his plight rather with that of other Russians, and if for all his personal inconveniences the Russian scientists makes more money and has a higher and more respected position in his society, then he feels he is in a privileged position and does not complain.

Mr. WOLF. The other question that I have is this. Do you have any thoughts on how we might tap the resources, the abilities, of some of our allies? I have just returned from Japan. I might say, Mr. Chairman, although I haven't discussed this with you, that I had some fine visits with the head of the Japanese committee comparable to ours, and with the head of their science and techniques committee. They are very anxious to work with us. I know there are others. Do you have any idea how we could better integrate their activities with ours?

Dr. VON BRAUN. There is a great eagerness on both sides to work together. In the military field one of the main stumbling blocks has always been military security. You cannot expect scientists in another country to make very valuable contributions in a field like ballistic missiles, unless you tell them first what the status quo is in your own country. If this status quo is classified information, then they are working in the dark, which is not very satisfactory for them and not very efficient from our standpoint, either.

In space science, in contrast to rocket engineering, the situation, of course, is quite different because most of these things are not classified anyway.

The CHAIRMAN. Are you through, Mr. Wolf?

Mr. WOLF. I just wanted to be sure I understood the answer. Do you have any idea that you would like to give us, either now or after some thought, on how we might better utilize the capabilities that are perhaps available to us?

Dr. VON BRAUN. I think international symposia while desirable, are not the complete answer. I have attended quite a few, and there is always a lot of beating about the bush going on. People would talk only about things you can read in the newspapers and professional journals anyway. The really important and interesting material, being classified, cannot be discussed. I do not know of a more effective way to promote scientific cooperation with our allies than inviting a substantial number of their scientists, well-selected people, of course, to this country and really showing them what is going on here. Thereafter we would sit down and discuss with them the areas in which they thought they could make valuable contributions.

The CHAIRMAN. Mr. Bass?

Mr. BASS. Dr. von Braun, I have heard many people say that the principal reason the Russians are now ahead of us in this space field is because they got started earlier in a serious way. Do you agree with that?

Dr. VON BRAUN. I think this is certainly one very important reason. But I think there is always this other element that in Russia the entire scientific education is conducted, shall we say, on a survival-of-the-fittest basis, and this is not the case here.

Our educational system is based on the premise that every American is entitled to a higher education, so the country is obliged to provide its citizens the means for a higher education. In Soviet Russia, the approach to scientific education is not unlike the philosophy on which West Point is run in this country. The basic idea is that the country needs so many Army officers a year, and the purpose of West Point is not to give American citizens a chance to get a military education but to produce so many professional Army officers a year. The

Russians run their entire scientific educational system on the same basis: The state needs so many physicists, so many mechanical engineers, and so many chemists a year, and the schools are there to provide them. Since the Soviets provide high incentive pay in these professions, there is a great rush to get the required education, but it is a ruthless survival-of-the-fittest training and only the very best will finally make the grade.

Mr. BASS. Do you know when, approximately, the Russians really started a policy of putting great emphasis on space technology, rocketry, and the space field? When did they get started?

Dr. VON BRAUN. From the information I have, I must conclude that the Russian large rocket program started solely as a military program, with Stalin himself making the decision that he didn't care how big the rocket would be to carry an atomic warhead across the ocean, he just wanted one and he wanted it quick.

Mr. BASS. About when——

Dr. VON BRAUN. And then the scientists in Russia said that these new big rockets would offer them the possibility to put scientific payloads in outer space. At first, it seems that these suggestions were highly unpopular in higher circles in the Russian Government. Apparently some people feared such a scientific space program would dilute the military effort.

Mr. BASS. About what time was this, would you say, what year?

Dr. VON BRAUN. Two or three years before Sputnik I, that would have been 1954, thereabouts, 1953, 1954.

Mr. BASS. Well, the Russians got started much before 1954, didn't they?

Dr. VON BRAUN. Yes, but only in 1954 the point had come where the scientific community in Russia saw that the military long-range rocket program was about to produce a rocket powerful enough to carry scientific payloads into orbit. The scientists apparently tried to get some of the new rockets for their purposes and they were turned down. Apparently they were turned down time and again because the military felt this space science project would distract from the military effort. But at the end the scientists got a rocket and Sputnik I went in orbit. The payoff in political propaganda was so high that now the scientists can get anything they want.

Mr. BASS. What were the Russians doing in 1947 or 1948 in this field? Anything?

Dr. VON BRAUN. Yes. They had a program aimed at the development of large rockets going on all this time.

Mr. BASS. So they were putting considerable emphasis in this field in the years just after the last war?

Dr. VON BRAUN. Yes, sir. Indications are that the Russians may have felt that they would never have a chance of catching up with American strategic airpower, so they might as well leapfrog that whole era of airborne, air-breathing, long-range aircraft, and go to rockets right away.

Mr. BASS. We didn't get started on this until quite a bit later than that, did we?

Dr. VON BRAUN. That is correct.

Mr. BASS. So this would be a big factor, wouldn't it, as to the reason why we find ourselves where we are now in this field?

Dr. VON BRAUN. Well, sir, long-range rocket capabilities had been studied in this country since the end of World War II. The Army and the Air Force knew all along what kind of a rocket it would take, at any given year after the Second World War, to carry x pounds of nuclear warheads over so many thousand miles range. But nuclear warheads at first were heavy, and so the studies indicated that rockets of such colossal dimensions would be needed that the designs were considered militarily unmanageable. Therefore the powers in the Pentagon said: If we build this enormous rocket, it will be a white elephant, so let's wait a little longer until nuclear warheads have become lighter and we can do the same thing with a smaller rocket. Maybe we waited a little too long in our reliance on strategic airpower.

The CHAIRMAN. Mr. Mitchell?

Mr. MITCHELL. Doctor, I have been interested in several of your answers of late. Maybe I do not interpret your views correctly, but I am going to ask you this. I gather that you feel that the American people, as reflected through our governmental processes, have not yet made the decision that we want to be first in space. Is that correct?

Dr. VON BRAUN. I think many people feel we should be first, but there are also many others who don't care.

Mr. MITCHELL. Are we making that maximum effort, if there is such a thing as a maximum effort, to be first in space?

Dr. VON BRAUN. Well, I can talk only about our own project, the Saturn. As I said, I don't believe that a higher funding rate for 1961 than the one now planned would give us much additional gain in time.

Mr. MITCHELL. Well, of course, I feel that you are qualified to speak for our space efforts in general. You speak of certain things, such as the Russian philosophy of the survival of the fittest. You speak of the fact that we definitely should be in a position to pay more for the scientists on your project and others. Doesn't that of itself say that we really haven't made the determination that we are going to go all out to be first in space?

Dr. VON BRAUN. I agree with you, sir.

Mr. MITCHELL. Thank you, Doctor, that is all, Mr. Chairman.

The CHAIRMAN. Mr. Riehlman?

Mr. RIEHLMAN. Dr. von Braun, if the program that you have set forth here today is followed and you had the funds and the scientists, is there any question in your mind that we aren't eventually going to catch up with Russia in this space program?

Dr. VON BRAUN. Sir, I think we can catch up in any field where we really make an earnest effort, whether that field is space or bombs or anything.

Mr. RIEHLMAN. Well, now, you outlined pretty clearly to this committeee today what your program is with the Saturn booster, which would put into orbit a tremendous payload.

It is my understanding that if that is accomplished within the next 18 months or 2 years, that we will have a greater capacity to put into orbit a larger payload than the Soviets have as of today. Am I correct in that?

Dr. VON BRAUN. Yes, sir; as of today.

Mr. RIEHLMAN. Yes. Well, now, we recognize that they are probably not going to stand still. We are not going to stand still, are we?

Dr. VON BRAUN. No.

Mr. RIEHLMAN. If we continue in this program?

Dr. VON BRAUN. No.

Mr. RIEHLMAN. Well, isn't it possible that if this program of yours is successful that we can expand at a greater speed in the years ahead in the production of larger boosters?

Dr. VON BRAUN. It is for exactly this reason that I suggested that we take another look in late 1960 or during 1961 and ask ourselves: "How is Saturn coming along? Do we now want to build two or three times as many?" Such an increase in production rate is definitely possible. But since today we are only at the beginning of the development program, much more than the additional moneys we are now to receive would not speed things up very much.

Mr. RIEHLMAN. Let me ask you this. Since this study has been made for increased urgency in this program how many people have you put on overtime

Dr. VON BRAUN. We have not put our entire development organization in Huntsville on overtime. Rather we apply overtime to widen certain bottlenecks. Our difficulty in the past was that whenever an unforeseen minor difficulty developed. I mean the kind of thing that could be straightened out by a relatively small team of people working 36 hours in a row, we couldn't make such an extra effort because we couldn't pay the men overtime. We are now using overtime discriminately, a small group here, a small group there. These groups are put on overtime for limited periods of time, so they can catch up time that would otherwise be lost to the overall program. In other words we use overtime to open up bottlenecks.

Mr. RIEHLMAN. There is a supplemental appropriation pending in the House. Do you have any plans for using those funds for a broader program of overtime in your field of activity?

Dr. VON BRAUN. No, sir. At least not until July 1, 1960. So far we have only this $1.5 million which does not permit us to go all out. And I am not aware of any additional appropriation for fiscal 1960, other than what NASA may make available to us through internal reshuffling of funds. We do whatever our funding permits.

Mr. RIEHLMAN. How important would the additional funds be for overtime in your program?

Dr. VON BRAUN. In this increased 1961 budget, an adequate allowance for overtime has been made. It is included in the $230 million figure. In fiscal 1960 we have a temporary funding difficulty which, as Mr. Horner pointed out, NASA will try to overcome through internal reshuffling.

You see, even if we put the entire NBMA organization in Huntsville on overtime between now and the 1st of July this wouldn't take up more than an additional $2 million, I think, anyway.

Mr. RIEHLMAN. What effect would that have on your program? Anything of a substantial nature?

Dr. VON BRAUN. Yes, it would help some; yes, sir.

The CHAIRMAN. Mr. Riehlman, are you through? Mr. Quigley?

Mr. QUIGLEY. I have no questions, Mr. Chairman.

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The CHAIRMAN. Mr. Karth.

Mr. KARTH. Doctor, I want to congratulate you on finally having sold your program to the powers that be so that you can get along with it with the sense of urgency I think it deserves.

In the last 3 years, how much of your productive time have you spent acting as salesman to the powers that be in attempting to convince them that this is a worthwhile project?

Dr. VON BRAUN. I would say more than 50 percent.

Mr. KARTH. You have on several occasions indicated that the moneys available for fiscal year 1961 are sufficient to carry on your program. How about 1958, 1959, and 1960? Do you think there was quite a considerable lack of interest during those years insofar as moneys are concerned, which set you back, let's say 1 or 2 or 3 years?

Dr. VON BRAUN. Sir, the Saturn program started out as follows: Somebody from ARPA came to us and asked us whether for $10 million we thought we could demonstrate on a static test stand that eight rocket engines could be fired up simultaneously. We asked, "Well, do you mean to make a decent missile program out of this?" He replied: "We don't have more than $10 million, so answer our question whether you can make that static test for $10 million." From these humble beginnings Saturn started snowballing.

Mr. KARTH. I think you have answered my question, Doctor, thank you.

Knowing what you know about Russia's state of the art and eliminating conjecture as much as we can, when would you say they would make their first soft landing on the Moon?

Dr. VON BRAUN. I wouldnt' be surprised if they make it this year.

Mr. KARTH. And when would you suggest that they might first orbit their man around the Earth?

Dr. VON BRAUN. I wouldn't be surprised if they made it this year.

Mr. KARTH. That is all, Mr. Chairman.

The CHAIRMAN. What was the last question?

Mr. KARTH. This year.

The CHAIRMAN. Put a man in space this year?

Dr. VON BRAUN. I would not be surprised if they did it this year.

The CHAIRMAN. Mr. Hechler.

Mr. HECHLER. I believe you have made a tremendous contribution for which people in this country and those all over the free world will always be grateful.

Dr. VON BRAUN. Thank you, sir.

Mr. HECHLER. And I think in addition to that, you having been born, brought up, and lived under a dictatorship, you perhaps appreciate the meaning of freedom a little bit more, maybe, than some of us here.

Dr. VON BRAUN. Very much so.

Mr. HECHLER. I am particularly impressed in what you have done over the past 15 years. You have shown a dedication to the ideals of America. You have shown not only scientific genius, but you have also shown an understanding of just what we ought to do in this program.

You have shown a sense of urgency. And I think that this committee will stand 100 percent behind you in what you are trying to do.

I hope bureaucratic and budgetary considerations will never again hamper you in your work. I would like to make one gentle correction in an observation that you made about NASA providing you the funds. It is my understanding that Congress provides the funds.

Dr. VON BRAUN. I am sorry.

Mr. HECHLER. And I say that in all good humor. I would like to reemphasize that if ever in the future there is any program that you feel is not being treated with the proper priority that you will come to this committee and let us know about it.

Now, I was impressed with some of the things you said about education. Do you think that we are running low in our stockpile of basic research upon which we have to draw?

Dr. VON BRAUN. Yes, sir.

Mr. HECHLER. Do you believe that in order to replenish this stockpile, it is just as important to spend money on education as it is on hardware at the present time?

Dr. VON BRAUN. Yes, sir.

Mr. HECHLER. Could you point to any particular way in which we could improve our educational system in order to strengthen the work that you are doing and others who follow you in the future?

Dr. VON BRAUN. I think anything would help that would make scientific careers more attractive as compared with free enterprise careers. I think we should never lose sight of the fact that in Russia the opposite number to the American businessman doesn't exist. So the young fellow in Russia who wants to get ahead in life has only one chance, he must go through the Soviet educational system, which, as I pointed out, is a survival-of-the-fittest type screening system. To survive the many exams he has to work very hard, and if he washes out he just does not qualify for the higher strata of the Soviet society.

Now, here in America there is always the easy way out. When a young fellow says, "I had enough schooling, I will go across the street and take a job as a filling station attendant," chances are that 10 years later he will make a lot more money than his friend who stuck it out at school and got a Ph. D. because he may have the Standard Oil franchise in town.

I think this is the crux of the entire problem of scientific education in this country: The huge gap between the low relative incentive for a man who decides to become a scientist and the high incentive which the free economy can offer.

Mr. HECHLER. I would like to ask one very personal question. Over the past 15 years, what are the two things that have brought the greatest pride to you, personally and professionally?

Dr. VON BRAUN. Well, I would say I felt my greatest personal and professional satisfaction when we placed Explorer I in orbit. To me it meant two things: In the first place, we had shown that the Western side can launch a satellite also, and, secondly, and this is a very personal matter with me, by making this contribution we could express our thanks to our adopted country.

Mr. HECHLER. Thank you, Dr. von Braun.

The CHAIRMAN. Mr. Daddario?

Mr. DADDARIO. Doctor, you said earlier that when the Saturn is tested, it will be the largest to be tested in the free world.

Now, in your motion picture, you also showed that when we are able to do this, we will be able, perhaps, to have a soft landing on the Moon or to orbit the Moon.

In view of the answer you have given to Congressman Karth, do I then understand you to mean that the Russians now have a million-and-a-half-pound thrust capacity at least?

Dr. von Braun. This I do not know, but I would consider it logical that the Russians—having already fired several rockets with approximately one-half of that thrust, and knowing that we are trying to leapfrog their rockets of the 600,000- or 700,000-pound thrust class—are probably busy developing a bigger rocket, too.

Now, whether their new rocket will have a million and a half or 2 million or 3 million pounds of thrust or only 1 million, this I don't know, but I consider it very likely that they are busy at this very time developing a rocket at least the size of the Saturn.

Mr. Daddario. As we discussed part of the fiscal problems and the efficiencies through which money can be spent, you noted that there is a strong lack of the top type of personnel because of lower Government salaries.

Have we, therefore, reached the point where in order to catch up with the Russians, if we believe that is necessary, that we must do something to take the limit off of salaries so that you can get the type of people you need in order to propel your program forward faster than you now can with the type of people whom you can pay to stay in Government?

Dr. von Braun. Yes, sir. As I pointed out, you can develop a rocket system such as Saturn only if you have high competence in Government quarters, simply in order to be able to spell out to industry what you expect to get for the tax money you are willing to spend in industry.

And I think this is our most critical problem—to build up and retain this kind of competence in Government. Let me give you an example. During the recent bidders' conference in Huntsville, for the second stage of the C–1 Saturn, we were confronted with very highly qualified representatives of 35 corporations. These men sat a whole afternoon asking very intelligent questions about all kinds of details. We were sometimes almost embarrassed to suspect that some of these industry representatives who, after all, wanted to get the contract from us, may know more about certain Saturn problems than we did. We work on the Government payroll, and that limits our ability to attract and hire highly experienced people. But you cannot contract the responsibility for the spending of tax money to industry.

Mr. Daddario. Is it then one of your recommendations that something ought to be done in order to give you the capacity to not only attract this type of person, but to pay them?

Dr. von Braun. Yes, sir.

The Chairman. Mr. Moeller.

Mr. Hechler. Will the chairman yield for one quick question?

The Chairman. Yes.

Mr. Hechler. I would like to ask one quick question. Because you believe the Rusians are going to make a soft landing on the Moon and make an orbital manned space flight so quickly, isn't there danger in building up the people with our emphasis on the Saturn program as we did prior to Vanguard, to feel that we might possibly get the first man up there and then to have a great letdown which would follow?

Dr. VON BRAUN. Sir, I think in a free society where you expect the taxpayer to put up the money for all these things, you just have to keep him informed. The Russians are better off in this respect because they don't ask the taxpayer whether he would agree to such a program, so they don't have that problem.

Mr. HECHLER. I would merely hope the press reports that by putting our emphasis on Saturn, we are not definitely going to be the first nation to get the first man in space?

Dr. VON BRAUN. No, I think in a free country the public must be expected to be mature and intelligent enough to accept a couple of setbacks, too.

The CHAIRMAN. Mr. Moeller?

Mr. MOELLER. Dr. von Braun, you and General Medaris have been a very successful team. It is very apparent from newspaper articles that General Medaris is quite critical of our present space program, both in NASA and in the military.

I don't know if he has told everyone exactly what he thinks ought to be done. But as you view it now, from NASA, do you think that we ought to have an entirely different approach, maybe, to the entire space program, both in NASA and the military?

Is there need now for a Cabinet post on space?

Dr. VON BRAUN. What is that?

Mr. MOELLER. A Cabinet post on space? Are we at the place where we need one person to make these decisions both for the military and for NASA?

Dr. VON BRAUN. I think when the Congress and the President assigned the space program to NASA, it was out of a realization that we first have to explore space before we can put it to military use. I think neither the President nor the Congress ever meant to say that the military can forget about outer space. After all, ICBM's are flying through outer space right now. But it is very difficult, if not impossible, to spell out in detail what forms warfare in outer space may take before anybody has ever been out there.

Now, the military way of budgeting big technological programs is by wrapping up all necessary elements into one package which is called a weapons system. For example, the military services no longer talk about airplanes, they talk about the complete weapons system capable of delivering bombs. This includes aircraft, weapons, navigation equipment, ground support equipment, and so forth. It is obvious that it is somewhat difficult to describe a military space weapon system in too much detail, before the first Mercury astronaut has ever returned from an orbit.

On the other hand, I don't think anyone has ever meant to rule the military out of outer space. A rocket vehicle like Saturn can be clearly justified today by the simple fact that if we ever want to send someone to the Moon we just need a vehicle of this size. We don't have to be nearly as specific to get the work on Saturn started as if we had to spell out all the details of a weapons system.

On the other hand, once you have a Saturn rocket, you can use it for many military applications also. So I do not believe that the military is losing its future capability in space by the fact that the Saturn program is administered by NASA. We will be responsive to all their needs.

Mr. MOELLER. In other words, you don't feel that at this particular time we need a new organizational setup with which to carry this on?

Dr. VON BRAUN. No. I think as long as enough money goes into this effort, we can handle it with the present organization—in fact, possibly with any organization.

The CHAIRMAN. Mr. King?

Mr. KING. Dr. von Braun, I assume from your testimony that eventually we will be producing many Saturns. Are you concentrating right now on one particular Saturn, or are you actually contemplating going into production on a larger scale?

Dr. VON BRAUN. Saturn, and all stages of it, can be produced in quantity like any ICBM. There are only a few peculiar things to consider, such as the size of it, which creates certain transportation difficulties, but that is all. Produceability is just as good as that of any other smaller missile.

Mr. KING. You are thinking in terms right now of many?

Dr. VON BRAUN. Yes, sir.

Mr. KING. Multiproduction?

Dr. VON BRAUN. Yes. Use of one basic rocket system for a great variety of space missions is the only way to get reliability and assurance. We consider the Saturn as the most promising future workhorse of space flight and we want it to become just that.

Mr. KING. On your chart, I believe you pointed out that there would be 10 test firings and the 11th you would consider to be operational? Now, those test firings, do they involve a complete Saturn vehicle so that the 11th one becomes the operational one and 10 of them are—I won't say wasted, but at least they are used just for experimental purposes?

Dr. VON BRAUN. The first three will be single-stage flights, in other words, only the first stage will be live and the second and third stage will be replaced by dummies. Then there will be a number of flights with the two-stage arrangement, where the first and second stages will be live and the third stage will be a dummy. And then we will finally have full-fledged three-stage flights.

After a number of complete three-stage flights, we hope we will have attained a sufficient degree of reliability to entrust multimillion-dollar scientific missions to Saturn or even the lives of a crew.

Mr. KING. So that it is the 11th one, then, when we get down to business of getting a man in space or using it for communications or one of the other purposes that you mentioned?

Dr. VON BRAUN. That is correct.

Mr. KING. One final question. Do you feel that this country ought to sponsor officially an amateur rocketry program under the aegis of our own military organization, perhaps, supervising and encouraging young people to enter into this under supervised conditions?

Dr. VON BRAUN. Sir, I have been approached by many rocket amateur groups, who inquired whether some action along those lines could be taken.

I was chairman of the membership committee of the American Rocket Society during the last year. In this capacity I initiated a so-called youth rocket workshop where personnel active in the youth rocket program met for 2 days in Princeton to work out a policy and recommendations, how such a youth program could be organized. They came up with a plan to run such a program jointly with the Boy Scouts of America. The reason for this was that the American Rocket Society under its charter as a professional society cannot conduct any experimental program. The charter doesn't allow it, for liability reasons and several other legal aspects.

I presented the program which this youth workshop proposed, in a talk to the membership of the American Rocket Society. The board of directors took a vote on it, and decided that the American Rocket Society could not back it up because the hazards involved were too great.

The board felt that with no amount of scientific supervision by experts, was it possible to protect a young rocket experimenter from blowing himself up, or maiming himself while testing an inadequately designed rocket.

Mr. KING. Yet many of the youngsters are going ahead anyway.

Dr. VON BRAUN. This is the other side of the ledger. They are now going underground and do it anyway. I've pointed to this danger repeatedly, but this was—my colleagues on the board of the American Rocket Society realize the danger, too, but the majority felt that there is all the difference between endorsing this kind of thing and discouraging it.

Mr. KING. Do you feel that there might be merit in further exploring possible schemes for organizing all of this amateur rocketry effort that is now being expended, whether we like it or not?

Dr. VON BRAUN. The American Rocket Society has adopted the official position that it will encourage things like youth science and youth space fairs, that it will encourage all kinds of educational programs that get the kids away from playing with gunpowder and get them closer to physics books and studies of the fundamentals, instead.

The American Rocket Society has initiated a youth program along those lines, but will definitely not support and will in fact discourage any rocket experimentation by youngsters. Since the directors of the American Rocket Society took this vote and since I am a member of the board of directors, I am now, shall we say, tied to the party line.

The CHAIRMAN. Mr. Roush.

Mr. ROUSH. Dr. von Braun, I appreciate the fact that you are here today. I have always thought that you had considerable imagination and that you certainly have had a sense of urgency for this program.

How many Saturn vehicles will we have when the Saturn becomes operational in 1964?

Dr. VON BRAUN. How many operational?

Mr. ROUSH. Will we have a backup vehicle for the one which is fired in 1964?

Dr. VON BRAUN. Yes, sir. The present program provides that from 1964 on we will have a regular flow of production. The old funding plan envisioned four a year, but with the new program, if we provide an adequate funding level in future fiscal years, we can probably increase it to six a year. After we have passed the hurdle or R. & D. firings, I mean once Saturn is successful and generally liked, there is no reason in the world why with more funds, we couldn't go up to a production rate of 10 or 20 a year thereafter. From then on it is just like putting a large aircraft in quantity production.

Mr. ROUSH. I had thought that there were at least four reasons why we are behind in this race to conquer outer space. One has been, in the past, a lack of imagination on the part of, shall we say, our administrators. Would you agree with that? I am not referring to either party. I am thinking of those people who are administrators responsible for drawing budgets, for providing funds, developing programs.

Dr. VON BRAUN. I do not quite agree with the word "lack of imagination."

I think the possibilities that space flight offers for scientific research are generally accepted by the scientific community. But there is a certain amount of soul-searching going on when various scientific programs start competing for the tax dollar.

Take the question: Shall we spend $100 million more on the Saturn program? Now there are a lot of other competing scientific programs that would like to have these same $100 million. And it is not possible, in my opinion—this at least, has been my experience—to justify a thing like the Saturn solely with scientific reasons.

You see, the Moon has been there for several hundred million years and nobody cared about its far side until the Russians photographed it. It is kind of difficult to prove that for scientific reasons we have to photograph the far side of the moon in 1961 and not in 1962.

On the other hand——

Mr. ROUSH. Those who won't believe that we have to lack imagination, don't they?

Dr. VON BRAUN. My answer is that this is not really a scientific question at all. It boils down to this simple fact: If the value of American stock in the eyes of the world drops a billion dollars because the Russians publish a photograph of the far side of the Moon, and if we could have done it for one-tenth of that amount, it would have been a good investment to have done it ahead of the Russians.

So this is not fundamentally a scientific question, it is rather a question of national prestige in the eyes of the world. It has something to do with our recognized position of leadership in the world.

Mr. ROUSH. I have one other area I want to touch on. Of the scientists—I will put it this way: How much could the top scientists on your team command in salary in industry?

Dr. VON BRAUN. The top people, easily twice as much as they are making now.

Mr. ROUSH. How much are they making now?

Dr. VON BRAUN. In the Government service?

Mr. ROUSH. Yes.

Dr. VON BRAUN. The top layer?

Mr. ROUSH. Yes.

Dr. VON BRAUN. Right now between $17,000 and $19,000.

Mr. ROUSH. And in industry they could command salaries at least twice that; is that correct, sir?

Dr. VON BRAUN. Yes.

Mr. ROUSH. That is all, Mr. Chairman.

The CHAIRMAN. Now, it is noon, gentlemen. Mr. Fulton has just one question.

Mr. FULTON. The question is this, because it has been a matter of strategic balance on the effort that should be put into our present force in being, the Strategic Air Force and our other methods of military defense, and the progress that we can make in space on a broader basis through civilian purposes and scientific research and development, as you say, the competition for the tax dollar.

Now, there has been a committee, a subcommittee of the Policy Committee set up, of 17 scientists. This committee on January 24 came up with a recommendation that man in space programs, for example, the Mercury, and, as a consequence, the Centaur and your particular program, the one you are working on, have their target dates postponed 3 to 5 years in order to give more attention to practical military purposes and security.

Now, to me your program for man in space and your aiming at the development of a broad scientific base for our U.S. programs are a necessary part of our progress in space and our catching up with Russia.

So, I, therefore, favor the greatest speed in the Saturn program and that it be given a DX, the highest national priority.

Now the question is, Do you agree with that approach or do you agree with this group of 17 scientists that there should be the postponement of the targets 3 to 5 years for man in space programs?

Dr. VON BRAUN. I have not read that particular recommendation, but I am greatly surprised——

Mr. FULTON. I can assure you it was made.

Dr. VON BRAUN. I am greatly surprised by it. In my opinion it would be a most fateful mistake if we let our man in space program slip several years. I also believe that this country can easily afford both space and military programs.

Mr. FULTON. That is what I feel.

Dr. VON BRAUN. And should do both.

Mr. FULTON. Thank you very much.

The CHAIRMAN. Mr. Hechler wants to put something in the record.

Mr. HECHLER. I would like to ask unanimous consent that every time Mr. Fulton brings this matter up, that I be given an opportunity to make my response in the record.

The CHAIRMAN. Will you put it into the record?

Mr. FULTON. I would like to bring—this question is as political as a "cat on a hot tin roof," because that was the subcommittee of the Democratic National Policy Committee that made the recommendation on January 24.

The CHAIRMAN. Are there any further observations here, political or otherwise? If not, Doctor, can you be here at 2 o'clock?

Dr. VON BRAUN. Yes, sir.

The CHAIRMAN. The committee will recess then until 2 o'clock and we will go into executive session at that time.

We have two rollcalls coming up. We may be interrupted, Doctor, but we hope, everything being in our favor, we can go right on through and finish up.

Whereupon, at 12:05 p.m., the committee adjourned to reconvene at 2 p.m. in executive session.)

(At 2 p.m., the committee being unable to resume because of House business, Dr. von Braun met informally and briefly with various committee members.)

REVIEW OF THE SPACE PROGRAM

WEDNESDAY, FEBRUARY 3, 1960

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

The committee met at 10:10 a.m., the Honorable Overton Brooks (chairman) presiding.

The CHAIRMAN. The committee will come to order.

We are happy to acknowledge, as a gift to the committee, a very fine clock, Mr. Secretary, that we have here. I had it put on the lower counter. I don't think Mr. Moeller will object to having it near him where all the members can see it very readily. We appreciate it. It helps us keep up with the time, which goes by in a hurry when you are asking questions in which you are very interested.

This morning the members of the committee are happy to have the Secretary of the Air Force, the Honorable Dudley C. Sharp, who is well known to most all of us here on Capitol Hill, and accompanying him, the Honorable Joseph V. Charyk, Under Secretary of the Air Force. Both have statements, and they are excellent statements. Some of the members have asked for copies to read in advance and I suggest, therefore, to the committee that we allow the Secretary to proceed with his statement, then the Under Secretary with his; and, following that, we will ask our questions.

If there is no objection to that procedure, I think it would be more orderly and we will get along with our work more quickly. Without objection, it is so ordered.

I might say, too, before beginning, that our staff—Mr. Carstarphen, to be specific—undertook to find us a loudspeaker. I know some of the members of the committee undoubtedly have noticed a loudspeaker. It seems to be working very well. It was suggested that we simply have a loudspeaker for the witnesses. The room is small and most of the members can be heard without effort and without need of the loudspeaker. It worked very well yesterday and I think it will work well again this morning.

Mr. Secretary, in this hearing we are requiring all of the witnesses to be sworn and, if you and the Under Secretary would stand, I would like to give you the oath.

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

Secretary SHARP. I do.

Dr. CHARYK. I do.

The CHAIRMAN. We are very happy to have you, Mr. Secretary. We know of the fine work you have done for many years over in the

Pentagon and I think we are fortunate to have a man of your caliber as Secretary of the Air Force.

Secretary SHARP. Thank you, sir.

The CHAIRMAN. You may proceed with your statement.

STATEMENT OF HON. DUDLEY C. SHARP, SECRETARY OF THE AIR FORCE

Secretary SHARP. Mr. Chairman and members of the committee, the Air Force welcomes the opportunity to appear before your committee once again to discuss our activity in the military exploitation of the area above the sensible atmosphere of the earth. We, of the Air Force, share your opinion that space is an important and critical area and that the manner in which we approach its use is vital to the future well-being of the Nation.

In our planning for future weapon systems, we do not differentiate between aeronautic systems and astronautic systems. We have but one purpose and that is to provide to operational commanders those weapon systems that have the capability of performing most effectively the essential military missions with which the Air Force is charged. As the natural consequence to this philosophy the choice of the weapon system to be developed and produced to satisfy a particular requirement is based on the relative effectiveness and cost of the various possible weapon systems whether they operate in the atmosphere or in space.

We are certain that the higher speeds and altitudes and longer flight duration that are characteristic of space vehicles will be just as significant as these same factors have been in the evolution of the airplane as a military vehicle. We are also certain that for the foreseeable future space systems will supplant neither the airplane nor the missile in our inventory of deterrent power but that each class of system will complement the others in the operational forces.

Military space systems have unique and valuable characteristics for certain military functions at the present time. For example, systems now under development can provide reconnaissance information and warning of ballistic missile attack far better than other known methods.

Therefore, we attach a high priority to the development of these systems. It is interesting to note that the first use of the aircraft was also in the role of a reconnaissance vehicle. We anticipate that as we learn more about space and the design of space vehicles they also will evolve into highly effective offensive and defensive weapons.

The Air Force is convinced that the military space vehicle will become increasingly important to our national defense. We are placing emphasis and priority on space weapon systems in our planning and development activities. We assure you that we will continue to do so.

We have within the Air Force a background of experience and knowledge that is directly applicable to the military space vehicle. There is such a close relationship between the intercontinental ballistic missile and space vehicles that the ICBM is, in a sense, a space system. Certainly the space vehicle is a direct descendant of the ballistic missile, just as the ballistic missile is a descendant of the airplane and the winged cruise-type missile. A high percentage of the research and development which has provided the Nation with the capability to place operating payloads into orbit was performed in the pursuit of aircraft and missile programs. It is a source of considerable pride to the Air Force that this is so and that our accumulated knowledge and experience has proved so valuable in the exploitation of space in the interests of national defense.

Succeeding Air Force witnesses will cover the details of our programs for the military use of space. Therefore, I would now like to discuss the National Aeronautics and Space Act of 1958 and the relations between the Air Force and the National Aeronautics and Space Administration.

We consider the National Aeronautics and Space Act to be an adequate basic framework to govern the conduct of this Nation's space activities. We believe that the Congress clearly stated its intent to provide for both the national security and the scientific exploration of space while insuring the most efficient use of national resources. The experience gained in the past year indicates to us that the present legislation and organizations need but little change for the most effective exploitation of space in the national interest. The Air Force is of the opinion that changes such as those recommended in the President's message to Congress on January 14, 1960, are desirable and will attain the desired end.

We do not believe that it is in the best interests of the Nation to add any new organization or organizational superstructure to those now existing. Indeed the trend of the past year has been in the other direction. The number of organizations participating in the program has been reduced and hence the requirement for coordination has been reduced while the quality and timeliness of our coordination has improved. We are confident that this will result in a better national space effort.

There is a historic and traditional relationship existing between the National Aeronautics and Space Administration and the Air Force. The Air Force and the National Advisory Committee for Aeronautics worked together for many years in the solution of common problems and in the process developed a warm and close relationship at all levels. NASA was created from NACA and it was inevitable that these bonds would continue to hold the Air Force and NASA in an effective and desirable relationship. We are happy that this relationship continues to exist both in aeronautics and space activities.

Even though NASA has taken on the new mission of scientific exploration of space during this past year and has experienced a significant growth in both personnel and responsibility, the coordination of our programs has been effective and satisfactory. We are constantly coordinating at all levels and we expect that our coordination will become even more effective in the future.

In one other important regard the NASA and Air Force relationship has been most satisfactory. During the past year we have been able to assist NASA in the conduct of a number of their space programs. We anticipate that the two agencies will continue to assist each other where special capabilities exist in one agency to satisfy a requirement in the other.

To summarize the Air Force position on our national space program, we are convinced that space vehicles will be an important part of our deterrent force in the future. Therefore, we are pursuing the development of these systems and the operational planning for their use in an aggressive manner.

We believe that the guidance given by the Congress to be effective and suggest that only minor changes be made on the basis of our experience. We are firmly convinced that the division of responsibility between the Department of Defense and NASA is proper and we know that we can continue to work with NASA for our mutual benefit and the benefit of the country.

In view of the importance we attach to our space programs we appreciate the efforts of your committee to insure that our national space efforts are effectively and expeditiously pursued, and we will be pleased to assist you in your most important task. Thank you.

The CHAIRMAN. Thank you very much, Mr. Secretary.

Now, Mr. Under Secretary, you have also a statement here and we would certainly appreciate your proceeding.

STATEMENT OF HON. JOSEPH V. CHARYK, UNDER SECRETARY OF THE AIR FORCE

Dr. CHARYK. Mr. Chairman and members of the committee, I am honored to appear before this committee to discuss the interesting and important subjects of aeronautics and astronautics. The Air Force appreciates the intense interest exhibited by this committee in these subject areas and is also appreciative of its concern relative to the enactment and implementation of the legislation which will insure the effective exploitation of programs related to these fields of technology in order to best serve the interests of the Nation.

The Air Force is proud of its history in the field of aircraft and missiles. Our present activities in research and development are geared to take full advantage of this background and experience in advancing the state of the art and in insuring the optimum development and introduction into the inventory of militarily significant weapon systems. It is the responsibility of the Air Force to pursue those avenues of technology which may have a major impact on the manner in which our mission responsibilities can be most effectively discharged.

In this endeavor, we also feel a responsibility to utilize to the fullest information being developed by other agencies and departments of the Government.

We endeavor to maintain, at all levels, close working relationships with such departments and agencies. In the area of interest to this committee, perhaps the most important of such relationships is that with the National Aeronautics and Space Administration.

The Air Force had a long and fruitful intimate association with the predecessor organization, the National Advisory Committee for Aeronautics, and these relationships have been broadened and intensified in the case of the present National Aeronautics and Space Administration.

We view our responsibilities to be the full exploitation of technology for the development of systems to enhance our military capability and strength. We do not view space to be a separate medium, but rather an extension of our previous horizons as a result of expanding technology. It is our responsibility to exploit to the fullest whatever media will permit better, more efficient, more economical methods for carrying out our military functions.

The expansion of our horizons to include space also permits the development of a capability to carry out functions of military importance that could previously be done in no other way.

In our assessment of the types of activities that should be pursued, we must compare and evaluate other means for accomplishing the same ends. We do not feel that it is our function to explore and exploit the space medium for its own sake. Rather, it is our responsibility to utilize to the fullest whatever means are best for the fulfillment of our defense responsibilities. There will be much that will be learned from the NASA programs that will provide a better basis for our deliberations and decisions and we intend to exploit to the fullest the benefits in knowledge, in hardware, and in capability that will accrue from the existence of a vigorous and effective space exploration program on the part of the National Aeronautics and Space Administration.

The Air Force, for many years, has been interested in the potential that mastery of the space medium suggests for the accomplishment of certain important military functions that cannot be so easily or so effectively carried out in any other way. Perhaps the most significant example is the Air Force program which was initiated as far back as 1946 and which later was designated "weapon system 117–L."

This system was designed to be a basis for enhancing our capability in reconnaissance and warning through the use of families of satellites. The reconnaissance function, both photographic and ferret, was clear from the outset and a little later, the use of such satellites equipped with infrared sensors to serve as a warning system against ICBM attack became apparent.

By today's standards, these initial studies were very crude. However, we must remember that the ICBM, at that time, was but a visionary dream.

The important developments in propulsion, materials, guidance, control, photographic equipment, and infrared sensors that were necessary to make fancy into fact were still in a very early stage. Even so, it was apparent at that time that the successful exploitation of the space medium would have important implications in the reconnaissance area.

This successful exploitation, however, would have to depend on much research and much development in the critical problem areas that I have mentioned. With the advent of a vigorous ICBM program in 1954, these capabilities began to take on more realistic and more imminent possibilities and the effort in these directions was steadily stepped up. The management responsibility for weapon system 117–L was transferred to ARPA in 1958 and was broken down into three programs which were designated Samos, Midas, and Discoverer. The responsibility for these programs was returned to the Air Force about 3 months ago.

While the technology associated with the ICBM program has obviously been of tremendous importance to space exploitation, the effective use of the space medium to carry out military functions in a better fashion and to complement other means for doing a military job demands certain capabilities which are of lesser importance in the case of missiles or in the case of programs for the scientific exploration of space.

In many instances, the requirements may be quite different. Probably the item of major importance in the use of satellite systems for carrying out military functions is that of reliability. If most of these systems are to be militarily effective, efficient, and economical a long lifetime is required.

Even the simplest systems involve payloads of considerable complexity and contain many active elements. Unusual demands on lifetime are imposed on the system by contrast with the type of lifetimes that are satisfactory for airborne systems or for ground systems. In most instances an improvement of at least one or two orders of magnitude is required to even make the system of potential interest. It means that our designs must be of a new type employing the proper balance between redundancy, cost, weight, and complexity and component selection must be based on extensive testing and developments that can help insure a long mean time to failure under the environment in which such components will have to operate.

Another area that I believe is of vital importance in determining the role that the space medium will play in military tasks has to do with the booster systems that are utilized. Our costs today for every pound placed in orbit are extremely high and if satellite systems are to provide the most economical solution for carrying out certain military jobs tremendous improvements must be made in regard to the booster systems that are used. Costs will have to be reduced in a major fashion and at the present time I believe that the most promising route is in the direction of simplicity, ruggedness, and physical recovery without the need for major reconditioning. It is noteworthy that these factors appear to be suggestive of booster approaches quite different from those for missile applications where performance is of the essence and the designs must be light and efficient.

The development of satellite payloads for the Samos, Midas, and Discoverer programs represents the prominent portion but only one element of the system. A useful system must include the associated ground-based environmental facilities for payload development and checkout, the associated launch sites, the ground stations, communication nets, data reduction and data display equipment and, of course, competent trained personnel equipped and able to operate the system and extract from it the necessary information on a continuous basis. These areas are essential to a useful system; they are elaborate and expensive; they require adequate time for full implementation and must be planned concurrently with the development effort on the satellite system per se.

The Air Force continues to explore, in a vigorous fashion other systems and other areas than can enhance its capability to carry out its military mission.

We are involved in the study of both polar and 24-hour communication satellite systems, in the study of satellite inspection systems, and in the development of a national space surveillance and control system, in the development of various types of auxiliary power systems, including nuclear, solar, and chemical types.

We have recently initiated the development of a vehicle that has been called Dynasoar. The Dynasoar is designed to furnish information basic to the problems of controlled return and precise landing from orbital flight, a capability which we feel to be fundamental to practical militarily useful space flight.

The exploitation of the atmosphere for maneuverability and controlled landing will require the exploration of flight problems in the atmosphere at speeds up to orbital and altitudes up to the limit of the sensible atmosphere.

It is our belief that the knowledge gained through the Dynasoar program will provide a sound basis for the determination of the military importance of manned systems employing these principles.

I would like to dwell briefly on one additional point which I feel to be of very great importance in the understanding and appreciation of our various research and development and weapon system programs. I have endeavored to emphasize that the development of a complete operational weapon system involves many factors beyond the normal development programs. These include such things as personnel training, operational facilities, handbooks, spare parts, etc. The cost associated with these operational aspects generally are overwhelming as contrasted to development costs. Some or all of these operational aspects must be pursued as the development program proceeds if we are to expect operational employment at the earliest date.

Such a procedure, however, obviously involves major risks and uncertainties. Technical deficencies and obstacles can and probably will arise and these will have a profound impact on the operational date.

In each case, therefore, a keen sense of judgment is required to balance the importance of the job, the technical risks involved and the associated costs. A maximum risk program in all cases would be prohibitively expensive, wasteful, inefficient and the economics in turn would limit the number of developments that could be undertaken. A minimum risk program, on the other hand, which would delay all operational aspects until the technical system was completely proven out would result in unacceptably late operational dates and limited military usefulness.

In each case, therefore, we must endeavor to balance all of these factors and to arrive at an optimum solution in consonance with the military threat, the military potential, the military function to be performed and the demands of other phases of our total military program.

I would now like to refer briefly to one last point made earlier by the Secretary and to reiterate my own earlier statement in regard to the importance of complete coordination and cooperation at all levels between the Department of Defense and the National Aeronautics and Space Administration in order to insure the maximum benefits to both organizations. The traditionally excellent relationships between the USAF and the old NACA have been continued and amplified during our 1-year experience in working with NASA. We have entered into informal and formal agreements as required at all levels to insure a total cooperative and effective program. We are sure that problems will arise in the future, but are confident that they can be resolved by these mechanisms and that they would only be complicated and magnified if we were to attempt to resolve these through formally constituted bodies outside of the NASA and the DOD as has been suggested by certain people.

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An excellent example of the type of cooperation that exists and is effective is that associated with the Department of Defense support of Project Mercury. Interaction and assistance has been effected at all levels. Air Force management and technical personnel have provided NASA continuously with information and details on Air Force programs that would have applications to the Mercury effort. Air Force biomedical, technical, and parachute personnel have worked with NASA in project planning. Air Force aircraft have been either loaned to NASA or scheduled for its use in performing preliminary tests. A jointly prepared plan for the complete support by the DOD in the total program is in final stages of coordination and approval at this time.

In summary, the Air Force looks forward to the opportunity of continuing a vigorous exploitation of the fields of aeronautics and astronautics for the purpose of providing this Nation with the most advanced and effective tools for its defense. We are proud of the part which the Air Force has played in producing our present strength; the skills and the resources available within or managed by the Air Force we believe will continue to play a vital role in our national defense picture as we expand our activities toward the new horizons that have been opened up in the dawn of the space age.

The CHAIRMAN. Thank you both, gentlemen, for what I think are very fine statements. They are comprehensive, they are informative and they are very clear. It clears up in my mind some of the questions that I had thought that I would ask.

I will ask this: The Air Force is interested in how many space programs? I mean how many does the Air Force consider it has a mission to perform? You have the Samos, the Midas and the Discoverer. You also have the Dynasoar. That is four programs. Do you have any additional programs?

Dr. CHARYK. Mr. Chairman, we have various programs in the study phase. I indicated our interest in the communications satellite program, also in the satellite inspection program.

The CHAIRMAN. Are those under the Air Force as a special charge and responsibility of the Air Force?

Dr. CHARYK. No, these programs at the present time are under ARPA.

The CHAIRMAN. The ones that are directly under you are Samos, Midas, Discoverer, and Dynasoar?

Dr. CHARYK. That is correct.

The CHAIRMAN. Are there any others under you especially?

Dr. CHARYK. There are many minor programs relating to components and elements of the space mission but these are the major programs.

The CHAIRMAN. I will ask you as a general matter, do you have enough money to properly push the Samos, the Midas, the Discoverer, and the Dynasoar programs?

Secretary SHARP. I would say, Mr. Chairman, that we do have at the present time.

The CHAIRMAN. Do you have the amount of money which you requested initially, of DOD and the Bureau of the Budget, for those programs?

Secretary SHARP. I think we do. I think I might ask Dr. Charyk to elaborate on that a little bit since he was involved in this area primarily at the time of the formation of the budget.

Dr. CHARYK. The dollars requested in the budget by the Air Force for these programs are included in the budget submission which has been made to the Congress.

The CHAIRMAN. So your request was really fulfilled 100 percent?

Dr. CHARYK. That is correct.

The CHAIRMAN. Is the Air Force interested in the man-in-space program?

Dr. CHARYK. We are very much interested in Project Mercury. I did allude in my statement to our continuing contacts with NASA in regard to Project Mercury.

The CHAIRMAN. Is the Air Force sufficiently satisfied with the progress being made in that program, the Mercury program?

Dr. CHARYK. I think our general evaluation of the situation is that the program is proceeding at an optimum rate consistent with the technical risks involved.

The CHAIRMAN. Now, you are certainly interested in the one-and-a-half-million-pound thrust engine program, aren't you?

Dr. CHARYK. We are certainly interested in the development of the large booster. I should add, of course, although at the present time there is no military requirement for a booster of this size, I think it would be surprising if, as time went by, we did not actually develop a requirement for such a capability.

The CHAIRMAN. The potentialities are there?

Dr. CHARYK. I would certainly say so.

The CHAIRMAN. I think the additional funds allocated by the President would cover that program.

Dr. CHARYK. I think they would expedite the program to the maximum degree consistent with the technical problems inovlved in such development.

The CHAIRMAN. As I understand it, your relationships with NASA are satisfactory.

Secretary SHARP. Very satisfactory.

The CHAIRMAN. Let me ask you this, just to satisfy my curiosity: Were you personally, Mr. Secretary, or the Under Secretary, or, were Air Force representatives consulted in the preparation of the recommendations for revisions of the National Aeronautics and Space Act, and particularly the rewording of section 309? That is the part on coordination and cooperation.

Dr. CHARYK. I was personally involved in discussions with representatives of NASA in regard to this legislation.

The CHAIRMAN. You sat in on that?

Dr. CHARYK. There was a series of meetings with representatives of NASA which I attended and in which we suggested various suggested revisions.

The CHAIRMAN. Were the revisions which you have suggested placed in the measure presented to Congress?

Dr. CHARYK. Yes, sir.

The CHAIRMAN. Are you satisfied with the proposals in that bill?

Dr. CHARYK. I think that the bill, as submitted, is very satisfactory from our point of view.

The CHAIRMAN. Now, is that the view shared by the responsible officers generally in the Air Force?

Dr. CHARYK. I believe that there is general concurrence that the provisions of the act, as amended, are quite satisfactory. I am sure that various individuals might have some thoughts on minor rewording and so on, but I would say as far as basic principles are concerned there is general satisfaction.

The CHAIRMAN. The Project Dynasoar to which you have alluded, both of you, in your statements, is being developed by the Air Force. Would it be preferable for the early stages of that project to be handled by NASA rather than the Air Force?

Dr. CHARYK. Actually in this particular program we do have an agreement with NASA in regard to the program as a whole. NASA people are involved with us in the general planning of the program, and I feel that the relationship as it now exists is satisfactory from both sides.

The CHAIRMAN. Now as to the F–1 engine and the Centaur project, they were transferred to NASA. Was that agreeable to the Air Force that those projects be transferred to NASA?

Dr. CHARYK. I may say, Mr. Chairman, that in regard to the large engine, this certainly falls in a category where we did not have a military requirement, so I don't think that there was any concern about that transfer. There were certainly people in the Air Force who were less enthusiastic about the transfer of the Centaur project. The reason being that the Centaur as an upper stage on our present ballistic missiles provides a payload capability that is essential to certain military requirements.

So there were people who felt that in view of the military requirement for the capability that would be produced, for example, by Atlas-Centaur, that the program should continue to be controlled by the Department of Defense. This was certainly an issue upon which there was not unanimous agreement.

The CHAIRMAN. And there is no unanimous agreement as of this hour, is there?

Dr. CHARYK. I think that people are adjusted to the present situation. Actually we have a joint committee on Centaur with NASA. Air Force representatives sit on this committee. They continuously review the progress of the program, the funding, the development, so we feel that we have a satisfactory contact, and I personally am confident that our requirements will be adequately taken care of in the present arrangement.

I have no reason to object to the arrangements that now exist.

The CHAIRMAN. Mr. Fulton.

Mr. FULTON. I would like to yield my time since I might go over the 5 minutes. I will take mine later.

The CHAIRMAN. You mean at this time you will pass the five.

Mr. Anfuso.

Mr. ANFUSO. Mr. Secretary, I should like to get a yes or no answer from you on this question:

You have stated you see no military necessity for large boosters at this time. Wouldn't a landing on the Moon have military implications?

Dr. CHARYK. At the present time I don't think we could define a military requirement for a landing on the Moon. I think there are many more important military jobs.

Mr. ANFUSO. Do you foresee that large satellites in the future could be used as launching bases for attacks on the Earth?

Dr. CHARYK. That is conceivable.

Mr. ANFUSO. That would require large boosters; is that correct?

Dr. CHARYK. That is correct.

Mr. ANFUSO. Mr. Secretary, may I ask you if you agree with General Power's statement that we ought to keep our air bomber always aloft?

Secretary SHARP. Mr. Anfuso, I agree with him in principle. We are working toward the capability of having an airborne alert as we call it. I am inclined to believe that this will be necessary and an important part of our defense at some time in the future. It is a little hard to say at the present time accurately exactly when. I think we should go ahead vigorously in our preparation so we will have it available whenever we find that it is necessary.

Mr. ANFUSO. That doesn't coincide with the view of the administration, does it?

Secretary SHARP. Yes, sir; it does. We are preparing——

Mr. ANFUSO. I thought General Power was disagreeing with the administration in that respect.

Secretary SHARP. I think General Power would like to have a larger capability than the administration has announced it is in favor of at this time, or rather has budgeted for it.

We are studying the possibility of enhancing this capability within our present plans.

There are many things we think are possible to do such as better utilization of our overhaul facilities for, let's say, overhauling engines and overhaul them more quickly so we will be able to have more airplanes in the air.

We are investigating possibilities of enlarging our airborne alert capability.

Mr. ANFUSO. Mr. Secretary, I am not inclined to be critical, I am merely trying to get at the facts. I mean your statement and the statement of other witnesses who have appeared before this committee and before other committees of the Congress, I think have added to the confusion in which I find myself, and perhaps other members and people in general. Somehow there is no unanimity, there is no definite understanding of our goals. General Power and the White House disagree, and others outside the White House disagree.

We have two thoughts coming out here, one which says we are the strongest Nation in the world, and the other view is that we should tell all the people the facts.

I am inclined to believe we should tell the people the facts, because we are in serious danger; and if people know the facts I think they will press us here in Congress and press this administration or any other administration to make an all-out effort and the kind of an effort which Dr. von Braun testified here yesterday we are not making.

May I ask you this, sir: In order to get at these facts, at the present time do you think we are militarily stronger than the U.S.S.R.?

Secretary SHARP. I don't think there is any question about that.

Mr. ANFUSO. In giving that answer you are taking into consideration our air bombers, the Strategic Air Command, our Polaris submarine capability, as compared to what the Russians have in air power, submarines, and ICBM's; is that correct, sir?

Secretary SHARP. That is correct, sir.

Mr. ANFUSO. Will the situation in your opinion be the same in 1961?

Secretary SHARP. I think it will. I think it is quite possible that in 1961 there may be some numerical superiority in missiles alone between——

Mr. ANFUSO. On whose side?

Secretary SHARP. On the Soviet side.

Mr. ANFUSO. Tell me what will the situation be in 1962?

Secretary SHARP. I think in 1962 there may also be a numerical superiority. However, I don't think this offsets our superiority in other areas. In both those years, 1961 and 1962.

Mr. ANFUSO. You still think that in 1962 we will still have greater military strength in spite of the increase in the number of ICBM's which some persons have estimated may reach 1,000 in 1962 on the part of the Russians as compared to 150 or 300 on our part. Is that correct?

Secretary SHARP. Well, I have never heard those figures, but I would say that numerically there is a possibility that the Russians may maintain a numerical advantage which I don't think would be adequate to offset our other advantages, particularly in view of the fact that one item that General Power brought out but didn't stress was the fact of early warning. Now, we have two ballistic missile early warning systems in process of construction.

Mr. ANFUSO. Mr. Secretary, I don't like to interrupt you. I know about these early warning systems, but we won't have them in effect until about 1964.

Secretary SHARP. Oh, yes, sir, we will have——

Mr. ANFUSO. As far as ICBM's are concerned.

Secretary SHARP. Yes, sir; we will have one coming into effect this year. We have another one which will become operational next year. The third one which is going to be——

Mr. ANFUSO. We will have an effective antimissile missile by 1961?

Secretary SHARP. No, sir. I was referring to the early warning system. The ICBM early warning system known as the BMEWS, which will give us warning and which General Power said would be required before he would feel we could abandon an airborne alert.

Mr. ANFUSO. Which would be about 15 minutes, is that right?

Secretary SHARP. That is right. We have a standby capability of launching our bombers in 15 minutes.

Mr. ANFUSO. Supposing, Mr. Secretary, that our Air Force was not on the alert, was not in the air at a given time, and supposing at that time we had a surprise attack on the part of the Russians of, say, 300 ICBM's—like General Power mentioned, an attack of that nature—and our bombers were not in the air. Do you still think after the destruction which was meted out by these 300 ICBM's, that we would still be strong enough to retaliate and destroy Russia?

Secretary SHARP. I think we would be in a very vulnerable position if we allowed ourselves to be in a state where we were not on the alert where we even suspected that the Russians had that many missiles and could possibly fire them all in salvo, which they would have to do.

I think if we allowed that condition to exist and were not on the alert and did not have a certain number of our bombers in the air, if we did not have ballistic missile early warning already in operation that we would be in very great danger.

Mr. ANFUSO. You recognize the danger of that kind of surprise attack. What are we doing to try to prevent that kind of surprise attack from crippling the United States? A retaliatory attack?

Secretary SHARP. In the Air Force we are building the ballistic missile early warning system, half of the North American portion of which will be available a little later on this year. We also have a 15-minute alert of our bomber force at the present time and we are laying plans to actually—we are actually flying at the present time some of our bombers on airborne alert and training the whole fleet.

Mr. ANFUSO. I will finish now by saying, Mr. Secretary, I congratulate you for that effort. Would you agree with me that perhaps we ought to have other systems developed too by 1961 or 1962?

Secretary SHARP. I don't know what other systems it would be practical to develop in that time.

The CHAIRMAN. Mr. Bass?

Mr. BASS. I should like to pass for the present.

Mr. ANFUSO. I beg your pardon, sir.

Mr. BASS. I should like to pass for the present.

Mr. ANFUSO. I thought you said for the president.

The CHAIRMAN. Mr. Karth?

Mr. KARTH. Mr. Secretary, planning means careful calculation of first-strike capability and counterstrike capability, does it not?

Secretary SHARP. Yes, it does.

Mr. KARTH. Do we have a first-strike capability?

Secretary SHARP. I think it is our national policy that we will not strike first. I think there is no question but what we have a first-strike capability.

Mr. KARTH. My question is, Do we have a first-strike capability?

Secretary SHARP. I think we do, yes.

Mr. KARTH. In other words, do we have a first-strike capability where we can pinpoint and destroy all Russian targets from which they can retaliate; is that correct?

Secretary SHARP. I believe that is correct at this time; yes.

Mr. KARTH. Then we are not deterred in effect, are we?

Secretary SHARP. No, we are not deterred if you look at it that way. We are deterred by national policy but we are not deterred otherwise.

Mr. KARTH. This is something that possibly could be changed? At least it is the policy at this time and I am merely asking you whether or not we have this capability.

Secretary SHARP. Oh, yes.

Mr. KARTH. Do you think there is any possibility that our retaliatory power, such as has been suggested by General Power, could be destroyed on the ground within a 30-minute period?

Secretary SHARP. If all the hypothetical situations which General Power apparently outlined came to pass—in other words, if we had no warning, if the Russians had superiority in missiles while we had no warning and if at the time we had no airborne alert, I think that mathematically that his calculations are probably correct. They do not take into consideration, as I say, the introduction of the ballistic missile early warning system in the latter part of this year and the other half of it next year, with a third foreign portion coming in later, and they do not take into consideration the airborne alert.

His argument was one in favor of having an airborne alert, with which we certainly agree, that this is probably going to be an important thing.

Mr. KARTH. When do we expect to do this?

Secretary SHARP. There hasn't been a decision made yet as to when we intend to put it in operation. This will depend upon our intelligence and the operational reliability of the ballistic missile early warning system when it comes into operation. These are matters that have to do with the overall national intelligence as it is given to us from time to time.

Mr. KARTH. From what I have read of General Power's speech I feel he has painted a rather drab picture. And from what testimony we have received from Secretary Gates I feel that he painted kind of a rosy picture. Which one of these two do you prefer to agree with, or would you strike someplace in between those two?

Secretary SHARP. Well, I certainly think that ordinarily, and as General Power has stated, it is the duty of a commanding officer of a force such as SAC, to look at the blackest side of the picture and try to be prepared to cope with it. He has made this statement. I think that he has done just that. I think he has offered the sensible solution to this possibility that he holds out, that such a situation could exist. I think he does take the gloomier side. He gives no credence to the ballistic missile early warning system working. We have these types of radars, long-range radars in operation now in other parts of the world observing satellites and observing ballistic missiles. We know that they will work. We have no reason in the world to believe that the early warning system will not work and will not be reliable.

So that I think from these various angles that he is a little pessimistic. I would be more inclined to agree with Secretary Gates that if we do the things that we are planning to do that we will not be in danger.

Mr. KARTH. Even though this is rather a gloomy picture I suppose this is a fairly good position for a military expert to take, isn't it?

Secretary SHARP. I would think so. And it is not any gloomier a picture than we in the Defense Department have known about for a long time. We built our plans on the fact that this situation might possibly exist. This is why we are training for the airborne alert right at the present time. A training airborne alert at the present time.

The CHAIRMAN. Will the gentleman yield right there?

Mr. KARTH. Yes.

The CHAIRMAN. It is a case of a burned child dreading the fire. We have been stung one time that way and General Power wants to make sure we are not going to be hurt again that way.

Secretary SHARP. That is right, and I think this is probably the right attitude for a commanding officer to take.

Mr. KARTH. You think the administration is treating it with the same sense of urgency that General Power is treating it with.

Secretary SHARP. I don't think we look at it in the administration from quite as gloomy—not quite as dark glasses as he does, but I think we must face the fact that we have to be prepared to take care of contingencies of this kind, and we are taking steps in that direction.

Mr. KARTH. Do you think there is a possibility of Russia having 150 ICBM's and 150 IRBM's by the end of this year?

Secretary SHARP. Well, there is no intelligence estimate that indicates anything like that, as far as the ICBM's are concerned. I think it is possible that in the IRBM area, they might have this many, but in the intercontinental ballistic missiles there is nothing that indicates such a thing at this time.

The CHAIRMAN. Mr. Baumhart?

Mr. BAUMHART. No questions.

The CHAIRMAN. Mr. Hechler?

Mr. HECHLER. Mr. Secretary, I want to congratulate you for having an able and effective Under Secretary like Dr. Charyk. I hope you can bring more people like that into the Government.

Did you approve General Power's testimony yesterday prior to its being submitted?

Secretary SHARP. I did not; no, sir.

Mr. HECHLER. Do you now approve of it?

Secretary SHARP. Do I approve of it?

Mr. HECHLER. Yes.

Secretary SHARP. I think he was very candid in his statement. I think that, as I have said before, he is taking the position of a commander who must look at the darkest possible side of things so that——

Mr. HECHLER. I just hope this doesn't conversely mean that the Secretary of Defense and our civilian officials must put on rose-colored glasses. You mentioned that he ought to put on—that it is right for him to put on dark glasses, but I certainly hope this doesn't mean that you should put on rose-colored glasses in viewing our situation because I think this would be disastrous for the American people.

Secretary SHARP. There is no question about that. I think our glasses should be very clear.

Mr. HECHLER. I want to help you clarify a little some of your answers to Congressman Karth about first-strike capability. You say we can use first-strike capability. You state that we are deterred by national policy but that could be changed. You are not suggesting, are you, that this should be changed?

Secretary SHARP. No; I am not suggesting it should be changed. I say we have first-strike capability. If we have the capability of striking Russia at all we obviously have the capability of striking them first if we felt that was the thing to do.

Mr. HECHLER. What situation could you conceive of our using that first-strike capability?

Secretary SHARP. I would rather not comment on that because these are policies which are set at a much higher level than I am and I would rather not comment on the possibility.

Mr. HECHLER. You would conceive, though, that there is such a possibility, is that correct?

Secretary SHARP. There are possibilities for all things I suppose, and this would be included in them.

Mr. FULTON. Would the gentleman yield?

Mr. HECHLER. Gladly.

Mr. FULTON. Don't you think we should take that up in executive session? I think even refusal to comment has a certain implication.

Mr. HECHLER. I appreciate the gentleman's comment.

The CHAIRMAN. We will leave that to the Secretary as to whether he wants to take it up in executive session or——

Secretary SHARP. I would much prefer to take it up in executive session because this question has many ramifications.

Mr. HECHLER. I notice, Mr. Secretary, in your testimony you mention the requirement for coordination has been reduced while the quality and timeliness of our coordination has improved.

Whenever we have two agencies, of course, we need certain mechanisms of coordination between them, and this committee has been given a number of examples of the committees and other coordinating devices between NASA and the Defense Department.

Yet, the Under Secretary mentions, we do not view space to be a separate medium but rather, an extension of our previous horizons as a result of expanding technology, and also said that we may develop a requirement, a military requirement for a booster in the future.

I can't quite get it through my thick head why we wouldn't move forward much faster in this country if the space and missile programs were under a central leadership where you wouldn't have to say, button, button, who's got the button, and pass the responsibility back and forth.

Wouldn't this provide a greater leadership for the entire program in the interests of our national security?

Secretary SHARP. I think it would be dangerous to have it under a single head because of the difference in the basic responsibilities between scientific space exploration as such and the military responsibilities of creating military weapons systems.

I am afraid if we had the whole of the project in the military, we probably would feel that our military portion of it was so important that we might neglect the scientific exploration and I think conversely it might be true if it were under some civilian agency that it might become so interested in the scientific exploration that they would ignore, or downgrade the requirements for military defense. I think it is a better apportionment of the plan the way it is.

Mr. HECHLER. I would not go as far as General Medaris does to say it ought to be in a single agency under military leadership, but I do believe we have some good examples in our history, and in current operations such as the Atomic Energy Commission with a military applications division, which I think makes a lot of sense.

Secretary SHARP. We have some examples of it having worked. In this particular case with the Air Force background, let's say the Defense Department background, that we already have developed and our capabilities that we already have developed in the area of space exploration, for military purposes, I think the situation is a little different.

With the Atomic Energy Commission no one else had the information. They had all the knowledge. In this case the military has a large proportion of the knowledge and I think we should retain the active interest in following up the military programs because of this.

We might not put sufficient emphasis on the purely scientific ones if we had both those responsibilities as suggested by General Medaris.

The CHAIRMAN. Mr. Riehlman.

Mr. RIEHLMAN. No questions at this time.

The CHAIRMAN. Mr. Daddario.

Mr. DADDARIO. If the early warning is effective in 1961, what will it allow the Air Force to do?

Secretary SHARP. It will give us a 15-minute warning and allow our normal ground 15-minute alert to take effect and get our airplanes in the air before the missiles strike.

Mr. DADDARIO. And what happens to the civilian population during——

Secretary SHARP. The same thing that happens to them that would happen if we had no warning because we have no antimissile missile system yet that is satisfactory to stop a ballistic missile.

I suppose if we could get a little warning, maybe some people could take over. Fifteen minutes is not much time.

Mr. DADDARIO. But to all intents and purposes, the civilian population would be at the complete mercy of the missile attack?

Secretary SHARP. I would say so. I don't see how they can do anything but take the 15-minute warning period and try to take cover the best way they can.

Mr. DADDARIO. Then we would have a situation, would we not, with the Air Force being able to get off the ground, with the pilots knowing that the country would be pretty well destroyed, that they would be going off to retaliate against an enemy and probably have no place to come back to?

Secretary SHARP. You see, I think in this kind of talk we rather lose track of what the Strategic Air Command and the Defense Department as a whole is trying to do. It is trying to create a situation in which an enemy such as the Soviet Union might be, would not dare to strike us with their missiles because they would know that they were inevitably going to be hit so hard in retaliation that it would be suicide for them to try.

This is our whole principle of deterrents. Now, if the deterrent principle fails even though we convince them they are going to be destroyed, and if they take the irrational action to attack us, I think the consequences would be very dire, but there is not much that we can do about that situation at this time except to keep our deterrent strong enough so that we are convinced that no rational person would dare to attack us in view of the consequences to himself.

Mr. DADDARIO. Well, of course, we all understand, Mr. Secretary, that is the aim and objective stressed often enough, but it does not preclude the possibility, does it, that there are other alternatives in the minds of military people which could allow them to launch such an attack and if they felt that they could knock down enough of our aircraft by ground-to-air and air-to-air types of defenses which certainly we feel we have a capacity for, that it could minimize the blow, whereas missile for missile, we probably could not knock down one missile in 1961 and there would certainly be a given amount of attrition, would there not, to our attacking force?

Secretary Sharp. We know we haven't a capability of knocking down ballistic missiles coming in, if that is what you are referring to.

Mr. Daddario. How about the capacity of the Russians in 1961 insofar as their ability is concerned, to knock down attacking aircraft?

Secretary Sharp. General Power, who is, of course, the commanding officer of the Strategic Air Command, has stated unequivocally that his bombers can do their job if they get off. I can't go into details as to how he thinks this out at the moment, except perhaps in executive session, but he unequivocally states that he can retaliate if he gets his bombers off.

Mr. Daddario. And you will have your own ideas on that which you can give us in executive session as well?

Secretary Sharp. Yes, sir.

Mr. Daddario. One last question, Mr. Secretary. On your last page you say, "We are firmly convinced that the division of responsibility between the Department of Defense and NASA is proper and we know that we can continue to work with NASA for our mutual benefit," et cetera.

Do you also carry that out so that there is a proper division of responsibility between the various services within the Department of Defense, that they get along mutually as well and there is no conflict between them?

Secretary Sharp. Naturally in the various services each is a little bit prejudiced as to his own service. I think that unquestionably with the overall control under the new Reorganization Act, that we are progressing very rapidly and satisfactorily in the direction of a tighter unification of our efforts, let's say, rather than unification of our individual services. I think great progress has been made and is being made in this direction.

Mr. Daddario. You don't get along as well within the Department of Defense as you do with NASA?

Secretary Sharp. I think we get along very well in the Department of Defense. People have different ideas. Certainly we get along well with NASA because as I say, we have worked with that organization satisfactorily for a long time and we both have exactly the same objectives.

The Chairman. Mr. Chenoweth.

Mr. Chenoweth. Mr. Secretary, you feel then that there is a pretty good balance between the civilian and military uses—space programs, today? That is the impression I get from your——

Secretary Sharp. I do, yes, sir.

Mr. Chenoweth. You feel we are not devoting too much emphasis to one or the other?

Secretary Sharp. I feel that adequate emphasis is being devoted to both of them. Certainly we have adequate emphasis in the military on what we conceive to be the military hardware that we need at this time and I am sure that NASA feels satisfied with the emphasis that is placed on their scientific program. We hope, of course, that it develops rapidly so that if anything falls out of it that is useful to us in a military way, that we can take advantage of it, which I am sure we will.

Mr. Chenoweth. What we are spending for NASA then is not retarding the military development of the missile?

Secretary SHARP. Not in the slightest. Not in the slightest and I would say, on the contrary, what we are spending with NASA will in the long run be very beneficial to the military.

Mr. CHENOWETH. This is a very controversial subject these days, as to just what our defense posture is.

Now, as Secretary of the Air Force, do you tell this committee that in your opinion, the Air Force is ready to do its part in the case of any emergency which should develop, that it will be ready to take care of itself?

Secretary SHARP. I can say that.

Mr. CHENOWETH. Without equivocation?

Secretary SHARP. Without equivocation or hesitation and I think the programs we are embarked on will assure us that this situation will continue to exist.

Mr. CHENOWETH. The Air Force has been developing this program over the years and you feel you will be capable of delivering the striking blow and retaliation which is probably holding the enemy off at this time because he knows of that force which we do have?

Secretary SHARP. I think our deterrent posture will continue to exist in adequate degree.

Mr. CHENOWETH. You don't subscribe to the theory, then, that we are a second-rate nation, today?

Secretary SHARP. I do not.

Mr. CHENOWETH. I am happy to hear you say that. Neither do I. Thank you, Mr. Chairman.

The CHAIRMAN. Mr. King.

Mr. KING. Mr. Secretary, under your early warning system which you say will be operational at least in part by September and further extensions of it later, under that we would have presumably 15 minutes warning?

Secretary SHARP. Yes.

Mr. KING. Would we be able to get an ICBM into the air within that 15 minutes?

Secretary SHARP. Yes, we will. We have plans to have a substantial portion of the ICBM force on 15-minute alert at all times.

Mr. KING. Would that be the Minuteman, essentially?

Secretary SHARP. Not only the Minuteman, but our Atlas and also our Titan that is coming in. The Minuteman is an easier system to keep on a very short alert. It can probably be kept on shorter alert time than either of the other two systems.

Mr. KING. Do you mean you can get Atlas and Titan into the air in 15 minutes?

Secretary SHARP. Yes.

Mr. KING. I thought it took hours to fuel them up?

Secretary SHARP. The part we keep on 15-minute alert can get into the air in 15 minutes.

Mr. KING. Do I understand a certain portion of them would be fueled at all times ready to go?

Secretary SHARP. Yes; this is the plan.

Mr. KING. Is it classified information as to just what number of ICBM's we have operational at this minute?

Secretary SHARP. I would say that this is classified information.

The CHAIRMAN. We will take that up in executive session.

Mr. KING. That is all I have.

The CHAIRMAN. Mr. van Pelt.

Mr. VAN PELT. No questions.

The CHAIRMAN. Mr. McCormack.

Mr. McCORMACK. I am going to ask you questions on another subject: You have seen the new bill amending the NASA Organic Act.

Secretary SHARP. Yes, sir; I have.

Mr. McCORMACK. Addressing yourself to section 309, is the Air Force satisfied with that language?

Secretary SHARP. Yes, sir. I think we are greatly satisfied. Dr. Charyk said a moment ago he was involved with NASA in drawing up these slight changes to the act. I think on the whole the Air Force is thoroughly satisfied with those amendments. I think some in the Air Force might have certain wording they would like to have clarified a little and I think probably they will discuss this with members of the staff but basically we are satisfied with it.

Mr. McCORMACK. Now, you say you might have some wording to clarify. Can you give us any indication as to what that might be now?

Secretary SHARP. I don't know about the details of that now. It would only be in clarifying wording so that the intent which we know exists is perfectly clear without any possible ambiguity. In the minds of some of our people there are some slight changes that might be advantageous. I think, however, they would be satisfied with the present wording although I think they would like to suggest some changes to the committee, sometime.

Mr. McCORMACK. To establish more definitely the original jurisdiction of the military in the field of research?

Secretary SHARP. I don't understand that question.

Mr. McCORMACK. To establish more definitely the jurisdiction of the Defense Department in the field of research?

Secretary SHARP. I believe Dr. Charyk might answer that better than I because he was intimately involved in drawing it up. However, I think we feel generally in the Air Force that the division of responsibilities as set out are certainly adequate as far as we are concerned.

Mr. McCORMACK. I understand the word "generally" has a very broad—could be applied very broadly. I can understand where you might in principle agree to something.

Secretary SHARP. I think we agree with the intent—I don't think there is any question but what NASA and the Defense Department agree completely on the intent of these amendments to the act as being perfectly satisfactory to both parties. As I say, there are some elements who feel certain words could be made a little clearer but they are not terribly worried about it and would like to make some suggestion to the staff of this committee.

If you would like to hear more from Dr. Charyk on the details I am sure he can tell you more about it because he was in on drawing these up.

Mr. McCORMACK. I don't know how much we are going into that.

The CHAIRMAN. We are going into it in a general way. Later on we will take it up in detail.

Mr. McCORMACK. Then I will wait until later on to take it up.

How are you going to determine what is military and what is the peacetime use? I can understand appliances, now, but it is difficult for me to separate research from the development aspect. Who is going to determine what is military and what is not?

Secretary SHARP. I don't think this will be difficult when we are able to arrive at a military requirement, let's say, for the larger booster that is coming along. When we are able to definitely say that we need this booster for certain military requirements to lift a certain sized thing into orbit I don't think we will have the slightest bit of trouble in establishing the fact that we need it.

Mr. McCORMACK. I will pursue it later. I was chairman of the select committee and I think I know the views of the members of the select committee and without regard to party we all react unanimously. We were very strong for NASA but we thoroughly appreciate in the world of today the importance of preservation of our country and in turn how vital the preservation of our country is connected with our defense and our Military Establishment.

With that broad statement, I would like to have any amendment considered from that angle. At least for one, in the world of today I am not downgrading the military. If anything I am emphasizing the military because I know some military benefits come slowly but I think we should do those things that will assure the very thing you said; a deterrence that will probably cause evil minds to rationalize where their own self-preservation is involved.

Secretary SHARP. I think this act certainly is conducive to exactly what you say. I don't think we have——

Mr. McCORMACK. We thought we did last time, but we found the construction was somewhat different when it got to the executive level. I have no further questions. I just wanted to give that broad observation. I want you to realize this committee appreciates the significance and importance of preserving our country and that that depends upon our military.

The CHAIRMAN. Mr. Fulton?

Mr. FULTON. I wanted to agree with the gentleman from Massachusetts, Mr. McCormack, to say we had worked together. I was one of the members working under his leadership as chairman of the Select Committee. It was a united effort and I think under his leadership it has advanced the space programs of the country very much to have had that kind of a broad statesmanlike approach.

I am interested, as you know, in trying to advance the programs. I am one of the eager beavers on space, I guess, and I am interested in seeing that there be as broad a base for development as we can get. That means I am interested in seeing that there might be competitive systems.

For example, we have Von Braun's system, the Saturn rocket, and you people also have your Hound Dog engine that you use on your long-range missile, your air-to-ground missile. I think you call it the plug nozzle engine, where you have fuel put in on the rim of an inverted cone and then the exhaust pushes out at the tip.

I understand there is great possibility that that might be maybe 50 percent more efficient than our current rocket engines. Would you comment shortly on the possibilities of developing that particular engine as an alternative system to the Saturn booster, because if you can get a 50-percent increase through a different configuration and through a configuration you already have on a small level, a 20,000-pound-thrust level, in operation, why don't we go ahead with something with your people on that?

Secretary SHARP. I think I will have to ask Dr. Charyk to answer that because the question is highly technical and he would have to comment on that.

Dr. CHARYK. I agree with you, Mr. Fulton, that the plug nozzle concept has very many attractive aspects. As a matter of fact, that particular approach was one of the things that I had in mind when I made reference in my statement to the fact that some of the rocket approaches that are attractive from a military applications point of view, are not always the same as exist in the case of missile applications, for example.

Mr. FULTON. Could I ask you, do you already have that under research and development with the Pratt & Whitney Division of United Aircraft, or are you just simply making the Hound Dog engine there, without doing any development on it with this possibly in mind, to get up to a million and a half pound thrust?

Dr. CHARYK. We are in the process of trying to firm up an actual development program which would incorporate this concept in an actual rocket engine.

Mr. FULTON. What would be your forecast of time, on such an R. & D. program?

Dr. CHARYK. We are trying to combine the introduction of this particular idea with several other ideas that we think are important to boosters for military space applications, and we have actually requested details of a development plan which is being prepared at the present time.

Mr. FULTON. Would you put a statement in the record on it, and I would like to have it correlated with the Saturn program, on time.

Dr. CHARYK. I will be very happy to do that, Mr. Fulton.

(The information requested is as follows:)

The plug nozzle engine principle has been investigated for the past few years by at least three major rocket engine contractors. The principle consists of the use of annular combustors, suitably subdivided into segments, which are then combined with an isentropic plug nozzle to form a rocket thrust chamber assembly. This assembly is then mated to conventional gas generators, pumps, valves, and controls to form a rocket engine. In contrast with the conventional rocket engine, the annular combustor, characteristic of the plug nozzle engine, would permit the development of a segment of the engine, thus simplifying the testing phase and reducing facility requirements. There is the further advantage of an inherent flexibility in engine sizing. Using one segment as a building block, it appears possible to arrange appropriate numbers of segments circumferentially about one plug nozzle to produce, within limitations, engines of different thrust sizes with minimum time and effort.

It is generally assumed that the plug nozzle engine will be technically competitive with conventional rocket engines as used in the Saturn booster. There exists the potential of a small increase in total impulse over the mission trajectory because of the variable expansion ratio characteristic of the plug nozzle. Except for the nozzle and combustors, the components are virtually the same for the plug nozzle engine as they are for the conventional liquid rocket engine. However, because of the manner in which these components are arranged, the plug nozzle engine is most conveniently adapted to large diameter boosters.

The meager inventory of design information relating to annular combustors, cooling, and thrust vector control, and the possibility that unforeseen development problems may arise indicate that a longer time would be required to develop an acceptable plug nozzle engine than that required to cluster existing proven engines for the Saturn booster. It is estimated that a minimum of 4 years and $150 million would be required to develop an engine in the 1,500,000-pound thrust class.

The Air Force is planning to activate a program aimed at the exploitation of the plug nozzle concept for rocket applications.

Mr. FULTON. In your statement at page 1 you say:

In this endeavor we also feel the responsibility to utilize to the fullest the information being developed by other agencies and departments of the Government.

Now, the converse of that ought to be true, too. You should feel the responsibility to give information to the other agencies of the Government.

Dr. CHARYK. I would agree.

Mr. FULTON. And is that the case in the other services, for example, the Navy? Do they get the fullest information from you?

Dr. CHARYK. I believe that our record is fairly good on that point. We try to keep them informed of our various development efforts and our plans.

Mr. FULTON. So you feel the relations are satisfactory and this so-called rumor about the Navy's part out in California at the Vandenberg Base in California—there is no real dispute out there, is there?

Dr. CHARYK. I don't believe there is any real dispute as such. Actually we made a presentation to the Navy sometime ago as to our general thoughts in the space program.

The difficulties, if you want to describe them as difficulties at Arguello and Vandenberg have dealt with rather minor things which have been resolved after discussion.

Mr. FULTON. So there is no real difficulty then with your Dynasoar problem and the Navy probably through its OPS-54 program?

Dr. CHARYK. I actually do not know of a Navy program that would be competitive with Dynasoar and the Navy is certainly familiar with what we are planning in the Dynasoar area.

Mr. FULTON. They have a manned maneuverable space program designated as OPS-54 and it was first outlined generally in the Connolly report.

Dr. CHARYK. I think this relates to certain studies the Navy has made. We have received copies of the Connolly report. I think this relates to certain studies the Navy has made. We have received copies of the Connolly report. I think all of the services continually make studies on various possibilities.

I do not believe that there is an active program along these lines.

Mr. FULTON. On your statement you have said on page 2:

The Air Force had a long and fruitful intimate association with a predecessor organization, NACA.

And then you say:

We view our responsibilities to be the full exploitation of technology for the development of systems to enhance our military capability and strength. We do not view space to be a separate medium, but rather an extension of our previous horizons as a result of expanding technology.

And then you say:

The expansion of our horizons to include space also permits development of the capability to carry out functions of military importance that we believe can be done in other ways.

And then you say:

> It is our responsibility to utilize to the fullest whatever means are best for the fulfillment of our defense responsibilities.

I think that you could rewrite that so you don't start off with the contention of the Air Force and you might make the other services a little more happy. I think they think you are preempting the field completely. I have always enjoyed Mr. McCormack's reference to the word "aerospace" that you people have manufactured——

The CHAIRMAN. It is a good word.

Mr. FULTON. That pretty well puts under the Air Force everything from the surface of the land, out.

Dr. CHARYK. I think we recognize, Mr. Fulton, that there are important military requirements for all three services using the space medium. I might cite, for example, the Transit program, the navigation satellite for which the Navy has responsibility.

Mr. FULTON. I might say to you, with regard to jurisdiction, our national policy is that we are to go into space for peaceful purposes, that space is open to everybody.

At one point you use the old military idea of the mastery of space. Now, under no context could it be felt that we are in a race into space for the mastery or the control of space.

The CHAIRMAN. Let me suggest to the gentleman there that we had in mind going into executive session at 11:30. Yesterday we missed the opportunity to go into executive session with Dr. von Braun. I have two more members I haven't recognized.

Mr. BASS. Mr. Chairman, I have one or two questions.

Mr. FULTON. * * *

The CHAIRMAN. I haven't checked the time.

Mr. FULTON. * * *

The CHAIRMAN. I have appointed the gentleman to check the time on all of us. Of course, when he is questioned, he can't check his own time.

Is the gentleman finished?

Mr. FULTON. * * *

The CHAIRMAN. Will you answer the question?

Dr. CHARYK. The connotation that I had in mind in the use of the particular words there, when I referred to mastery, was mastery in the sense of being able to operate in the media, solving the technical problems associated with operating in that environment.

The CHAIRMAN. Mr. Teague.

Mr. TEAGUE. No questions, Mr. Chairman.

The CHAIRMAN. Mr. Bass.

Mr. FULTON. * * *

The CHAIRMAN. Well you know the rules, there.

Mr. BASS. Mr. Secretary, I would like to refer back again to the statement made by General Power to which some of my colleagues have referred earlier this morning.

What I have to say, I would like to make clear, in no way do I question General Power's integrity or his loyalty. But it seems to me, he is being a good advocate of his part to get a bigger slice of the pie. He doesn't have the overall picture which the Secretary of Defense or the President have in relation to our overall deterrent power, and that is to my mind what counts.

For instance, I didn't see in his statement anything more than a very minor passing reference to our Polaris submarine and the Polaris missile. Would you comment on that? Do you agree in general with what I say, or not?

Mr. SHARP. Yes; I do. I think this is a natural tendency in commanders. I think we would find the same thing true in the Air Defense Command and the Tactical Air Command, and the Navy and Army. Each one feels that since he only sees his portion of the picture, as you pointed out, that he could do better with a little more and would like to have a little more.

I think it certainly is true when you take the whole concept of deterrents and national defense considered as a whole, you have a different picture than when you are looking at only one segment, as General Power is looking at it.

We have various bodies constituted to look at the overall picture including the Joint Chiefs of Staff. I think the Secretary of Defense, advised by the Joint Chiefs of Staff and the President advised by the Secretary of Defense and the Joint Chiefs of Staff and the Security Council have a better opportunity of looking at the whole picture including the Polaris submarine and the aircraft carrier strike forces and the deployment of intermediate range missiles in the hands of the British, for instance. In Europe we have many facets to our overall defense picture and I think only the people who see the overall can come to sensible conclusions.

Mr. BASS. I am very glad to hear you say that, Mr. Secretary. I certainly agree that the people of this country ought to get the facts on our defense situation, but I abhor these statements and implications that we are a second-rate power now or that our program is such that we will be in the next year or two.

Secretary SHARP. I agree with you. I also deplore the impression that is given.

The CHAIRMAN. Mr. Quigley?

Mr. QUIGLEY. No questions, in the interest of getting into executive session.

Mr. FULTON. I have one more qeustion.

The CHAIRMAN. Mr. Quigley waived his question so we could go into executive session.

(Whereupon, at 11:30 a.m., the committee proceeded in executive session.)

[EXECUTIVE SESSION]

REVIEW OF THE SPACE PROGRAM

WEDNESDAY, FEBRUARY 3, 1960

House of Representatives,
Committee on Science and Astronautics,
Washington, D.C.

The committee met at 11:30 a.m. in executive session, Hon. Overton Brooks (chairman) presiding.

The Chairman. The committee will come to order.

Mr. Secretary, we are very anxious to talk to you in executive session. Yesterday we were anxious to speak with Dr. von Braun in executive session. We let it go over until the afternoon, and we missed him entirely. He had to go to Canaveral last night, and we missed him. We don't want to miss this opportunity with you.

Mr. Fulton is very anxious to ask you a question.

Mr. Fulton?

Mr. Fulton. I have been one of those who for about 3 years has been talking about the strategic difference between knocking down missiles and intercepting them, or simply affecting their velocity, either slowing it, keeping it the same, or increasing their velocity, or diverting their guidance control so that they go off course.

Now, I have talked a good bit about energizing, maybe, from beneath the missile, or from the rear, and I have asked why we don't have such programs. Now I find, through Mr. Teague yesterday, that there is actually such a program that is in concept and has been started on research and development, although I have been given no particular notice of it at any time. And I have said this at many, many hearings.

And, secondly, I further understand that the program is now in the process of being blocked. When that situation exists—and I think it is such a fine research and development field as an alternative to Nike-Zeus, which everybody admits can easily be saturated, and nobody even claims complete coverage for—why has that situation arisen?

A part of the question I had this morning was, Are you open with the other departments of Government?

Honestly, with me on this, somebody should have come to my office, or somebody should have said, along the lines that you are talking, "Yes; we have a practical program"; and if there is a dispute over it, which I understand there is, this committee should have known about it first, rather than find out through private sources.

Would you comment, Mr. Teague, if you would like?

Mr. Teague. Dr. Charyk, the program he is talking about is one that VARO in Dallas—is there a Dr. Ruina under you someplace?

STATEMENT OF HON. JOSEPH V. CHARYK, UNDER SECRETARY OF THE AIR FORCE—Continued

Dr. CHARYK. Yes, sir; there is.

Mr. TEAGUE. I don't know whether you have been familiar with this or not.

Dr. CHARYK. Yes, I have been familiar with this particular effort.

Mr. TEAGUE. I understand you have put study money into it, but you have closed it down to a great extent. In other words, money was in the appropriation for this last year, but somebody along the line decided not to use it.

Dr. CHARYK. I think I could clarify this situation: The idea to use energy sources for the destruction of incoming ballistic missiles is an idea that is not a new one. It has been studied for a good many years.

There are major technical difficulties involved. We have endeavored to review during the last few months the complete technical situation and try to determine the critical problems on which efforts should be pursued in order to determine once and for all whether the idea can be exploited or not.

The result of this deliberation has been to come up with a research and development program that addresses itself to the major technical uncertainties that exist in regard to the concept.

It is true that certain individuals had requested funds to proceed with a complete facility. We felt this was premature until we had pinned down in a better fashion, some of the major technical uncertainties and to my knowledge, the program is being funded at a maximum level consistent with the technical state of the art.

I may add that in order to be sure of our ground, we actually set up a special scientific advisory committee to help us in looking at the overall effort——

Mr. TEAGUE. Who advised you to go ahead?

Dr. CHARYK. Who advised us to pursue just the type program we are pursuing?

Mr. TEAGUE. That isn't the information I have.

Dr. CHARYK. I think it would be possible to make available to you the report of the scientific group that looked at this particular thing.

Mr. TEAGUE. Mr. Daddario and I saw this thing in Dallas and we asked these people to show it to the committee yesterday and that is how it was shown.

We have now asked Chance Vought to show their proposal on a nuclear-powered missile in which you people are very active. But that is how this thing came before the committee.

Dr. CHARYK. I think it would be of interest to you to actually see the review of the program by the Scientific Advisory Committee.

Mr. ANFUSO. I am also interested in this project. Would you give me that opinion of the Scientific Committee that you speak of?

Dr. CHARYK. I would be very happy to.

Mr. ANFUSO. You also mentioned that at the present time you are studying some major technical difficulties; is that right?

Dr. CHARYK. That is right.

Mr. ANFUSO. Do you expect to have a report on that soon?

Dr. CHARYK. Well, the program is being activated and we will, of course, keep in close touch with the program to see how the problems are being resolved and it is our intent that if there is promise, to step up the program accordingly.

The CHAIRMAN. Mr. Secretary, too, I sent a man over this morning to the Air Force to talk to you about a program he has of using natural gas to get these missiles out of the well, or out of the silo they are in, and get them up in the air. I am no technical man and there are not many on the committee who are technical, but his reasoning seemed to be good. He thinks the Air Force can save a lot of money by the use of natural gas to get the missile started before its actual flight.

Could that be looked into?

Secretary SHARP. We would be interested in looking into that.

The CHAIRMAN. Mr. McCormack suggests coal, too.

He didn't suggest coal, but if coal could be used, that would be all right.

Mr. FULTON. Could I just finish on this one point, Mr. Chairman: Would you include a broader statement in the record on this history on the item we are interested in, bring it up to date and give us the projection for the future?

Dr. CHARYK. I would be very happy to.

(The information is classified.)

Mr. QUIGLEY. I think the members who sat in on this briefing yesterday were quite impressed. We recognize it is, in their words, a gamble, a calculated risk.

You say that the program—you said here today that the program was being activated. That if it shows promise it will be moved forward. Now, it was my understanding on the basis of what we were told yesterday that the budget for the current year provided for some $10 million that was to be used for the construction of this facility to be erected out at Yucca Flats, at Indian River Air Force Base, which is not now being used, and the decision was long since made in the Air Force to go ahead on this project. Congress voted the money and everybody approved it, but somewhere along the line someone or a few persons have just said, "Let's not. Let's wait a while."

Dr. CHARYK. Actually this particular item falls within our applied research program which includes several thousand projects. This program experiences continuous changes as we go along.

It is true that the group that was concerned with this particular effort recommended going ahead with a facility. This is what led to the review that I made reference to, the review by the Scientific Advisory Board and we are essentially, to my knowledge, implementing the spirit and the recommendations of this group.

Mr. QUIGLEY. May I ask when that review was made?

Dr. CHARYK. It was made in the last few months.

Mr. QUIGLEY. Subsequent to congressional action and the appropriation for the money to build the facility?

Dr. CHARYK. I think it is true that the money wasn't explicitly marked out for this particular item. This comes under the applied research program and it is true, of course, that the total dollar amount there was authorized by the Congress and is being used for applied research.

Mr. QUIGLEY. Well, like the other members, I think we would like to have as much information on this as we could possibly get. This appears to all of us, as laymen, as one of those areas where maybe we ought to take a gamble.

Dr. CHARYK. I think I should also add that our activity here is really a supplement to work in this area being undertaken in the Advanced Research Projects Agency. In other words, it has been our judgment that augmentation beyond the ARPA effort was desirable and this has led to the program to which I referred.

The CHAIRMAN. Let me suggest this: I was impressed too by the demonstration yesterday of these people, and I hope the Air Force will not likely turn aside their request for investigation.

Now, it is 11:45. If we are going to get anywhere with the Secretary in executive session I suggest we proceed.

Mr. Secretary, can you tell us here in executive session what really is the situation in reference to the capability of the Air Force in contrast with Russian capability and what is the situation in reference to the missile program in contrast with the Russian missile program?

You said you had confidence in General Power. He is a great officer and a great American. I have confidence in him, but now what is behind all this?

Will you tell us in executive session or if you have any other statement you want to give us in executive session?

STATEMENT OF HON. DUDLEY C. SHARP, SECRETARY OF THE AIR FORCE—Continued

Secretary SHARP. I don't quite understand what you mean by what is behind it all, other than that General Power stated a hypothetical situation that he said could come about and that he was worried about it unless we did certain things. Unless we got an early warning system, unless we put our bomber fleet on an airborne alert as he suggested, that we might be subject to the kind of attack that he was talking about at some period in time.

In one of his speeches he mentioned a period of about 2 years hence, in his second speech. In his first speech he didn't indicate any time element.

As I say, these are not new considerations for the Defense Department. We have realized for quite some time that we have had to prepare ourselves for an airborne alert so that if things looked as though they were tending in this direction, that, as General Power indicated, we could do something about it.

We are moving and we have been for some time moving in the direction of training and buying spare parts for an airborne alert.

The CHAIRMAN. If you have any general statement you want to give us in executive session, we would like to have it.

I would like to also note in the projects which you referred to in your opening statement—are we properly funded on those projects to push them ahead with the utmost practical speed?

Secretary SHARP. I think we are; yes, sir. I think it is generally agreed in the Air Force that we have sufficient funds to move these forward as rapidly as it is technically possible to move them.

If we find later on that they can be moved forward more rapidly than we now suspect, I am sure we will request of Congress some additional funds for this purpose. If it seems advisable, that is.

Mr. ANFUSO. Would you yield, Mr. Chairman?

The CHAIRMAN. I yield.

Mr. ANFUSO. Mr. Secretary, I want to sincerely congratulate you for your honest and forthright statements.

I have made the statement I have made because I sincerely fear the trouble we are in.

Isn't the whole trouble—rather, doesn't the whole trouble lie in the fact that the administration—I am referring to any administration—the administration says, "Here, all that you can spend is $40 billion for defense. You fellows in the Air Force, you in the Navy and the Army, you just fit yourselves under that."

Now, as a result, you in the Air Force have to skimp a little. You may have some projects that you think will make us more secure, but you have to just lay them aside and take others that you think you can pass or get through.

Isn't that really the whole trouble?

Secretary SHARP. Well, I wouldn't say—I wouldn't put it that way. I would say it is the responsibility of any administration to afford us with an adequate defense system at as reasonable a cost as it seems sensible to provide it with.

If we accumulated all the desires of all the commanders in all three services and in the fourth service, the Marines, and put them all together, we would have a fantastic figure. The only practical way that I can see of arriving at something that seems to be reasonable is to give us in the departments a general mold that they would like to have us put our portion of defense into. The mold must necessarily be tighter than what everybody wants or we won't exert the kind of decisionmaking effort that is necessary to be made to try to keep the things within the bounds of reason economically.

Now, when we get through with trimming and cramming everything we can into the mold and exercising all of the economies that we can uncover in our services—and we continually find them when the pressure is great enough, that we can do without some things that were really not necessary at all—after we do all this and get the product in this mold we turn it over to the Secretary of Defense and the Joint Chiefs, and finally the President and the Security Council. Then I think they have to look at the product of this mold and say, "Is this an adequate defense?" If it is not, I think they would come back and say, "No, we haven't an adequate defense. I guess we will have to enlarge the mold."

But certainly so far it seems to me we have been able to hold the expense of our defense within the bounds of reason through this process and I don't know of any other process that would work.

I am sure that if the Joint Chiefs and the Security Council and the Secretary of Defense all advised the President that the product of this mold is not adequate, that he would relax the size of the mold, but I don't know how we could ever arrive at the kind of a product that we try to turn out unless you go at it that way. I know of no other way to go about it.

Mr. ANFUSO. General Taylor was Chairman of the Joint Chiefs of Staff, wasn't he, for some time?

Secretary SHARP. No; he wasn't chairman.

Mr. ANFUSO. What was his capacity?

Secretary SHARP. He was the Army Chief of Staff on the Joint Chiefs.

Mr. ANFUSO. Anyway, if that was his criticism, what I just said—and he said we would require $55 billion to $65 billion to really put us ahead of the Russians, that is in the book. You have read his book, haven't you?

Secretary SHARP. Yes. That is his opinion. It isn't agreed to by a lot of other very knowing people.

Mr. ANFUSO. We have asked that question of the Joint Chiefs of Staff many times and the answer is, "The administration says, 'all you can spend is $40 billion and you boys come under that.' "

Secretary SHARP. They have given us money for an adequate defense—I say apparently we have been able to come up with a product out of this mold which satisfies our leaders that it is an adequate product, that we in this way have adequate defense, looking at it from the overall picture.

As I say, I don't know of any other machinery that you can think of that would carry out responsibilities of any administration to offer an adequate defense at as reasonable a cost as it is practical to do it.

Mr. ANFUSO. Now, I don't think you have complete agreement on that, Mr. Secretary.

For example, Dr. von Braun said yesterday we could have spent more on research before and we are not making an all-out effort today. You don't have general agreement on that.

Secretary SHARP. I am sure we don't have general agreement. We don't even have general agreement in the Joint Chiefs of Staff.

I am sure that you would find that other members than the Air Force member of the Joint Chiefs of Staff are not particularly enthusiastic about an airborne alert at all that General Power is recommending.

This kind of disagreement is normal and it doesn't mean that everybody agrees with every statement that every individual general makes that he ought to have more money, or that every individual scientist makes that he ought to have more money.

Mr. ANFUSO. Mr. Secretary, someday if we could just have the heads of all these departments come here in executive session and answer just one question: What more can you do and let them each tell us what more could be done. I would be satisfied then that we are not in the great danger that I think we are and I think the people would be more reassured.

That is all, Mr. Chairman.

The CHAIRMAN. Mr. Secretary, am I correct when I say that the Strategic Air Command is thoroughly sold now on the airborne alert, and General Power expresses the view of the Strategic Air Command, not his own views so much, but they are thoroughly sold on that?

Secretary SHARP. His view is as commanding officer of the Strategic Air Command. I am sure the rest of the members of the Strategic Air Command pretty well agree with him, but, then, all the members of the Joint Chiefs of Staff don't necessarily agree with him.

The CHAIRMAN. But the burden of countering a major sudden attack falls on the Strategic Air Command. The initial burden of it is there, and we have that problem that we give them and they say they need this. Now, when we don't give them that, are we backing them up as we should?

Secretary SHARP. I think we have to give them the capability of an airborne alert. I don't think there is any question about it.

The CHAIRMAN. I am glad to hear you say that.

Secretary SHARP. We are doing it. We are preparing for it at present.

The CHAIRMAN. Mr. Bass, you lost the floor there. We recognize you.

Mr. BASS. Referring back to my good friend, Mr. Anfuso, I am sure you don't think we should give these Chiefs of the various services a blank check.

Mr. ANFUSO. I never said that.

Mr. BASS. That is the way you are talking. "Give them all that they want."

Mr. ANFUSO. Now, Mr. Bass, I think we ought to examine this. We ought to examine this viewpoint.

For example, I have read in General Taylor's book that certain things which are absolutely essential were denied because they couldn't be fitted in under the budget.

Now, I don't know whether that is true or not, and I think, I say, that I would like to see from my own safe assurance, I would like to see each administrator come here and say, "Well now, let's see what more can we do." And if we are all satisfied at the end that we can't do any more, then let's tell that to the American people.

Are you satisfied that we are doing all that we possibly can to catch up with the Russians? All the witnesses say that we are not.

Mr. FULTON. Could we go back to the Air Force while we have him here? We only have 4 more minutes. This is very interesting, but I think the two witnesses should be sworn before they get into their——

The CHAIRMAN. They have been sworn.

Mr. FULTON. I mean Mr. Bass and Mr. Anfuso.

The CHAIRMAN. I think we could continue this with probable profit to ourselves but not in the presence of our two distinguished witnesses today. Let's get what information we can out of them.

Mr. RIEHLMAN. May I ask the Secretary a question?

The CHAIRMAN. Mr. Riehlman.

Mr. RIEHLMAN. Now, certainly every one of us has great respect for General Power and his deep interest in SAC and his great responsibility, and that is exactly, I think, his position. He has this tremendous responsibility of destroying a nation should we be called into war suddenly.

Now, he has to face that situation. I have heard his predecessor talk in pretty hard terms about what his job was. He has told me on occasion before committees, "My job is to kill. That is exactly what my assignment is, and I take this responsibility seriously and I want everything I have to have at my command if that hour comes."

Now, General Power has taken in his statement a hypothetical situation; that he finds himself without any other help and our strategic airplanes are on the ground, and that he takes into consideration that Russia at some time in the future is going to have 300 intercontinental ballistic missiles that will be shot over here and hit every one of our bases. That is the position he is taking, isn't it?

Secretary SHARP. Yes.

Mr. RIEHLMAN. You and I just don't believe that sort of thing is going to happen in this country, but we don't want to close our eyes to it either. So we are preparing to put a certain portion of the Strategic Air Command on an alert basis. Taking into consideration that we have other defenses located in other parts of the world, and I don't believe that the general has taken all of that phase of our defense program into consideration when he has made his presentation.

Secretary SHARP. No, and you must remember that we also have this ballistic missile early warning system for just exactly that reason. It was started a number of years ago and is supposed to amount to something in the neighborhood of $800 million of expenditures when it is completed.

Mr. RIEHLMAN. Well, that is the point.

Secretary SHARP. You see, the ballistic missile early warning system is not under the control of the Strategic Air Command; it is the Air Defense Command's responsibility. He somehow or other doesn't take this into consideration as much as I would like him to take it into consideration; that these things are coming in right away, very shortly, and before we think the Russians will ever have this capability.

Mr. RIEHLMAN. I would like to see them, too, but I am not arguing with his position to any great degree. I go back to what I have previously said, that he takes this position of his and his responsibility seriously and we want him to, but here is the other point, and I want your comment on it: I have heard it on television and you have and many of our friends around the table here; we are all concerned about it—these drastic statements, and what does the ordinary person garner from all of this? What is his conclusion?

Well, the responsibility rests upon the administration and the Congress, and that we apparently are apathetic about it; the committee isn't. We are trying to do everything we can, but we are concerned about our Nation and want to do everything we can to be done.

Mr. Anfuso has said before this committee that he has some figures that Russia will have a thousand intercontinental ballistic missiles in 2 years from now.

Now, have you ever heard such a figure given anywhere?

Secretary SHARP. I have never heard a figure of that magnitude.

Mr. RIEHLMAN. Well, I haven't, and I just wondered about it because, listen: He is just as great a patriot as I am, but it is this type of information that destroys the faith of our people and our country and puts us in the category of a second-rate nation where we will never catch up.

Secretary SHARP. You asked me the question had I ever heard of a figure like a thousand missiles in 2 years and I categorically say that I never have heard a figure that even approaches that amount.

Mr. RIEHLMAN. We have had the advantage of having intelligence people before us too.

Secretary SHARP. I want to make it clear that this must be limited to intercontinental ballistic missiles.

There have been some statements that they might have quite a number of intermediate range ballistic missiles. I don't remember the number, but I do remember the number of intercontinental ballistic missiles and it is only a fraction of that figure.

Mr. RIEHLMAN. With our present strength, and the great responsibility that rests upon your shoulders as Secretary of the Air Force, do you have any fears as to our striking ability today or within the next 2 or 3 years ahead?

Secretary SHARP. No, I do not if we continue on our program. I think it is perfectly adequate and I think there will not be what is called a deterrent gap in this period you are referring to at all if we follow our programs as we fully intend to.

Mr. ANFUSO. I want to say to my distinguished colleague from New York that I have never stated anything which has not been publicly stated before. I will find you that statement. I didn't say now. Where in 1962, when we will have 150 to 300 ICBM's, the Russians will probably have a thousand. Now, getting back to public statements, I want to also tell the gentleman that General Power's statement, the speech that he made in New York was cleared according to him, according to his testimony yesterday, before the Senate Preparedness Committee, it was cleared with the Pentagon and State Department before he made it and there he had said what he was going to say, that 300 ICBM's could destroy——

Mr. RIEHLMAN. We are not arguing that point.

Mr. SISK. Mr. Chairman, a point of order.

I have a great respect for my colleagues here, but I thought we were going to have an opportunity to question this gentleman from the Air Force. I have not had a single opportunity to ask a question. All I have heard this morning mostly is argument between members of the committee.

So far as I am concerned, Mr. Chairman, I move that we now adjourn.

The CHAIRMAN. I was going to recognize the gentleman because through error I overlooked recognizing him to ask a question.

Mr. ANFUSO. I think the gentleman should be recognized.

The CHAIRMAN. The Chair will recognize Mr. Sisk.

Mr. SISK. Mr. Chairman, I will ask no questions. It is after 12 o'clock and I have made a point of order. The House is in session.

The CHAIRMAN. There has been a point of order and the committee will adjourn until 2 o'clock. Thank you very much, Mr. Secretary.

(Whereupon, at 12:10 p.m., the committee adjourned, to reconvene at 2 p.m., the same day on another subject.)

REVIEW OF THE SPACE PROGRAM

THURSDAY, FEBRUARY 4, 1960

House of Representatives,
Committee on Science and Astronautics,
Washington, D.C.

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

The Chairman. The committee will come to order.

I have a little preliminary matter here that I think I can read into the record and by that time we will have fuller representation from all sides of the committee.

I have a copy of the Air Force magazine of February 1960. There is an article in it entitled "A Strange Dualism," and this article—by the editor, apparently—says:

> A strange dualism that invades the administration's thinking on space technology is underscored by the statement above. ["* * * I refer to our effort in space exploration, which is often mistakenly supposed to be an integral part of defense research and development." From the President's state of the Union message, Jan. 7, 1960.] The President's view has caused some consternation on Capitol Hill and it may become the basic touchstone of arguments between the executive and the legislative branches in the weeks ahead. Already Representative Overton Brooks, Democrat, Louisiana, chairman of the House Committee on Science and Astronautics has taken strong exception to the President's view. Congressman Brooks was quoted prior to his committee's current hearings on missile and space posture as saying: "The President's statement fails to take into account the effect of space achievements on other countries and fails also to consider the potential of satellite vehicles in the U.S. defense." An extension of this latter idea, the use of military space vehicles as a possible new key to world peace was explored by Air Force Chief of Staff, Gen. Thomas D. White, in his recent address at the National Press Club, excerpts from which are now printed on pages 62 and 63 of this periodical.

Now, General, what I thought would be a very good idea, if we could start the proceedings this morning by asking you to give us a copy of your address which we will be glad to insert in the record at this point, to set out your views on the future missions of the Air Force.

STATEMENT OF GEN. T. D. WHITE, CHIEF OF STAFF, U.S. AIR FORCE

General White. I am sure we have a copy of that address, Mr. Chairman, and we will be glad to submit any other views in writing that you may desire.

(The information requested is as follows:)

Address by General Thomas D. White, Chief of Staff, U.S. Air Force, Before the National Press Club, Washington, D.C., Monday, January 11, 1960

Mr. Lawrence, members of the National Press Club and guests, I am honored to address the National Press Club once again. An appearance before this audience is a privilege and an opportunity I value highly.

For over 175 years, our country has successfully countered threats to its existence from depressions, disease, internal conflict, and wars with other nations. Our country prospered because its foundation was deep in the solid rock of rugged determination. Our success in the future will need the same determination. Whether we like it or not, the United States is now faced with a new and different challenge—and this time the challenge is to its very survival. The continued existence of our country and the basic principles for which it stands will depend on how we meet this challenge. We must be willing to expend that extra effort required to be first in a race where there are no rewards for second place.

It is to this thesis that I want to direct my remarks today.

The economists are calling this new decade "the Golden Sixties." Others refer to the next 10 years as "the Soaring Sixties." The military man must look on them as "the Serious Sixties," unless drastic changes transpire in the world of tomorrow.

Some of the problems which confront us can be highlighted by these queries:

What are the prospects for peace?

What is the Communist plan?

What is the true nature of the threat to national security?

What effect will the new weapons have on our future security?

What are the prospects of military operations in space?

These next 10 years hold many promises and, no doubt, many surprises. Technology will continue to advance and will provide man with increased capabilities in various fields—including that of waging war. It is my earnest hope—and I am sure yours, as well—that the means of waging peace also will improve.

We enter the 1960's with new evidence that peace is truly a universal goal—at least on this side of the Iron Curtain. The enthusiastic reception given President Eisenhower on his recent trip abroad stands as a monument to that fact.

The President has defined our objective as "* * * peace with justice * * *" None will quarrel with that goal. However, anyone who reads the newspapers knows that many differ on how best to achieve it. That is the problem that comes with the challenge.

How do we achieve peace with security and freedom? How much military strength is adequate to preserve the peace? What kind of strength? How should it be used? These are the military elements of our national strategic problem.

The world knows that the United States will never commit aggression. On the other hand, I have seen no real sign or portent to indicate that Communist leadership has abandoned its plan for world domination. Communists have committed acts of aggression. They have recently reaffirmed their intention to dominate the world. At the same time, they profess their desire for lasting peace and have suggested universal disarmament.

If we draw false conclusions that the fundamental Communist plan has changed, our peril will be immeasurably increased. In all our unhappy dealings with communism and its leaders we must have learned one sure lesson: we can only negotiate with communism from strength.

The word "stalemate" has sometimes been used to describe the current situation wherein two great strategic attack systems face each other. "Stalemate" is incorrect, in fact—misleading—because of the word's static implication. We are actually in a dynamic situation keyed to exploding technological development. Until dependable disarmament measures can be achieved, we have no recourse but to maintain and improve the fighting forces which will make an enemy fear to attack. Possession of such forces provides the United States with the strength and the opportunity to work out arrangements to secure the permanent peace we want.

Today, this Nation possesses a strong strategic deterrent—the great majority of which is contained in the Strategic Air Command. This is not an indiscriminate force—but one which has the ability to destroy the warmaking capacity of any aggressive nation, no matter how powerful, and to achieve military victory. To maintain this capacity and to continue as a powerful deterrent to war, SAC must remain strong—not only in quality but in quantity. We must continually advance this force—in the national interest—through the development and procurement of better weapons, by improved protective measures such as hardening and mobility and through precise coordination and control.

As technology and military weapons advance hand-in-hand, the expense goes up accordingly. This aggravates the problem of national security because we must be equally prepared for today while we develop our weapons for the future. This essentially is the mandatory task of modernization—an expensive task which I expect will become more so as time goes on.

Of course, there is a positive need for military capabilities to fight various types of lesser wars. But in our evaluation of this requirement, we cannot for a single moment lose sight of the fact that a flareup anywhere in the world is a potential fuse to a complete blowup. Recognizing this, every measure must be taken to keep our general war deterrent strong and ready. Capabilities designed primarily to meet the requirements of lesser wars must not be gained at the expense of our capability to fight and win a general war.

In evaluating U.S. military potential for actions short of general war, two important points are often overlooked. First, in any assessment of free world capacity for smaller wars, the strength of our allies must be taken into consideration along with our own. We in the Air Force recognize fully that in addition to strategic deterrence, one of the keystones to national security is collective security. The United States is not the sole "limited war policeman." The remainder of the free world also has substantial military capabilities. In 1958, these forces consisted of 5 million men, 1,700 combat vessels and 14,000 jet aircraft.

Another point that is often neglected in the somewhat freewheeling discussion that goes on concerning "limited" war—is the military budget. Obviously, none of the military services operates with a blank check whereby it can build special forces for every type of war we might have to fight. Even so, less than one-third of this country's total military expenditures over the last decade has gone for the development and support of the forces designed primarily for their general war role. In my opinion, the other two-thirds of the military budget has served to provide something very substantial in the way of capabilities for limited war. The U.S. Marines, most of the Army and Navy, and much of the Air Force are specifically prepared for small wars.

Now, in the light of these general observations, let's take a look at the effect some of the new weapons will have on our military position. First, I would like to emphasize that the Air Force will require both manned and unmanned systems. Missiles and aircraft, for example, are complementary weapon systems—each with definite and decided advantages. Although the growing performance capability of missiles indicates they will have an increasing role, the needs for manned vehicles will be many and varied.

I agree with those who feel there has been excessive talk about manned expeditions to the Moon, Venus, Mars, and beyond—as though these ventures were well within our present capability. They are not. However, our pilots will probe far above the Earth's surface in the X–15 rocket craft and in the Dynasoar. We are also participating with NASA in the Astronaut program. All three of these projects are steps toward exploiting man's judgment and skills. With the Dynasoar, for example, we will gain knowledge basic to the control, return and precise landings of suborbital vehicles. This knowledge will help make piloted space operations of the future practical.

For the present, the advent of long-range air-to-surface weapons launched from aircraft presents us with a whole new realm of possibilities. Early this year, the first of these weapons will be operational with Strategic Air Command units. One of them, the Hound Dog, is a supersonic air-to-surface weapon with a nuclear warhead. It will enable the bomber to launch attacks while still several hundred miles from its designated target.

We also have under study an air-launched ballistic missile. This missile, which I have nicknamed the Sky Bolt, will, of course, be hypersonic. It is being designed to attain ranges of approximately 1,000 miles. We have already proved in prototype tests of this new weapon that it can be launched from aircraft at both subsonic and supersonic speeds. You can well imagine the potential of such weapons when carried by our current long-range bomber aircraft—and eventually by nuclear-propelled aircraft with practically unlimited endurance. This combination of aircraft and missile will provide our country with the most mobile striking power ever achieved. Sky Bolt aircraft would possess true global mobility. They could operate over the high seas, friendly land masses, or areas inaccessible by other means—with the capability of attacking within minutes. In addition, they would be essentially invulnerable to surprise attack.

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A strategic striking force composed of airborne missile launchers, land-based missiles, submarine-launched missiles, and fast long-range bombers will provide this Nation with the versatility required to achieve optimum combat effectiveness—until such time as even more advanced systems are developed.

Of course, the majority of Air Force systems today operate within the atmosphere. One notable exception is the ballistic missile which is really the first of the space vehicles. Thus, certain weapons of war already have the capability of invading the fringes of that heretofore inaccessible area popularly called "space." More can be expected to follow. This is a logical outgrowth of the technological explosion to which the world has been exposed.

Lacking specific guarantees that the benefits of space science and technology will be used solely for peaceful purposes, it is essential that we consider the application of this knowledge to our own military capabilities. There is no dividing line between air and space—they are one vast operating arena—and they must be considered as one medium—aerospace. Advancing technology will inevitably carry with it the opportunity for improved aerospace capabilities. Therefore we must move steadily toward operations in space—not merely because it is there—challenging us—but because it is vital to our Nation's security to do so.

The overpowering element in evaluating military stability in the world today is the possibility of surprise attack. It is a major obstacle to preserving the peace, the big barrier to reducing our military budget and the key to much of our strategy and tactics. With this in mind, let us consider an interesting series of developments in the technological revolution.

The development of nuclear warheads made it practical to develop aerospace vehicles with intercontinental range. It made practical the concept of the big missile which required a new and radical development in rocket propulsion. The nature of this vehicle, with its intercontinental range, also demanded new and radical developments in electronic guidance. These concepts and developments have now become a practical reality—for example, we possess an operational ICBM whose effectiveness far exceeds our original planning objectives.

All of this has intensified the problem of surprise attack—but, the same technology which gave birth to the big guided missile carries in it the seeds of a possible solution to lasting peace. The big rocket has propelled us into space, and its guidance requirements have accelerated the science of electronics.

These technologies have advanced to the point where new controls for peace are conceivable. I do not say that there will ever be an absolute guarantee against surprise attack. Absolute guarantees are few. But I do say that the time is coming when the possibility of surprise attack will be reduced—reduced through advanced technology to the point that we can live with the problem and perhaps solve it.

In this respect, there are certain specific military advantages that we can expect to gain from the extension of our capabilities farther out into aerospace. Among them are more reliable communications, improved early warning and better reconnaissance. Two of these are particularly valuable as far as defense is concerned—their main purpose is to provide us with warning of impending attack. Midas, a satellite containing infrared detection devices, is being developed to obtain the earliest possible warning of an ICBM attack against this country. Samos is another defensive satellite designed to give us a reasonable answer to the question "What are the actions of a potential enemy?"

A year ago, in testifying before the House Committee on Science and Astronautics, I said, "The major military threat which faces our Nation today lies in Soviet aerospace power—even though, at the moment, this power is expressed in terms of aircraft and ballistic missiles. The primary military deterrent which has contained this threat and which has precluded it from developing into catastrophic reality, is U.S. aerospace power. This has been true for the past 10 years with our conventional and early jet fighters and bombers. I am convinced that it will continue to be true as we operate with improved jet aircraft, missiles and eventually spacecraft and satellites. The decisive weapons of the future will be aerospace weapons. That nation—or group of nations—which maintains predominance in this area—not only in its military forces, but also in its laboratories, in its industries and in its technology—will possess the means for survival."

Nothing has occurred since that time to change my conviction. Moreover, further contemplation of man's extension into space suggests to me that here in this vast arena we may find the most imaginative and challenging key to the control of peace. We must take every advantage of this possibility.

The CHAIRMAN. I want to say to the committee we have one of the finest Chiefs of the Air Force that we have had. He has helped as much as anybody I know in developing the Air Force from a corps in the Army to an independent, self-integrated Air Force such as we have at the present time and I think we owe, to a large extent, the peace of the world today to the dynamic attitude of the Air Force in making it the better part of wisdom for anyone not to attack us at this time.

So we are pleased to have General White here. The general tells me he has other commitments, which I know to be the case, and I am therefore going to ask him, if he will, to proceed to read his statement. We will then go around for questions and then we will release him after that and General Wilson and General Boushey will remain.

By the way, too, General, we are requiring all of the witnesses to be under oath at this hearing. Would you ask General Wilson and General Boushey to arise, too?

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

General WHITE. I do.

General WILSON. I do.

General BOUSHEY. I do.

The CHAIRMAN. Have a seat, gentlemen.

General White, you have your statement and we will be glad if you will proceed.

General WHITE. Thank you, sir.

Mr. Chairman and members of the committee, it is a pleasure to appear before your committee once again. This Nation's activities and progress in science and astronautics are matters of great concern to the Air Force and we welcome the opportunity to discuss these important subjects with you.

Our country's announced national policy is that the use of the expanding medium of aerospace be directed to unselfish and constructive ends—to the advancement of scientific knowledge and techniques for the benefit of all mankind. The Air Force is committed to that policy without reservation. We are most desirous of seeing this Nation's space program flourish.

The Air Force is an instrument for safeguarding peace. Thus, as far as the Air Force is concerned, our mission in space is for security purposes. Technology has enlarged our operational sphere, permitting us to achieve greater altitudes. The conduct of military operations in this ever-expanding area of aerospace is one of our major responsibilities.

In a way, the Air Force position today with respect to operations farther out in aerospace is somewhat analogous to that of the Montgolfier brothers after they successfully launched the first unmanned balloon in 1783. Free flight had been achieved—but there were many questions unanswered. Could man utilize this new means to travel with reasonable safety? How far and how high could he go? What pattern might the evolution of air transport be expected to follow? The first man went aloft that same year, in 1783, but it took over a hundred years to find some of the answers to those questions.

Today, the question is often asked, "How far do we plan to send manned vehicles into space?" The answer, as I see it, is—as far as they need to go in regular operations. I feel that initially our systematic missions will operate at rather shallow altitudes—relatively speaking—within a few hundred miles of the earth. Our immediate operational concern is events which may occur on earth and in the zone immediately above it. We don't prove anything by operating farther away than we need to go. I want to emphasize, at this point, that what I have said concerns regular operations of manned vehicles. Naturally, we can expect these to be supplemented by special operations at greater altitudes by both manned and unmanned vehicles.

Knowledge gained thus far in the preliminary probings far above the earth is of absorbing interest to members of the civilian scientific fraternity—not only in this country, but elsewhere in the world. This information—the reports, studies, and analyses—is also of significant interest to the Air Force. This is true because it deals with phenomena, conditions, and other aspects of the expanding operational arena in which the Air Force must continue to operate. For example, the stability and control of an IRBM or an ICBM is a subject of very urgent importance. During missile test firings all the various components must be carefully checked and tested individually, since they must work together in an environment which cannot be simulated on the ground. The more we learn about the interplay of all the forces acting on a free flying missile such as vibration, aerodynamic and dynamic loads, the sooner can our research show the way to development of improved and more reliable systems. Stability and control will, of course, become even more of a critical requirement as we phase into manned space operations.

During the past year, the Air Force was given primary responsibility for assisting NASA with the launching of future research vehicles and for giving other support to the projects they may require. This is a very logical arrangement. Our missile bases on either coast are the only existing major installations with the adequate facilities the necessary experienced personnel for placing sizable research devices in orbits or other trajectories. The Air Force's future operational concepts will be significantly influenced by the scientific profile which NASA develops on space environments and phenomena. I feel it is equally certain that the Air Force, in the course of its own operational or experimental test missions, will develop byproduct research data of prime interest to the civilian program.

At the present time, the Air Force is engaged in five major projects designed to further our operational capacity at greater altitudes above the earth's surface. Two of these are manned vehicle projects—the other three are unmanned satellite projects.

The X-15 and the Dyna-Soar, of course, cannot be considered true space vehicles. They are, however, our initial efforts in placing man at speeds and altitudes never before achieved. Of equal importance, they are our first attempts to place man in this medium with the ability to maneuver—a most important element in manned vehicle aerospace operations of the future.

The three unmanned satellite systems to which I referred are the Midas, the Samos, and the Discoverer series of satellites. Two of these are particularly valuable as far as the defense is concerned—their main purpose is to provide us with warning of impending attack. The Midas will be a satellite containing infrared detection devices designed to obtain the earliest possible warning of an ICBM attack against this country. The ballistic missile warning system we now have under construction—called the BMEWS—should give us an average of 15 minutes' warning from approaching ballistic missiles. Midas will detect missiles just after launch—while in the boost phase—thus giving us longer warning. We feel this system will complement the BMEWS system and, in addition, give us double verification of any ballistic missile attack against us.

The Samos is another defensive satellite which is designed to give us a reasonable answer to the question "What are the actions of a potential enemy?" The Discoverer series of satellites is primarily designed to furnish us with advanced engineering data and to develop biomedical recovery techniques.

A year ago in testifying before this committee, I said:

> The decisive weapons of the future will be aerospace weapons. That nation—or group of nations—which maintains predominance in this area, not only in its military forces, but also in its laboratories, its industries, and in its technology, will possess the means for survival.

Nothing has occurred since that time to change my convicition. In fact, each passing day confirms my belief.

The probable theater of initial space operations for the Air Force is an infinitesimal sliver of space in comparison to the diameter of our solar system which I am told is on the order of 9.2 billion miles. Nevertheless, it is important that we continually press forward to achieve even greater altitudes and speeds. Contemplation of operations farther out into aerospace suggests to me that in this vast arena we may well find the most imaginative and challenging means for attaining the permanent peace we all desire. I feel that the time is coming when the possibility of surprise attack, for example, will be reduced—reduced through advanced aerospace technology to the point that we can live with the problem and perhaps solve it. It is to our common interest to assure that we overlook no opportunities to gain the specific advantages which I am certain exist in such an extension of our military capabilities.

The CHAIRMAN. Thank you very much, General White. We appreciate very much your fine statement.

Now, yesterday morning we adopted a rule. We will go around the committee for one question and then if there is time available we will go around the second time with more leisure. That is with the idea of giving everybody an opportunity to question such outstanding witnesses as we have been having before this committee this year.

With that in mind, I am going to ask General White, the Chief of Staff of the Air Force, this question:

We have been reading in the press, hearing over the radio, and seeing over television so many references to the situation with respect to our national defense. The need of having the strategic air force that will be on 24-hour duty, in the air 24 hours of the day: we have been hearing about the progress which Russia has made in the science of ballistic missiles. We have been reading about the missiles falling into the Pacific, southwest of Hawaii, which is pretty close to this country and we are disturbed. Will you now, General, in your answer to this question, give us the facts as you see them with reference to these vital issues which concern the committee and the people of the country so much at this hour.

General WHITE. I must be mindful of the fact that this is an open session, Mr. Chairman. I will do my best to fulfill your request within the perimeters of complete security.

The CHAIRMAN. I think there has been so much said in the press that it ought to be an open session.

General WHITE. I will try to make a statement which will clarify the situation.

The very fact of the existence of atomic weapons and intercontinental ballistic missiles means that warning time, in case of an attack, is relatively short. The most we could expect to get under the presently contemplated warning system that we have in BMEWS is about 15 minutes. Now until that system is in operation and has been proved out and on the assumption that at some point the Soviet Union will have a significant number of missiles, then prudence would indicate that we must maintain a certain proportion of the Strategic Air Command on air alert. Anything on the ground is not likely to be able to get off within the 15-minute period, but anything that is in the air is relatively invulnerable. That is the theory on which an airborne alert has been developed, particularly by the Strategic Air Command.

The publicity on this subject seems to me to have acquired considerable impetus from a speech that General Power, the commander in chief of the Strategic Air Command, gave in New York several days ago in which he referred to the Soviet Union having a hypothetical number of missiles. I would like to point out that what he said was hypothetical. He didn't say they did have them, nor did he state they would have them at any particular time. He was speaking purely of a hypothetical case in which he did certain mathematics which showed what the result of a surprise attack without warning, with that number of missiles, might do to the atomic retaliatory forces of the United States. The whole burden of his speech was leading to the solution which he foresees for this problem, namely, the airborne alert which I have just described.

Now there has been some confusion over the difference between the actual initiation of an airborne alert and what has been termed the on-the-shelf capability to do so. I think that clarification here might perhaps be useful.

To order an airborne alert at this time is one condition which we do not see is needed as of now. There could well be a situation which would make an airborne alert prudent in the future. By an on-the-shelf capability we mean having first the trained crews in the proper number and the necessary spare parts and extra engines which would permit General Power to maintain a proportion of his heavy bombers on this air alert continuously. Because of the lead times in the procurement of equipment and in the training and in developing the techniques, it is necessary to plan this, to give the orders for the production of this extra material and to start the training of the crews some time in advance. That is what we mean by having an on-the-shelf capability. At the end of this lead time, when you have the material, when you have the people; then, if it appears desirable, you give the order to execute the airborne alert.

I think that highlights the issues as I have interpreted them from what I have read and, of course, what I have heard and been involved in, in a number of the committee hearings.

The CHAIRMAN. Mr. Martin?

Mr. MARTIN. I have no questions at this time, Mr. Chairman.

The CHAIRMAN. Mr. Miller?

Mr. MILLER. No questions.

The CHAIRMAN. Mr. Van Pelt?

Mr. VAN PELT. No questions.

The CHAIRMAN. Mr. Teague?

Mr. TEAGUE. No questions, Mr. Chairman.

The CHAIRMAN. Mr. Riehlman?

Mr. RIEHLMAN. General, I only have one question and that is this: Certain provisions are underway for an on-the-shelf program. Do you feel that with the information that you have, that that program is sufficient?

General WHITE. I would say this, Mr. Riehlman, that from my relatively narrow position, I did ask for more money than has been provided in this budget for that purpose; but I would like to make it very clear that my views were fully considered by my constituted superiors who have the responsibility for the final decision. The provision made for an airborne alert capability is significant, and I accept the decision of my superiors as I properly should, and must.

Mr. RIEHLMAN. That is all I have.

The CHAIRMAN. Mr. Anfuso?

Mr. ANFUSO. General, I asked an ordinary citizen yesterday how she felt about what she was reading in the newspapers, about the disagreements between President Eisenhower and generals in our Armed Forces and she said that she was in a state of confusion. She didn't know whom to believe.

I don't want to get you involved, General, in a squabble with the President—you have enough headaches of your own—but I am sure you would agree with me that General Power, like yourself and other generals who feel that they have a duty to perform in safeguarding their commands and the security of our country, have performed a valuable service to the country, to the President and to the Nation in making these criticisms, in that they are welcome in a democratic form of government.

However, the situation still exists that as far as the public is concerned, they are in an utter state of confusion.

Would you recommend, sir, that this Congress as soon as possible, after these hearings, make some kind of a clarifying report actually stating the nature of our defenses, compared with the Soviet strength in actually giving the people the facts as to the security, the present security of the United States?

General WHITE. I can't help, Mr. Anfuso, but state that in that context it becomes a national political problem, and it is far beyond my purview to offer a recommendation.

The CHAIRMAN. Mr. Sisk?

Mr. SISK. General White, the question which I am going to ask probably should have been directed to the Secretary yesterday and unfortunately the opportunity wasn't presented but because of a statement within the overall statement which he made, I want to ask you this question: To what extent do you think the philosophy of the Air Force today is giving proper emphasis to space, space exploration, and the use of space militarily—and I am referring now to the fact that an ICBM uses space—as against what many people have charged was a failure on the part of the Air Force to wake up to the realities of space. And I am sure you are familiar, General White, with the common charge that sometimes people have made that one of the problems we had in getting into this overall picture was the fact that the philosophy of the Air Force was that the manned aircraft was the last word and would forever be the last word. I am quite concerned because of a statement in Secretary Sharp's remarks before the committee yesterday which indicated that to some extent possibly the old philosophy still hangs on that in the foreseeable future, or as far ahead apparently as the Air Force can see, the manned bomber is still the ultimate.

I feel this is a fearful philosophy and I would like to have you express what you believe to be today, the Air Force's philosophy of space. And I am speaking both militarily and otherwise.

General WHITE. Well, I am very happy to have the opportunity to make a statement in that respect.

I believe that the record will show that the Air Force has been the leader in recognition of, and in attempts to take advantage of, the unique characteristics that space offers. I think the record will show that the Air Force took the lead, the first step in aerospace, namely, the development of guided missiles and more particularly and more lately, ballistic missiles, which are truly aerospace vehicles in that they travel into outer space outside the palpable earth's atmosphere before returning to it.

I think it is also a proper statement, and one that I have made many times, that there will be a continuing requirement for manned vehicles, manner aircraft and in the future, manned space vehicles.

We are faced with a most difficult situation, involving both technology and the efforts of our potential enemies, in that we must do a number of things. We must maintain a capability as of right now.

Now, let me discuss the capability and the requirement right now: The bulk of both Soviet and U.S. retaliatory forces lie in the manned aircraft because we are just coming into the ballistic missile age. This is something that we are also developing.

I see a mix between that type vehicle and manned aircraft in some proportion from here on out, but that proportion will change. As of now, the manned aircraft is numerically and predominantly the major element of the force; but as time goes on, as we develop, and as we produce and make operational more ballistic missiles, then the proportion of manned aircraft in relation to the overall, will go down.

Now, on top of this we now have before us capabilities, opportunities, requirements, in the next extension of this element. That is into space beyond the palpable earth's atmosphere. Here, too, we are going ahead with those developments which have either a unique capability in that medium which we cannot acquire elsewhere, or where we can do a job better in space than we can either on the ground or in the atmosphere, or we can do it cheaper.

And that, I think, poses the type of technological and I might say personnel problem, base problem, with which the Air Force is faced. Trying to integrate the force needed now and for the immediate future, making certain that we are properly covered for the future in those types of weapons systems which will be available in the immediate future and at the same time not neglecting those unique characteristics, unique opportunities, that the state of the art indicates will still be a little further into the future.

I would like to state unqualifiedly that the Air Force feels that space is an area in which there will be certain military requirements and that we certainly have programed a very large part of our budget in missiles. But we are also maintaining our manned aircraft, modernized to the degree that we can and to the degree that we feel—or largely to the degree that we feel necessary—to meet the present or the very immediate future.

Mr. SISK. Thank you, General White.

Mr. MCCORMACK. Will the gentleman yield?

Mr. SISK. If I have time, I will be glad to yield.

Mr. MCCORMACK. I have heard some opinions from competent persons about the life of manned aircraft from a military view. Would you care to express an opinion, General, on that?

General WHITE. I believe that history has proved that the manned aircraft has been controversial since its invention. I have personally been in the flying business since the days of Billy Mitchell. I have observed these problems over the years. We are presently having a recurrence, perhaps. In my opinion there will be a requirement for manned weapons systems from here on out. But the proportion will change. In the past we have had 100 percent bombers in our retaliatory forces.

As of now, I can't give you the exact proportions, but it is less than 100 percent because we are beginning to phase in air-breathing missiles, the intercontinental ballistic missiles, and the intermediate range missiles.

So the mix is changing now, and I anticipate it will continue, with the proportion of manned vehicles on a relative basis being smaller than it is now, but, nevertheless, an appreciable part of the future forces.

Mr. MCCORMACK. You haven't any limit in your mind, then? Nobody can say definitely?

General WHITE. It is too early, in my opinion, Mr. McCormack, and we have given a great deal of thought to just what the proportion should be. We are certainly little beyond the dawn of this age of ballistic missiles.

I can cite an example of the difficulty of stating that now. At what rate of exchange would you exchange a single intercontinental ballistic missile for a single B–52 bomber, for instance? It is an equation we don't have worked out yet and I think it will be some time, but I think it is fair to say, as I have—and we do have it in our programs—that the proportion of manned bombers is going down. There are other fields such as the tactical field and, of course, the airlift field where the manned aircraft has the predominant role from here on out, in my opinion.

The CHAIRMAN. May I say to the members of the committee, we are operating under Mr. Fulton's motion of yesterday to limit everyone to one question. Mr. Fulton, you will be recognized.

Mr. FULTON. The question comes up as to your method of phasing down the manned aircraft and phasing up the ballistic missiles—IRBM and ICBM.

That decision as to the weight of phasing and the method of changing the reliance from solely manned airplanes to some dependence on missiles is not a political decision, but it is a very complicated technical decision, based upon balanced forces upon which the United States relies for its defense—and the capabilities of potential enemies and their combined forces.

So that the question then resolves itself not to what we would call a missile gap, but whether there might be an overall defense gap.

I believe that there is no overall defense gap, because we have the predominant power in the world today in the United States, as against our potential enemy, and that the question must be dealt with on a technical basis, rather than on a political basis. Do you agree?

General WHITE. I agree, in general, that that is a very erudite statement, if I may say so, of the military problem. It really is. I agree with you.

I would like to take just the kind of problem that you have mentioned: How do you equate a bomber that can carry multiple weapons and heavier weapons with a ballistic missile which carries only one warhead? How do you equate that bomber when it is equipped with air-breathing missiles that will go 400 or more miles with an atomic warhead on it now and probably in the future? Then add the air-launched ballistic missile with a thousand-mile range on top of that of the airplane.

That gives you some feel for it. I agree it is diversity of forces that has the greatest effect on our overall national defense posture.

The CHAIRMAN. Mr. Hechler——

Mr. HECHLER. General White, with your indulgence, my question will take about 2 minutes to ask, and I hope I have the indulgence of the committee while I ask it.

The CHAIRMAN. You have one question, Mr. Hechler. Go right ahead.

Mr. HECHLER. General White, you are in a position of leadership and what you say has very great influence over what the people in the country think and I believe your job is made much easier by stressing the nature of the crisis that we face.

Now, the Secretary of the Air Force yesterday quite honestly pointed out that he, as well as the Secretary of Defense, had to look at the broader picture and that perhaps General Power as a field general had to look at the picture somewhat through dark glasses.

Secretary Sharp said that he preferred to take a somewhat rosier view. We had a little discussion here about the use of rose-colored glasses [putting on a pair of rose-colored glasses].

Now, it is entirely possible to look at our missile program through rose-colored glasses. And when you do put on rose-colored glasses, you see quite a few amazing things. The Russian missiles suddenly look not as powerful. Their capabilities become intentions, and pretty soon, after you look through these rose-colored glasses for a while, there just isn't any missile gap at all.

And furthermore, as you look through these glasses you might say that the United States should not be overly concerned with catching up with the Soviet Union. And as you look through these glasses, you see a parade of generals—Gavin, Ridgway, Taylor, Medaris, Power. Perhaps through these glasses those generals and their point of view may seem a little parochial. The generals have all sorts of ideas [taking off the rose-colored glasses].

But the question I would like to ask you, General White, is this: Isn't it high time in this country that we take off these rose-colored glasses and stop lulling the American people into complacency and tell the people that they are really facing the greatest crisis in American history?

Some people have said we shouldn't panic the people. I have never met a man in this country that is scared or panicked, but I have met thousands of people who are complacent.

The question I would like to ask you is this: Is it not high time that every man, woman, and child in this country has to put forth every ounce of heart, mind, and muscle if we are going to meet what is really the gravest crisis which has faced humanity, and the American people are going to have to sacrifice a few big tail fins and fat consumer expenditures and work hard for the preservation of humanity, itself?

You, in your statement, have said, "It is for our common interest to assure that we overlook no opportunities." I think that is a step in the right direction, but isn't it time we sound a warning bell in the night?

General WHITE. You have asked me a very long question. Mr. Chairman, I can only reply at about equal length, if I may.

Without seeing it in writing to review, I would have difficulty in replying to every point. But I would like to make the first point, that in my opinion—and I have been around a long time—there is no complacency in the Department of Defense. There are sincere and dedicated people to whom the love of this country and recognition of their responsibilities is uppermost in their minds.

I believe I stated earlier that the invention of the atomic weapon and the long-range delivery vehicles has had a very decided impact on the whole business of planning for national security.

You spoke of rosy glasses. I would prefer to use another color if I might. I used this as an example once before and I haven't been able to think of a better analogy and I think it is a really useful one.

Let's start with General Power, who has a single, but exceedingly important command—in my opinion, the most important command in the world today—in the free world, certainly. He has a certain mission. General Power sees his problem in black and white. Now, let's move it just one echelon higher—which happens to be myself. General Power is charged with the strategic forces of the Air Force. As Chief of Staff of the Air Force, insofar as my duties are concerned, I have to consider strategic forces for the Air Force, the air defense of the United States, which is a large portion of the responsibility of the Air Force, and I have to think of our tactical forces which are for the purpose of meeting oversea commitments for limited war. I have to think of airlift forces for the same purpose. I have to keep in mind the balance of well-being of nearly a million people, of the research and development requirements, and so on and so on.

So when General Power's requests come to me, they have the utmost scrutiny. But instead of seeking the problem at my level, in black and white, I begin to see it now in a shade of dark gray.

Now, let's go to the next echelon which is the Secretary of the Air Force, my immediate superior. He has other considerations which make the problem—I am not saying it downgrades any problem, but it is really a broadening of the responsibility—he has other things to think of. He is one of the civilian Secretaries; he is a close personal adviser of the Secretary of Defense. His view is broadened and, for want of a better phrase, I would say he sees things in a little lighter shade of gray.

Now, you come into a kind of an anomaly. We next come to the Joint Chiefs of Staff. I take off my hat as Chief of Staff of the Air Force, and I sit down with my colleagues, the Chief of Naval Operations and the Chief of Staff of the Army, and I immediately become concerned with not only the Air Force problems, but also with those in the Army, the Navy, and the Marine Corps.

And here again, you get different evaluations, different judgments based on factors which, themselves, are in many cases unknown, and which vary. The reflection of the doctrine, of the experience and of the different responsibilities of these people comes up with yet another element.

Now, we go to the Secretary of Defense. He is concerned with these things and many other things. So each gradation has new factors and new judgments, and that is one of the reasons that General Power may appear to be solely concerned with one thing. That is really all he is concerned with, in the narrow sense of the word. And that, I think, is what causes some of the difficulties.

Mr. McCormack. Have you eliminated the Director of the Budget?

General White. I have not eliminated the Director of the Budget because you can go on higher.

The Chairman. He is not in the air.

Mr. Teague. He is in the air.

Mr. Fulton. Let the record show the gentleman from West Virginia took his rose-colored glasses off at the end of his questioning.

The Chairman. The gentleman will loan everyone on the committee those rose-colored glasses at the proper time.

Mr. Moeller.

Mr. Moeller. I would like to follow with a question comparable to that asked by Congressman Anfuso.

I am sure we wouldn't expect you to clear the air all of a sudden here but certain statements were made by top people in the Air Force in recent weeks and quoted in the papers, and these same men seem to have been slightly ridiculed in other statements made by other people—this could easily become a political situation, I am sure, but I think we as a committee would like to know, would you stand by and put your approval upon the statements made by General Power and, for example, General Schriever? He expressed some disappointments and dissatisfactions a few days ago which appeared in the newspapers.

You would say this is absolutely correct and accurate? You would approve of this?

General White. I will give you a very frank answer to that. General Power's speech was properly cleared, according to all of the rules of the game. I feel certain—I can't speak for him—but I believe General Power, himself, did not realize the turn that would be given to his speech. As I say again, the purpose, if you read it all, was directed to support for the airborne alert, which he feels is necessary. So I would say that in that respect it was unfortunate that he made the speech the way he did.

But it was not foreseen by him that it would lead to—and evidently not by any of the clearing authorities—that it would lead to the kind of a situation that we find ourselves in now, creating so much discussion.

The CHAIRMAN. Mr. Roush.

Mr. ROUSH. General White, my question is a simple, practical question.

General WHITE. I will be very grateful for that.

Mr. ROUSH. How soon do you contemplate a military need for a million- or a million-and-a-half-pound booster engine?

General WHITE. That is a difficult question for me to answer because I am not a scientist. I have great enthusiasm, and I hope not an excess of imagination, about the future of space for military purposes. I am confining myself only to the military side of it, because that is the only side that I am concerned with as Chief of Staff of the Air Force.

I think that as of the moment the boosters we have are adequate for the military space missions, but as we learn more about space, as the state of the art progresses, I have no doubt that larger boosters will have an application in the military sphere.

I would point out that for the immediate future, I would anticipate that the military requirement will be more for numerous boosters than it will be for a few very large boosters.

Now, General Boushey and General Wilson are here, who are really experts in these matters, and I think that they can give you a more authoritative answer in that respect than I can.

The CHAIRMAN. Mr. Chenoweth.

Mr. CHENOWETH. I would like to ask just one question.

General White, I personally have great confidence in you and your staff and in the Air Force to accomplish its mission, and I am telling my people that the Air Force and the Army and the Navy and the Marine Corps are ready to meet any emergency or contingency which may develop.

And I am on good ground in telling them that, or should I resort to some of the tactics which others have, and spread a word of fear and concern among them that they might have some real fear?

General WHITE. You are absolutely on solid ground in my opinion, sir.

Mr. CHENOWETH. I appreciate that.

The CHAIRMAN. General, I know you have to leave shortly, but before you leave I would like to ask you two or three questions.

Are Midas and Samos and Discoverer—they are your programs—also X–15, that is your program—do you have in your budget sufficient funds to push those programs with all optimum speed?

General WHITE. We feel we are adequately funded in the Discoverer program, and in the Samos program. We would like to study more the immediate future of the Midas and it is presently before the Department of Defense.

The CHAIRMAN. You are asking for more money for the Midas?

General WHITE. We feel perhaps we could go faster. We have to have a scientific evaluation of it, which is not completed yet, which would justify more funds if the scientists tell us that what we would like to do is a practicable and desirable thing to do at this time.

The CHAIRMAN. Just for the purpose of explaining fully, what is the Midas program?

General WHITE. The Midas program is a satellite which would, through infrared detection devices, be able to report the boosting of a thing like a ballistic missile at the time it blasts off. In other words, you don't have to wait until you see the warhead coming through the radar screen as you would with other types of warning. Here you get much earlier warning because the heat generated by the booster will be picked up by the satellite.

The CHAIRMAN. Now, that is a defensive program. How much more money do you need on that?

General WHITE. I would have to turn to one of my staff here to give you the amount of money that we are asking for, and I rather suspect that that might be something best stated for executive session.

I feel that since this is a future thing which has a bearing on the overall aspects of security, it would be best to have that entered into the record under classification.

The CHAIRMAN. Do you favor the Air Force having a monopoly on the military use of space, or do you favor a joint command, or a joint development program?

General WHITE. I don't favor any of those things, sir. I believe that there are military requirements for all of the services in space. I believe, as I stated earlier, that any military mission that can be done either uniquely, more cheaply, or better in space should be done that way. All of the services could have, and some do now have, requirements in space.

Now, the joint development of the services is very closely integrated in R. & D. now. To have a single R. & D. program for this even in the military, I feel would be a mistake, for the same reason that we don't have them in the other weapons.

In other words, I look on the space weapons systems just exactly as I do on the terrestrial and aeronautical ones.

The CHAIRMAN. Well, General, what is holding up our Dyna-Soar program? It has been in the works a long time. When we were out in California they told us they would have certain tests over in February. That was last February. Is it proceeding as it should?

General WHITE. We have adequate funds to do the program as we see it now, but again, those who are connected with it think that we can go faster. I am happy that they do, because I think we should get on with these new weapons systems. Here again a technical evaluation is in progress which will decide whether we should go faster and therefore have more funds.

The CHAIRMAN. So you will let us know later on that?

General WHITE. Yes, sir.

The CHAIRMAN. Are there any further questions?

Mr. McCormack?

Mr. MCCORMACK. I yield to Mr. Anfuso.

Mr. ANFUSO. General, you spoke about what happens in the different stages—how appropriations are made, and how requests are made.

General Taylor, in his book, said that the fault really lies at the top; that you are given a set amount to start off with—say $40 billion—and then all of the military agencies have to conform to that and, therefore, you have to take off a lot of things that you may require and need in order to comply with that figure at the top.

Do you think that perhaps this might be an answer: Do you think if we added a couple billion dollars at the top, and then during these discussions in the Joint Chiefs of Staff you might permit all of these different agencies to get a little bit more money and maybe they will all be able to wear rose-colored glasses?

General WHITE. I think every service chief would like to have more money. I think Mr. Gates has stated that. While we all support the program as a composite program, if we were individually permitted to change the priorities, each of us would have different priority from that which we support as a composite.

I don't know whether any given number of dollars additional would reconcile these priorities and changes. Obviously at some point they would, because if everybody's priorities were fulfilled then everybody would agree with them.

Mr. ANFUSO. And do you think some additional money would have helped in 1953, 1954, 1955, 1956, and right after the first sputnik?

General WHITE. I can only say that I have been more or less in the front office of the Air Force for a good many years, and I remember no year when any service was fully satisfied with the amount of money it got.

Mr. MARTIN. Or any other service.

Mr. ANFUSO. Would additional money have helped us in catching up with the Russians in those years?

General WHITE. Well, certainly any money that one gets to translate to hardware requires several years' lead time so I can only say "yes." If we had bought more things, or had money for more things several years ago, we would have more things today.

The CHAIRMAN. Mr. Sisk.

Mr. SISK. Just one question, General White. In the light of your answer to my question a while ago, with reference to the continuing need for manned aircraft—and I am inclined to agree completely with you on this, General White—what is your personal opinion on the decision to pull the plug on the B–70 program?

I am asking for your own personal opinion, General White, and I don't propose to put you on the spot, but as I understand this is the only proposed weapons program in the military for a really advanced manned aircraft and I have been somewhat concerned by this. If you could, I would appreciate your giving me your personal opinion on what you think of the situation.

General WHITE. I will do so, sir.

I have certain responsibilities which are relatively narrow, as Chief of Staff of the Air Force. I have certain backgrounds as a professional miiltary airman. I can only say that as I understand you ask me the question that I personally feel that we ought to go on with the B–70 as a weapons system as rapidly as feasible.

The decision was made not to do that. I respect those who made the decision, and naturally I must accept it. We are going to do the very best we can with what we have.

Mr. SISK. I appreciate your answer, General White, because I was asking you for your own personal opinion, and I appreciate having it.

Thank you, Mr. Chairman.

The CHAIRMAN. I want to concur with the general. I think we ought to go ahead with the program.

Mr. Fulton.

Mr. FULTON. General, you are an expert on Government procedures, as well as an expert in your own particular military department.

Actually, it is the Congress of the United States that raises the money for a particular year's budget, and the Congress that then sets what the proportions of distribution will be and gives you the amount that you are entitled to spend in a particular fiscal year of the U.S. Government; is that not right?

General WHITE. I am sure that the Constitution states that the Congress shall raise armies or something to that effect.

Mr. FULTON. There is no element in your answer that would be a criticism of the Congress of the United States during the fiscal years 1953, 1954, 1955, 1956, 1957, 1958, 1959, and 1960, that would make it appear that there has been a strategic failure of Congress to defend this country, or give adequate funds to the military establishment, that have seriously impeded its progress in research, development, or in hardware?

General WHITE. Of course not, sir. My reply was to a question that if we had had more money in past years we would have more forces today. I am not criticizing anyone. I am not saying we should have had it, but it is a fact that had we had more money to buy things with several years ago we would have more things today.

Mr. MARTIN. If we all had more money we would have more things.

General WHITE. That is exactly right. It is a fact of production.

Mr. FULTON. Let me finish on one point. I am interested in the development of thrust and perhaps the Saturn program is not the only program that we can have for the development of large thrust. For example, you have the inverted cone type engine, a jet engine, with the power around the base of the cone.

Can you tell us whether you could have progress in that direction through added research money, if you got it? For example, I would like some competing programs for large thrust, and when you in the Air Force have the capability of an engine with greater efficiency than you get under the ordinary type engine, maybe we on this committee should look into it.

General WHITE. Well, sir, I can only say that in the general case, competition between very much needed elements that go into making up a weapons system is healthy, provided the competition is not wasteful duplication.

Now, as to this particular aspect of it, I think that either General Wilson or General Boushey can give you a more authoritative answer than I.

Mr. FULTON. Why it is that the strategic area in which the Air Force is interested, everything that you would call the cis-lunar area—that is between this earth and the moon—because of the capability of orbiting vehicles that could be brought in in a very short time to a target within the free world—why isn't your strategic area broader than you say in your statement?

I talked this over with General Boushey a couple of years ago, and I think we both agree that it is clear out to the moon.

General WHITE. Well, I personally think that getting out to the moon is something that may well develop as a military requirement, but at the moment I am advised that the real requirements from a military point of view, are at relatively lower altitudes; several hundred miles from the Earth's surface.

Mr. FULTON. There has been testimony here before this committee on this particular set of hearings that probably within this coming year, the Russians will have a soft landing on the moon. Would the establishment of a base by a potential enemy on the moon that we could not in any way reach give them freedom of action and, therefore, a strategic advantage that would cause us to have a less capable defense in the United States?

General WHITE. I do not rule out any possible developments from space. I can only say that as of the moment we have not figured a way to use the moon for a military purpose, which would be either cheaper or better than ways that we have in the present state of the art to do the same mission.

Now, what the future would reveal, my imagination tells me we don't begin to know, but we should not close our minds to the possibilities.

Mr. FULTON. That is all. Thank you.

The CHAIRMAN. Mr. Hechler has one short question.

Mr. HECHLER. A very quick question, General White.

You were talking about leadtime. I wonder if you would comment on what you feel the importance of a strong educational system is, in relation to the strength and national defense of our country a decade hence.

General WHITE. I am out of my field, certainly out of my responsibilities, but I think that history shows that an educated populace is a better population as a whole. I think that there are many requirements in the educational field. I think we must, of course, keep up, advance, improve our technical education. We need to have youth encouraged to go into the more difficult disciplines, shall I say certainly in my own case, and I think in the popular view—mathematics, physics, chemistry, nucleonics, and so on—are among the difficult disciplines. We must encourage the young man to take that kind of an education.

On the other hand, I think that the humanities have a very great value, because science alone and things alone do not make a good civilization. So there is a balance in which I am not qualified to predict or to recommend but we certainly must have both, and I would give emphasis in the present state of affairs to the scientific side.

The CHAIRMAN. I don't want to cut off anybody, but we promised to let the General go early, and we have another very important witness this morning, General Roscoe Wilson, Deputy Chief of Staff.

Mr. QUIGLEY. General, if the Bureau of the Budget recommends additional funds for military expenditures, and if the administration recommends additional funds for military purposes, and therefore these additional funds are recommended or included in the budget message, then isn't it easier for the military services to get these additional funds from Congress than it is if they are omitted from the budget message?

General WHITE. Well, the executive side of the Government, the President, sends his budget to the Congress and presumably——

Mr. QUIGLEY. If these additional funds are included in the budget message, then it is easier to get those additional funds from Congress than if those additional funds are omitted from the message; isn't that correct?

General WHITE. I would assume as a general case that is true. You mean as opposed to a supplemental?

Yes, I think I would agree.

Mr. MCCORMACK. General, I have been in Congress 32 years. I don't know much. When Congress appropriates money, how can we force the executive to spend it if the executive doesn't want to? I refer you to Nike-Zeus and I can refer you to other things—the 900,000-man Army, the 200,000-man Marine Corps. Will you just tell us, when we do all these things you talk about, how we can force it?

General WHITE. That is a problem, Mr. McCormack, far beyond my purview or ability to answer.

The CHAIRMAN. Mr. Chenoweth.

Mr. CHENOWETH. Last year, General, when you were before a committee, you made some estimate as to what the future of the manned air force was in the Air Force program.

I think you made some predication that perhaps in 10 or 15 years it might be obsolete. Would you care to comment on that? I want to be sure I have your thinking on that.

General WHITE. I don't believe I said it just that way, Mr. Chenoweth. Earlier today I have stated what my thesis is, and I am sure it has been that right along. As far into the future as I can see, we will have a requirement for manned aircraft, and perhaps manned space vehicles. But the ratio under the conditions as I foresee them now, of bombers—we will take that one field—to other types of strategic weapons, will decrease. The exact ratio will probably never be static for very long, but as a general rule for the immediate future, the ratio will go down.

Mr. CHENOWETH. Thank you very much, General.

The CHAIRMAN. One more question and then the Chair is going to call the next witness.

Mr. Fulton.

Mr. FULTON. I am sure the good gentleman has never forgotten when Congress said to you, "Instead of a 48-group Air Force you should have a 70-group Air Force," and we couldn't get the President clear back in 1948 or 1949 to go ahead and give you the planes. Could we?

General WHITE. I don't know, sir.

Mr. FULTON. You remember that, don't you?

General WHITE. I remember many——

The CHAIRMAN. Thank you very much, General, for coming here and before you get away I want to say that you have sent us for liaison an excellent man there, and that is Col. Jack Sims, and I want the record to show how cooperative he has been with this committee.

We certainly thank you for coming and bringing your able Deputy Chief of Staff with you. We will hear him in a moment, and, as I understand, you have a very busy schedule so we are going to release you.

General WHITE. Thank you, Mr. Chairman. As always, it is a pleasure, and an honor to be here.

Mr. MARTIN. I am very delighted to know we have such an excellent man at the head of our Air Force.

Mr. FULTON. And such a diplomat.

The CHAIRMAN. Now, Lt. Gen. Roscoe C. Wilson, Deputy Chief of Staff, Development, Headquarters, U.S. Air Force.

We are pleased to have you, General Wilson. You have a statement. I have been glancing through it. It is a very fine statement. We will appreciate your presenting that statement to the committee.

You have sitting with you General Boushey. We are happy to have General Boushey, too. We know him and we know he has a wonderful background. With men like you in the Air Force we can depend upon you.

STATEMENT OF LT. GEN. ROSCOE C. WILSON, DEPUTY CHIEF OF STAFF, DEVELOPMENT, HEADQUARTERS, USAF, ACCOMPANIED BY BRIG. GEN. H. A. BOUSHEY, DIRECTOR, ADVANCED TECHNOLOGY, USAF

General WILSON. Mr. Chairman and members of the committee, I am honored to appear again before this committee to discuss the U.S. Air Force activities in development of military space systems.

I thought that in the course of this discussion, sir, I would like to pursue the philosophy you discussed with us in the Pentagon about 3 weeks ago.

The Air Force, throughout its history, has constantly strived for greater speeds and higher altitudes, because as our speed and altitude capabilities have increased, the military effectiveness of our weapon systems has experienced a corresponding increase. We are confident that the exploitation of space through militarily significant space systems will increase our ability to deter attack on this Nation and to strike effectively in the event of attack.

The first point that I would like to make is that in our view space is a location. It is not a function, nor a military program. Secondly, space is only a part of a larger location which we call the aerospace. The term "aerospace" has solid scientific foundations. The physical characteristics of this location are such that it is impossible to set a limit on the end of the earth's atmosphere and the beginning of true space. This environment has gradually changing physical characteristics, but unlimited extension. Thus, aerospace is a meaningful term necessary to the understanding of our future military operations.

The Air Force does not compartment its activities into aeronautics and astronautics, or into nonspace and space. Because the aerospace is a continuous area of operations, our overall research and development program is oriented toward the fulfillment of military requirements in the most effective manner without regard to the question of where in the aerospace medium the necessary weapon systems will operate. The major criterion for the choice of a particular system to satisfy a particular military requirement must be the relative effectiveness of that system compared with other methods of doing the same job.

When we apply this criterion of relative effectiveness to military space systems we consider that the Air Force should develop a space system to perform a particular function if—

(*a*) It is the only way to do the job. For example, satellite interception; or

(*b*) It is the best way to do the job, and is not prohibitively expensive. For example, early warning and tracking of hostile ICBM's; or

(*c*) It is the most economical way to do the job. For example, certain communications requirements can be met in different ways. An artificial ionosphere or a satellite system may prove to be the least expensive.

Our research and development program has the dual purposes of providing the technical information on which these decisions can be based and of developing operational weapon systems.

The Air Force does not separately identify a space research and development program. However, it is possible to discuss the part of our research and development program which is primarily oriented toward operations beyond the sensible atmosphere of the earth. I emphasize, however, a large part of our effort is applicable to both aeronautic and space systems and, hence, is aerospace.

The Air Force research and development program, since World War II, has provided the background and capability for the military exploitation of space. Without the knowledge, techniques, and equipment resulting from our extensive research and development on aircraft and missiles, we would not now be approaching the operational use of military space systems. In fact, the major portion of the total U.S. effort in space is based on propulsion, guidance, and control, and other techniques and hardware that resulted from Air Force research and development. We are confident that this background of knowledge and experience, together with the knowledge and experience which our tremendous supporting industrial complex has accumulated, will be a major factor in the technological struggle which we face.

Our current research and development effort in space is in three parts. The first area of effort is the study program. This program, while small from the standpoint of expenditures, has proven its worth many times. In this program, the Air Force and the industry consider new methods of doing a particular military job, and the systems that would be required by these new methods. In this way, we benefit from the efforts of many experienced and knowledgeable people and are able to pick and combine the best of many ideas. Currently, a major portion of our study program is directed toward possible space offensive and defensive weapon systems.

For example, we have studies on offensive orbital systems ranging from a low orbit Dynasoar-type vehicle to offensive systems dispersed and hidden in the vast reaches of space 100,000 miles or more from the earth. In the defensive area we are considering systems that will enable us to inspect satellites and determine their intentions, and space-based ICBM defense systems. Other studies are on recoverable boosters, reconnaissance, and space logistic, maintenance, and rescue ssytems. These studies include both manned and unmanned systems.

Our second area of effort is in applied research on space components and subsystems. In this program, our aim is to develop techniques that will provide the basis for development of future weapon systems. One extremely important part of this program is concerned with space power systems. The typical military space system must have a long, useful life. A critical factor in attaining this long, useful life is the necessity for reliable electrical power generation with the minimum weight of equipment. We are actively working on methods for generating electrical power such as converting solar energy directly or mechanically, direct chemical conversion—a sort of continuous battery—and direct conversion of heat from either solar or nuclear sources. We are also much concerned with propulsion techniques, both for boosters and for low-thrust propulsion in space.

Propulsion is the key to space use. Up to the present we have not learned how to scale up a missile propulsion system to increase its thrust. Thus, each program must be undertaken as a separate and distinct development effort. On the other hand, there is every reason to anticipate a series of significant achievements in propulsion over the next decade.

For example, chemical propellants presently operate well below their 400-second theoretical limit in specific impulse. The result here is that only a small percentage of system gross weight is available for payload. Upward progress in specific impulse is forecast with improved chemicals, nuclear rockets, controlled nuclear explosion, ion rockets, and magnetohydrodynamic devices. Such advances will result in dramatic increases in payload percentage despite a significant increase in fixed weight of systems.

These and other advances will not be automatic. To achieve them we must support a selective research and development program carefully directed toward anticipated requirements. The boosters which we are currently developing for our ballistic missile programs have been designed for military missions. As you have heard in previous testimony, they are also proving to be the mainstays of our satellite and space systems. Nevertheless, it is apparent that Thor, Jupiter, Atlas, and Titan boosters will not be adequate for all of the systems we anticipate.

I will not go into detail on the third area of effort, the current Air Force space systems development. You have already heard about the Discoverer, Samos, Midas, and Dynasoar systems. General Schriever will cover the status of these systems in detail in his testimony tomorrow.

I would like to address myself to the question of possible military space systems of the future. Many of these systems have characteristics that we can foresee at this time. These systems can be grouped in the usual four military areas:

1. Defense.
2. Offense.
3. Reconnaissance and surveillance.
4. Support.

As with the aircraft, the first operational military space systems will be for reconnaissance and surveillance.

In considering the offensive possibilities, we must mention that the ICBM is essentially a space system. The same techniques, knowledge, and hardware are necessary for ballistic missile systems as for space systems. There will be improvements in ballistic missiles; improvements which will make them more effective weapon systems, and which will greatly complicate the problem of defense against them. We also envision other offensive systems which would fall into the category of space systems and which would greatly increase the Nation's strategic military power.

It appears that for some time to come the offense will continue to maintain ascendency over the defense. The U.S.S.R. has the capability to develop advanced offensive systems. Therefore, we must make every effort to provide a defensive capability against both the ICBM and offensive space systems.

We have concluded that it will be possible to provide effective defensive measures against some offensive systems through the use of defensive military space systems. However, the timing of developments is such that our primary defense of the future as in the present must be based on the capability of our strategic forces to deter war, or, failing that, to survive an initial attack by passive measures.

The cost of satellite systems, is the source of much concern to us in the research and development program. In considering the various systems which could perform a particular military mission, we are constantly aware of the present high cost of putting a pound of payload in orbit. We are endeavoring to reduce that cost to 10 or 20 percent of the current figure.

To make reductions of the order we desire, we are studying the possibility of recovering the boosters which put our satellites in orbit. Here I would like to draw an analogy. Our present approach resembles a situation where we would load a jet airliner with passengers and fly it, without first test flying it, from New York to Los Angeles and then throw the airliner away on arrival. Obviously such an operation would be wholly uneconomical for the airline. If we find ways of recovering the launch vehicles for repeated reuse, we can greatly reduce the cost of placing numbers of satellites into orbit.

We are studying two ways of recovering boosters. One is by using parachutes carried in the main stage. The other is by using an advanced aircraft, say of the B–70 class, as the first stage.

Another approach is to use the boosters developed for scientific space programs. The ingredients of a military R. & D. program for "space" systems, like those of aerodynamic systems, are quite different than those of a scientific program. In the booster area such factors as military urgency, fast reaction, reliability, cost, concurrency and complexity of operations combine to make the military requirement incompatible with development for space exploration. It is expected that the civilian space program will require boosters of very large thrust. In this regard, the civilian and military requirements are similar in that many of the future military payloads will also require very large thrust. However, the military satellite will almost certainly be launched in much larger numbers than will the civilian space vehicle.

Consequently, the recovery and producibility aspects will be of much more importance to the military than to the scientist. The military booster research and development program will be more economical if we spend more money initially incorporating recovery, reproducibility, simplicity, and reliability into its development concept.

Checkout time on the launch pad is another factor which must be drastically reduced before this Nation can afford a large military space program. Again this becomes an important factor only when large numbers of boosters are considered. Reliability is also a different problem for the military for similar reasons. In addition, it is conceivable that the military space vehicle will require a fast reaction capability whereas the civilian program does not need to pay for this capability during the development stage. While these are only a few of the factors involved, it should be apparent that very detailed coordination will be required whenever joint usage of large thrust boosters is envisioned. We expect to benefit greatly from the scientific and technical knowledge generated by the NASA; we also expect the NASA booster program to reflect military needs where possible without compromising their mission; but we believe that a booster program designed to meet military needs will in the end be necessary to make military space systems economically feasible.

In conclusion, I would like to reemphasize that the Air Force does not look on space as a function, but as an extension of the area of our operations. Our development efforts are geared to that philosophy and space systems must stand on their merits in comparison with other systems. We are confident that the Air Force research and development program can provide the capabilities required for the effective military exploitation of the entire aerospace medium.

The CHAIRMAN. Thank you very much, General Wilson, for your detailed statement. We appreciate it.

Would you like to elaborate, General Wilson, on any additional needs that these programs referred to by General White—the Midas, the Samos, the Discoverer, and the X–15—that there might be for additional funds there?

General WILSON. We are satisfied with the progress we are making in the Discoverer which as you know, sir, is the first stage of development, really, for the Midas and the Samos. This is the basic research portion of that program.

We are also satisfied with the progress on Samos because it is somewhat down the road and we think we are spending what moneys we have now effectively in this time period.

On the Midas we are not quite so sure as to what our needs will be. For the moment we are all right. But we are increasingly optimistic about the Midas program. We have high hopes for it and it is quite possible within the very near future we may need more money to exploit what comes out of this program.

So very briefly, I must say that we appear to be all right at the moment, but tomorrow we might need a great deal of help.

The CHAIRMAN. You overlooked the X–15.

General WILSON. We are satisfied with the X–15 program.

The CHAIRMAN. Mr. Fulton.

Mr. FULTON. I would like to have your judgment as to whether there will be, within the years 1961 or 1962, a gap, or deficiency in our defense capabilities in the United States as against any potential enemy, or grouping of enemies as far as the Air Force is concerned? That is based on the assumption that I had thought we had the best Air Force in the world and that in the present and projected future we were going to maintain it on a balanced approach, with many types of weapons.

Now, if that is not so and one country, for example, by an oversaturation in number of missiles, can wipe out your defensive capabilities in the U.S. Air Force, I would like to know it.

Would you please comment on that?

General WILSON. Well, sir, I can only comment, of course, from my position within the Air Force.

Mr. FULTON. I want it from the Air Force point of view completely.

General WILSON. And I would like to make this a personal answer if I may, sir.

Mr. FULTON. But only in your official capacity.

General WILSON. I think we have to look at all of our weapons systems in their entirety. It is possible that we may be behind in certain categories of weapons, but ahead in others.

If I could digress for a moment, there may be critics in Russia who might complain that there is a carrier gap since the Russians don't have any.

In this country my judgment is that at the moment we have a good Air Force, because we have at the moment the weapons systems that would appear to be capable of coping with the job with which we are faced.

Now, it is my job in the development side to make certain that technically no gap opens up in the future. You understand, sir, that I am not in the production or the numbers racket.

Mr. FULTON. That is why I ask for your judgment.

General WILSON. I think if we stay on the course we are on now, we have considerable assurance there will not be a technical gap open up which will be felt in the 1965 period and beyond which is the area in which we are interested.

Mr. FULTON. Not leaving my question, but asking simply for an explanation, what do you mean by the two words "considerable assurance"? I don't understand.

General WILSON. This may be because I have been dealing with scientists for a long time, sir, and hate to make flat statements. I, myself, have complete confidence.

Mr. FULTON. In what?

General WILSON. That we have the capability to cope, today, with an enemy situation.

Mr. FULTON. And in the future?

General WILSON. In the future I have the same confidence.

Mr. FULTON. Thank you. That is all.

The CHAIRMAN. And would you likewise give your own personal views to show how they differ from the official views?

General WILSON. I am not sure they differ at all, sir. I am just trying to make clear that I am a specialist in the Air Force and hesitate really to comment on the operational areas, on which I am simply tangent.

The CHAIRMAN. Mr. Miller.

Mr. MILLER. No questions.

The CHAIRMAN. Mr. McDonough.

Mr. McDONOUGH. No questions.

The CHAIRMAN. Mr. Anfuso.

Mr. ANFUSO. General, are you taking into consideration all of our offensive and defensive capability, and comparing that with the Russian offensive and defensive capability?

General WILSON. Yes, I am, sir.

Mr. ANFUSO. You mentioned the year 1965. Did you mean by that that in 1965 we will have that offensive and defensive capability?

General WILSON. By that, Mr. Anfuso, I meant that the efforts of the research and development begin to have their effect on the force in being about 5 years in the future. And so it is in this area that we are working now to make certain there will be no technical gap developing between us and the Russians.

Mr. ANFUSO. Will we be vulnerable at any time before that?

General WILSON. I don't believe so, sir. Not on the technical side. Not on the scientific side.

Mr. ANFUSO. Let me ask you, General, can you tell us the comparative destructive capability of a bomber loaded with atomic bombs as compared with an ICBM, or IRBM?

General WILSON. I believe this is classified, sir.

Mr. ANFUSO. You will give us that later?

General WILSON. I will be happy to get you the information.

Mr. ANFUSO. Do you believe in satellites that can carry out both military and civilian functions, or in vehicles which could land or take off from a manned space station?

General WILSON. We have adopted an open-end philosophy in our thinking. We have no designs at the moment for such a device, but at the same time, we recognize the possibility that this could happen. Our process has been to project our present technology as far into the future as possible: To include lunar bases and lunar landings and lunar weapons systems, and beyond. But not to start at this time to devote our energies on that end of the spectrum, but rather to devote our energies to the nearer end of the spectrum so that we can take advantage of moving into this outer area as our technology progresses and our needs demand.

Mr. ANFUSO. Just one final question: On page 9 you refer to the military booster research and your desire to recover the booster, which would be a very laudable thing to do and would save this country a lot of money.

General WILSON. Yes.

Mr. ANFUSO. Do you have the money to carry out that research?

General WILSON. We have the money at the moment to carry out the studies and to make certain starts on the program. We have enough money to do this. As soon as we hit paydirt in any of these areas, we will need more money in these areas, which we could probably either get from reprograming, or perhaps we would have to ask Congress for assistance.

Mr. ANFUSO. Thank you, General.

The CHAIRMAN. Mr. Chenoweth.

Mr. CHENOWETH. General Wilson, I want to commend you on a splendid statement. I think it one of the most impressive statements that I have heard in our whole series of hearings and it has greatly impressed me.

General WILSON. Thank you, sir.

Mr. CHENOWETH. As I understand it, the so-called space program as far as your part of the Air Force is concerned is just one of the components of the whole Air Force program. We are not relying solely on space vehicles or satellites, it is just a part of our overall offensive and defensive program.

General WILSON. Yes, sir.

Now, we have been evolving this philosophy and we checked it with the chairman the other day to be sure we were on the right track. There is a tendency to think horizontally, terrestrial, air, and space. We have been trying to think vertically in terms of weapons systems and to make these systems competitive.

The military requirement governs. Then we pick the best way to do the job.

Now over and above all this is the national space program which is indeed a horizontal show. But we feel this is probably the job of the NASA, and our job is to stick to the weapons systems.

Mr. CHENOWETH. You are trying to produce the weapons which you think will be of some benefit to the Air Force, either from an offensive or defensive standpoint.

General WILSON. That is correct, yes, sir.

Mr. CHENOWETH. On page 4 you referred to your studies dealing with offensive systems dispersed and hidden in vast reaches of space 100,000 miles or more from the Earth.

Would you care to elaborate on that just a little?

General WILSON. I would love to, sir, but this is classified. It is a very intriguing sort of an idea.

The CHAIRMAN. We will go into executive session later on.

Mr. Quigley?

Mr. QUIGLEY. No questions.

The CHAIRMAN. Mr. Sisk.

Mr. SISK. General Wilson, on page 9 right after you discussed the recovery possibilities you start the second paragraph with the statement that checkout time on the launch pad is another factor which must be drastically reduced before this Nation can afford a large military space program.

General WILSON. Yes, sir.

Mr. SISK. What do you mean by that statement?

General WILSON. Well at the present time every one of our launchings resembles a scientific experiment. We have vast arrays of equipment all over the place. We have large numbers of people, we have instrumentation checking on instrumentation. All of this costs a great deal of time and a great deal of money and the efforts of a lot of people. These things should be reduced to some sort of an automatic process to save time, effort, and money. This is what I mean, sir.

Mr. SISK. Well, the reason that I asked this question is because of a statement of the Secretary of the Air Force yesterday in answer to a question. It was a point I would have liked to have pursued at the time, but we did not have the time. It had to do with the fact that a 15-minute warning was sufficient. In other words, if we had 15 minutes' warning, we would have ballistic missiles in the air.

Now, I have visited Patrick Air Force Base, and, of course, we have Vandenberg out on the west coast and so on. I have some very grave doubts about that statement and I simply wanted an explanation of what we are talking about here. I agree with this statement, but I think at least at present, even our so-called operational equipment, launching is still a rather slow and tedious business, isn't it?

General WILSON. It can be greatly improved, Mr. Sisk, as you well know. Yes, it is slow and tedious. And with a certain amount of misfortune, our timing could be delayed. But we are gaining ground. We are getting better and in the future we are going to get very much better in this area.

Mr. SISK. I appreciate that and I realize the necessity of the time element in launching and the checking and everything that must go on and I simply wanted to clear up this idea because I felt that the statement yesterday—and it may have been meant in a little different way, but it seems to me it left entirely the wrong impression because I think today, with a mere 15-minute warning, that we probably wouldn't have an ICBM in the air anywhere.

Certainly, based on what we have seen of our ability to launch—and I question that Russia could launch one in 15 minutes and I haven't seen their operation—but knowing the technical problems that you people are going through in this, I agree completely with your statement here. But I think it is important that people realize that we have a long way to go to get these things to where it is just automatic and you snap a button and it is on the way.

General WILSON. Well, this opens another area that we have taken under study. We have no solution for it at the moment, but that is how do you reduce the time of the decisionmaking process, which can be even more critical than the time to get the missile off its pad. This is a very difficult problem.

The CHAIRMAN. Mr. Bass.

Mr. BASS. General, I believe you testified earlier—I just want to make sure about this—that in your opinion, at the present time we have overall military superiority over Russia, is that correct?

General WILSON. Yes, sir; this is my opinion. I think General Power has the world's most powerful force. I see it occasionally. He has it under control and I am convinced that we have overwhelming superiority, today.

Mr. BASS. And, in your opinion, do you feel that for the balance of this year and for 1961, as the President had budgeted for defense do you feel that this is an adequate program to enable us to keep our military superiority over Russia?

General WILSON. I can't give a yes or no answer to that, Mr. Bass. I have to answer it this way: We have adequate funds to do what we are doing, now, but we are very hopeful of some breakthroughs in several areas. If these should occur, to exploit them properly, we probably will come back to Congress with a request for more money.

An example of this is the Dynasoar. At the moment it is moving along rather slowly. But if it lives up to our expectations, it can become an expender of very large sums by next year. There are several areas of this sort.

Mr. BASS. I understand, General, but for the present, at least the way things are at present, are you satisfied with the budget?

General WILSON. For the present, yes, sir.

Mr. BASS. Now, there has been a lot of newspaper publicity——

General WILSON. May I qualify this a little bit, too. We have a shifting situation in research and development and it is necessary to switch funds from project to project. Within this flexibility at the moment I am satisfied. But if you should take one project out and say, "Are you satisfied with the funding on this particular one, today?" I may not be. Do I make myself clear, sir?

Mr. BASS. What particular one?

General WILSON. For instance, we have great expectations for Midas. We could use a little more money on Midas, now. We probably have more money in Dynasoar than we can spend at the moment. I would rather take the money from Dynasoar and put it on Midas. It is an internal adjustment.

Mr. BASS. That is an internal adjustment but the overall amount seems reasonably correct.

General WILSON. Yes, sir.

Mr. BASS. There has been a lot of publicity over General Power's statement the other day, particularly with his contention or his statement that in his opinion we ought to budget funds right now for a 24-hour alert for his SAC forces. Do you agree with that?

General WILSON. This is really a little out of my sphere. I am an R. & D. type. I will answer it this way, sir: We have the world's most powerful military force. We don't have at the moment the defense against all of the things that the Russians might come up with in the next year or so.

To protect that force we have to resort to passive means and one of these passive means is the air alert. General Power is the expert on the techniques, whether he shall go to dispersion, hardening or air alert. It is his military judgment that that is the best way to go along. Since I can't improve on his judgment, I would have to back him up, you see.

The CHAIRMAN. Mr. Hechler——

Mr. HECHLER. General Wilson, I would like to add my compliments on your fine statement. I have no questions.

The CHAIRMAN. Mr. Moeller.

Mr. MOELLER. No questions.

The CHAIRMAN. Mr. King.

Mr. KING. General Wilson, could you state once more in the simple language of the layman, where the delineation of authority is between the Army, the Air Force and NASA, insofar as they are in the space field?

General WILSON. May I take the military side first?

Mr. KING. Yes.

General WILSON. As they exist today, there are four agencies concerned. There is ARPA, which is engaged in far-ranging studies. And each of the services are engaged in studies of their own particular weapons systems needs. The Army, for instance, is charged with the payload of the interim communications satellite.

The Navy has been given payload responsibilities for Transit, the navigation satellite.

The Air Force is charged with the entire systems responsibility for Midas, Samos, Discoverer—plus putting the Army and the Navy systems into orbit and integrating their payloads into the package that puts them into orbit.

Is that clear, sir?

Mr. KING. Now, our ICBM's that presumably are or will be shortly in readiness to go into action as a retaliatory measure if necessary and so on, are they the joint effort of the Air Force and the Army?

General WILSON. No. Those are assigned to the Strategic Air Command. Those that are operational. They are the Atlas, Thor, and

Jupiter. They are assigned to the Air Force for operational purposes.

Mr. KING. The Titan?

General WILSON. Titan is still in the research and development stage. It is assigned to the Air Force. That is an Air Force project. When it comes into operational status, it will be assigned to the Strategic Air Command.

The CHAIRMAN. Mr. Miller.

Mr. MILLER. General, you said, I believe, we have the world's most powerful military offensive capability in the world today.

General WILSON. Yes, sir.

Mr. MILLER. Then you qualified that by saying that we did not have—I am paraphrasing it now, as I remember it—a defensive apparatus to compare with that at this time, is that correct?

General WILSON. I believe I said, sir, that we don't have the defensive means to cope effectively—I meant effectively—with the weapons which the Russians might develop in the next year or two. I would like to qualify that once more, sir, by saying, "active" defensive means. We do have certain passive means.

Mr. MILLER. I appreciate that. Active defensive means.

Insofar as you know, if it is not classified, have the Russians, admitting that they too have a great offensive potential, have they an offensive potential any greater than our offensive potential?

General WILSON. To the best of judgment they have not, sir.

Mr. MILLER. That is one of the reasons that we have a stalemate, today.

General WILSON. Yes, that contributes to a balance.

Mr. MILLER. There is a balance there.

The CHAIRMAN. General, may I ask you a question or two here: This simplification program that you referred to, is that funded? I have been told by the Air Force there was nothing we could save as much money on as a simplification program and it is not underway, is it?

General WILSON. No, sir.

The CHAIRMAN. Why is that?

General WILSON. Well, it is in part. I think I must confess to you that our thinking is just being straightened out in this whole area. We have just evolved these thoughts and gotten ourselves straightened out within the last year. We are already funding certain reliability programs. These are an important part of the simplification program.

For the rest, they are in the study stage and we do have some funds in this area to see what we can do. Now, as soon as we can determine what we can do we will go ahead and do it.

The CHAIRMAN. Well, is there any phase of research there that the Air Force feels it should go into, that you are denied the right to do?

General WILSON. No, sir.

The CHAIRMAN. So in every phase of your research and development program you are satisfied with it, then?

General WILSON. I must qualify this, Mr. Chairman. I am an R. & D. man——

The CHAIRMAN. That is why I am asking you that, too, General.

General WILSON. And I can always think of things that we would like to do and would like to spend money on.

We do have in the Air Force a group——

The CHAIRMAN. Tell us about every one that you have in mind that has in your mind a DX priority.

General WILSON. I would like to consider this. May I put it in writing for you, sir?

The CHAIRMAN. I wish you would.

(The information requested is as follows:)

The following programs have a DX priority and are funded to meet the schedules as presently planned:

Atlas.
Titan.
BMEWS (Phase I).
Samos.
Discoverer.
Minuteman.

The funds that we are requesting in fiscal year 1961 are adequate to meet the requirements of the program as scheduled. However, it is conceivable that a technical breakthrough or an unusual degree of progress may dictate that more money be made available to exploit the event and thus to compress the present schedule. In the event that more money is required in any area, we have three courses of action open to us, depending upon the type of unforeseen success and the amount of money required to exploit it. We can reprogram within our existing program. This means eliminating or reducing funds for some other approved project. We may request money from the DOD emergency funds. And finally, we may request additional funds from the Congress.

Although the Midas program does not have a DX priority as yet, the Air Force considers it one of the highest priority projects and is endeavoring to obtain a DX priority comparable with the urgent requirement to add this system to the Air Force inventory. Based on present reviews of this program, we can already foresee a need for additional funds in fiscal year 1961. These funds will continue the fabrication of vehicles, continue the engineering efforts at an optimum rate, and take similar actions to hold the program to schedule.

The CHAIRMAN. I am perfectly willing to come back here this afternoon if the general can do it and the members would do it.

Mr. ANFUSO. Mr. Chairman, I will not be able to be here. May I ask him one question?

The CHAIRMAN. Wait just a minute. Let's get this settled. I don't suppose there are enough members who will be able to make it this afternoon to justify the general coming back.

Mr. FULTON. I suggest we finish this morning.

Mr. MOELLER. Will we have an executive session?

The CHAIRMAN. We can't do it this morning. We won't have time. General, you will give us a complete list of those and approximately the amount of money that you need in reference to them.

General WILSON. Yes, sir.

The CHAIRMAN. Do you feel the Air Force should have a monopoly on the military use of space or do you think that a change in organization such as a joint command, or a joint development program would improve the situation?

General WILSON. No, sir, I don't agree that we need either of those. My whole thesis has been that we are considering systems, weapons systems in the military, and I believe that each service should develop its own requirements for its own weapons systems and pursue them. There is the means among the services and with the NASA for flow and exchange of information and I certainly don't see the need for a common command to do this sort of work.

The CHAIRMAN. You think there is enough coordination now to get the results from every service and from NASA and everything else that you need?

General WILSON. I have noticed an increasing exchange. There is enough now and I think it is getting better because the spirit is getting better.

The CHAIRMAN. I am glad the spirit is improving.

Mr. Anfuso?

Mr. ANFUSO. General, do you have any knowledge upon which to base an opinion as to the number of ICBM's, IRBM's, and submarines with atomic power that the Russians will have in 1961, 1962, 1963, and 1964?

General WILSON. I have not, sir, personally.

Mr. ANFUSO. And of course the numbers of weapons I have mentioned will alter the previous opinion as to our military security for those years, will it not?

General WILSON. Yes, sir.

You see, the military side of the house determines the requirements and one of the controlling factors of that determination is intelligence—intelligence based on capabilities. Somewhere in this process, those factors are considered, but at my stage of the game I do not have any personal knowledge of it.

Mr. ANFUSO. Thank you.

The CHAIRMAN. Mr. Fulton?

Mr. FULTON. I think Mr. McCormack of Massachusetts and I are always interested in the Air Force's use of the word "aerospace," and we always get quite a chuckle out of it when you come up here because it seems to be either a badge or a defense. So many witnesses use it and they put it right at the beginning of their statements.

Now, I have been thinking of that since you were here and I told Mr. McCormack I was going to ask you some questions about it because you say the term "aerospace" in your statement has solid scientific foundations.

I was at one time going to be an economics and mathematics professor and was a fellow in it in my senior year at school, and I'd like to, in that context, do some defining with you.

General WILSON. All right, sir.

Mr. FULTON. I would agree with you that space is a location, but to me I think it might be better to say that it is an infinite series of points in three dimensions.

General WILSON. All right, sir; I will agree with that.

Mr. FULTON. And then on your word "aero." It is rather peculiar that your word "aero" doesn't even have in it the context atmosphere, or an atmosphere. So, on your own premise, I would take your word "aero" to mean something like this, that it would be a chemical mixture of gases with varying proportions and decreasing density and a lessening of the occurrence of the elements as well as a lessening of the pressure extending from the earth—and I don't say the surface of the earth—extending from the earth through either the ionosphere or the troposphere.

Now, the rather remarkable thing about that definition is, I am defining chemical elements, and then you hitch on a definition of chemical elements to a point of geography called space. So I don't think you have solid scientific foundations to hitch geography to a chemical mixture and make a word "aerospace." Now, do you?

General WILSON. We have solid scientific foundation for some term. Maybe the artifically manufactured word "aerospace"—perhaps it should be "aero-space"—isn't precisely the word. But we do need some sort of a word that describes a vertical slice from the surface of the earth to infinity and we can't think of a better——

Mr. FULTON. You see what you get into with that, the other services see the word on your posters whereby you recruit people and you are assuming unto yourselves complete jurisdiction of the air, atmosphere, and outerspace, which cause trouble.

The CHAIRMAN. Would the gentleman yield? I just asked him if he thought the Air Force had a right to a monopoly. I had it written here so I could follow it and I asked General White that and they both denied it. Frankly, I think we are straining at a gnat when we question the word "aerospace."

If we can come up with a better word, that is something else.

Mr. FULTON. I yield to Mr. Hechler.

Mr. HECHLER. I think it was a great loss to the teaching profession when Mr. Fulton decided not to become an economics and mathematics professor. [Laughter.]

Mr. FULTON. I might say I wound up as a corporation lawyer because I couldn't make any money in teaching.

I am serious about this word "aerospace" and I am sure Mr. McCormack is, because it seems to be a fundamental of the Air Force premise when they come before committees on jurisdiction. Now, it is not a small thing. And it is all very well to defend and to deny monopoly, which, of course, I would expect. But it is a much different thing as to who has the basic jurisdiction, beginning at some point on the surface of the earth and extending outward.

For example, I think probably the Air Force is moving up so that the Army is taking over ground cushion effect. So from a point of 6 inches to 8 feet you have moved away from that surface. Likewise I think you are moving away from the vertical takeoff, and then moving that vehicle into close ground support and hedgehopping. You are moving out of that, aren't you?

General WILSON. No, sir, not at the moment. We do have an active project in this area. This is the VTOL-STOL program. Mr. Fulton, I am sorry that this term is objectionable to you. I am sure we would adopt anything that would describe a vertical way of looking at this. That is what we are searching for.

The CHAIRMAN. May I say this, if my colleague would yield, that there is enough bickering over there in the Pentagon that we ought not to have the bickering here over that question.

If the gentleman will come up with a better word I will be the first one to use it.

Mr. FULTON. I will be the first one to move to strike that remark in all good grace from the record.

The CHAIRMAN. Well, there is enough bickering over there.

Mr. FULTON. I don't want to characterize something that is not serious to you. It is to me. It is within our jurisdiction.

The CHAIRMAN. It is not within the jurisdiction of this committee.

Mr. FULTON. It is up to us to look into who is doing certain activities in space, or the atmosphere. This committee has the jurisdiction of both for peaceful purposes.

The CHAIRMAN. Will the gentleman proceed with his questions? I will not interrupt you again.

Mr. FULTON. I don't want to be stopped on the other.

Let me go a little further. I am interested in the big booster program. You heard me explaining my interest in the nozzle-type configuration for big booster engines. I think you have a good start. Now, do you need any money for research and development on the nozzle-type engine, on the possibility of using that as a substitute or an alternative to the Saturn program, and that we might be able to do it much cheaper by getting a big increase in efficiency through your developments already? Now, would you comment on that?

General WILSON. Yes, sir.

This is a fairly new application of an old principle, but it is a new thought and could very easily lead to a breakthrough.

Mr. FULTON. Then, don't you need some money on it?

General WILSON. Yes, sir.

Initially we will get the moneys we need through our internal reprograming process. If the thing indeed turns out to be a breakthrough, we have the authority to appeal to the Department of Defense for additional funds to pursue these breakthrough processes.

If this turns out to be enough, we will be all right. If it doesn't, we will have to come back to Congress. But right now, sir, we have enough to do what we are doing, by the process of reprograming.

Mr. FULTON. Can you put your program and your projection of it in the record at this point? I would like to follow up these various alternatives that may be quicker and cheaper than something we are embarked on, which, as you can see, is running into a tremendous program.

General WILSON. Sir, may I have the time to work this out in writing?

Mr. FULTON. I do want that.

The CHAIRMAN. I wish you would do that.

General WILSON. We will submit it to you, sir.

(The information was received but is classified.)

The CHAIRMAN. Now, General Boushey, do you have a statement to make?

General BOUSHEY. I have no statement to make.

Mr. FULTON. May we welcome General Boushey and say it is always a pleasure to have him. Both on our select committee and on the current committee he has given us every cooperation.

The CHAIRMAN. That is right and he is in charge of advanced technology. He has a very important contribution to make to the Air Force and to the country.

We want to thank you gentlemen for being here and if there is no further business we will adjourn until tomorrow morning at 10 o'clock.

(Whereupon, at 12:10 p.m., the committee adjourned to reconvene at 10 a.m., Friday, February 5, 1960.)

50976—60——32

REVIEW OF THE SPACE PROGRAM

FRIDAY, FEBRUARY 5, 1960

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

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

The CHAIRMAN. The committee will come to order.

This morning we are happy to have a friend of ours here, Lt. Gen. B. A. Schriever, Commander, Air Research and Development Command, the U.S. Air Force. We have had General Schriever before. He is a man whose qualifications everybody knows. We are fortunate to be able to have him this morning.

General, do you have anyone who is going to sit with you to support your testimony?

General SCHRIEVER. No, sir, Mr. Brooks. We have General Yates here who is also scheduled to appear, but I will take care of the situation as best I can; yes, sir.

The CHAIRMAN. We are swearing all the witnesses in and I thought we could swear them all in together.

General SCHRIEVER. General Yates—you might swear him in now. He will testify today, also.

The CHAIRMAN. All right.

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

General SCHRIEVER. I do.

General YATES. I do.

Mr. FULTON. I welcome you both, too, glad to have you, both of you.

General SCHRIEVER. Thank you.

The CHAIRMAN. Now, we won't meet this afternoon. In the first place, General Schriever has an appointment and then some of my colleagues are taking a long weekend off, making speeches. Already they feel the impulse to say something upon this historic week that is coming up. So we won't meet this afternoon. But we do have witnesses scheduled for Monday.

Dr. Sheldon, who are they on Monday?

Dr. SHELDON. On Monday we start in with Navy witnesses. Mr. Beresford, perhaps you have the names of the witnesses?

Mr. BERESFORD. The Secretary of the Navy and Assistant Secretary Wakelin.

The CHAIRMAN. We can't postpone those, so I hope everybody can be present Monday.

Mr. FULTON. May I ask is the Sisk bill listed for action?

The CHAIRMAN. Yes, Monday afternoon, so we won't meet Monday afternoon. That is in good shape and it ought to come up without any trouble Monday afternoon.

Mr. FULTON. I say to the members of the committee, I have had one request for time on the Republican time, but feel free to ask whether it is Republican or Democrat. My understanding is that we only have 20 minutes on either side. I want any member of the committee to feel free to ask for time.

The CHAIRMAN. I am satisfied we will take most of the time.

Well, General Schriever, we are happy to have you this morning. You have a prepared statement?

General SCHRIEVER. Yes, sir; I do.

The CHAIRMAN. If you will proceed, we would appreciate it.

General SCHRIEVER. All right, sir.

STATEMENT OF LT. GEN. B. A. SCHRIEVER, COMMANDER, AIR RESEARCH AND DEVELOPMENT COMMAND, U.S. AIR FORCE, ACCOMPANIED BY COL. BERYL L. BOATMAN, EXECUTIVE OFFICER, HEADQUARTERS, ARDC

General SCHRIEVER. Mr. Chairman and members of the committee:

It is again a pleasure for me to appear before your Science and Astronautics Committee.

This is a welcomed opportunity to talk with you about the Air Force research and development program as it pertains to space.

But, before proceeding, I would like for a moment to recall my last appearance before your committee. As you recall, that was last July 28. Following those hearings, you and your committee, in its report to the Speaker of the House and to the public, expressed confidence in the Atlas program. I quote:

> It is the belief of the committee that the Congress and the American people can be assured that the development of our ICBM strength has suffered no real setback by recent events, and can confidently expect that each new objective achieved by our rocket programs will be an additional guarantee for peace and our future security.

I am pleased to be able to report to you today that your confidence in the Air Force's stewardship of the nationally urgent Atlas program was not misplaced.

To discuss the Air Force research and development program as it pertains to space, I believe we must first examine the military requirements in space. Second, review of our present space projects, and third, briefly outline what we need to do to assure optimum progress in military space development.

OUR MILITARY REQUIREMENTS IN SPACE

The Secretary of the Air Force recently referred to the continuing nature of weapons systems development, and the necessity of providing the operational commanders with a constantly increasing capability to carry out their essential missions in defense of the Nation. I would like to expand on this subject briefly as it relates to military space requirements.

The defense of our Nation is the primary responsibility and concern of our military forces. The ballistic missile force which is constantly being strengthened and developed will be the most significant factor in deterrence to all-out war.

The CHAIRMAN. General, would you suspend just a moment there. Mr. Finch, will you see what the draft is? See where that draft is coming from and, too, is the press adequately provided for? If it isn't, we could make room for them a little bit up here. I can ask the members, if they will, to move forward a little bit there; if the press doesn't have places, we can give them an adequate place here.

All right, General, if you will proceed.

General SCHRIEVER. This deterrence can be strengthened by the development of such military systems as are necessary to provide surveillance, warning, navigational, meteorological, and communications data. With the advent of the ballistic missile which can travel more than 5,000 miles in 30 minutes, intelligence, early warning of missile launchings and reliable and rapid communications have assumed unprecedented importance. These capabilities are more urgently needed by the United States than the U.S.S.R.

I say this because our free way of life places few obstacles in the path of a determined agent who seeks to pinpoint on a target map our vital installations, or who wishes to observe and report our every move. We do not enjoy this same freedom of movement and action with respect to the U.S.S.R. For example, our information on Soviet ICBM sites is inadequate; whereas Soviet data on American missile base locations is excellent.

We must, in the face of this situation, be able to detect hostile acts, communicate information and commands, and be able to make decisions swiftly. Our national policy and moral consideration both conceded the initiative to the Soviets. It is my belief that the Soviet threat in the military ballistic missile age will be the greatest in our history.

It is imperative that we continue to maintain that kind of defense posture which, if war comes, will provide us sufficient alert so that we can withstand a first onslaught and rise up and lash back at precise targets with an overwhelming blow. The opportunities of maintaining and strengthening our deterrent posture lie principally with space vehicles, since space is a medium in which many military missions can be performed more economically and efficiently than on land, sea, or in the atmosphere. These military missions include those which have the capability of missile detection and alarm, and strategic intelligence and communications. This capability, coupled with a combination of hardened, dispersed, and mobile ballistic missiles, together with other weapons of the free world, can assure us of this kind of defense posture for the foreseeable future.

I feel certain that if we have this capability, and the Soviet Union knows it, we can continue to maintain the peace.

The Air Force ballistic missile program has established the base for achieving this capability in space, not only to serve the military requirements, but also national needs.

As I stated in my speech at San Diego in February 1957, it is my belief that at least 90 percent of what was being done in the Air Force ballistic missile program could be directly applied to an astronautics or space program. In other words, projects that one could visualize for the future would be undertaken with the propulsion, guidance, and structural techniques which were under development in the Air Force ballistic missile program at that time.

From a technological standpoint, it is, I think, a normal transition to step from these ballistic missiles into space systems. As evidenced by recent events, our missile programs have provided this country with the hardware and foundation for urgently needed civilian and military space systems. Equally important, this program which represents the greatest single peacetime scientific government and industrial effort, has produced new knowledge and new industry, and has provided this country with a capability which was virtually nonexistent 5 years ago.

From a national standpoint, progress in space research is essential for both security and prestige. Civilian and military space operations complement each other, and both should be pursued vigorously. We are cooperating with ARPA and NASA in order to achieve a maximum return at minimum cost in our national space effort.

In my opinion, close cooperation is desirable, and should be continued, between the existing space agencies—primarily the Air Force, which now has responsibility for all military booster development, systems integration, and launching operations, and NASA, which is responsible for civilian space boosters and other civilian space activities. The Air Force has entered into a number of agreements with NASA, insuring smooth operation between the two agencies. These agreements have effectuated complete and working understanding on the scheduling of launch stands, and the allocation of boosters and other matters including facilities, personnel, funds, and operation in general.

I feel that such cooperation has proven its feasibility and is preferable to the creation of a superagency to coordinate all space efforts.

I would like to depart from my prepared statement here and state—and I would like to put this into my statement—that all military services have a very definite interest in space operations, and I do not want to imply in anything I have said here that the Air Force is the only service that has an interest in space.

The other services very definitely do have an interest in space systems. I, as commander of ARDC, have talked to my military counterparts, and I can assure you that I will do everything possible to cooperate and assist other services in their interest in the space field.

Mr. FULTON. You are to be congratulated on that statement.

General SCHRIEVER. As for the specific needs of the Air Force, our present requirements fall most urgently in the area of satellite systems which will add to the overall capability of our counteroffensive forces. I have already described the necessity for early warning and strategic observation satellites.

As I have also pointed out, we should have—at the earliest practical moment—satellites for communication between our forces in all parts of the world, and for command of these forces in an emergency. These will be essential to the effectiveness of our deterrent strength.

For support of these operational systems, there is a need for weather and navigation satellites in the near future.

These, then, are clearly discernible military space system requirements. As we look further into the future, we can expect that some of the unmanned vehicles for reconnaissance and surveillance may give way to manned vehicles offering greater reliability and versatility in performing not only these but other defense mission operations. Needless to say, in carrying out the Air Force responsibilities in air defense and strategic air operations in the future, we shall rely heavily on space systems.

Let me turn to present military space projects. First, the Discoverer.

For the past year, the Air Force has been actively carrying on a program of experiments with the Discoverer series of space satellites. Since the last day of February 1959, we have launched—and I had eight in my prepared statement, sorry it is nine, and we were not successful yesterday, but we have launched nine of these satellites, injecting six of them successfully into the orbit.

The successful launchings have included the last four—that is before the one yesterday.

The primary purpose of this series is to develop and test components and techniques which will be used later in operational satellites performing various military missions. In this objective, the program has been highly successfully. For example, the injection of satellites into orbit has been accomplished with a high degree of reliability; stabilized orbital flight has been achieved; and the performance of the satellite as a whole has been accurately programed and controlled in flight. All these are essential features of an operating military satellite.

The Discoverer program is also being used in certain biological experiments which will be of value in any future program to put men in space. The Discoverer program should be thought of as a preliminary to the establishment of military orbital systems. Two such systems, now in different stages of development, are the Midas early-warning satellite and the Samos observation satellite. The functions of these two systems can be simply defined.

MIDAS

Midas is intended to detect the launching of ballistic missiles by a possibly enemy of the United States. It will make use of infrared sensors, which will react to the heat of the rocket engines during the first few minutes after launching.

Samos will provide strategic information on activities and preparations within the borders of a possible adversary, which might be the prelude to a surprise assault directed against this country or its allies.

The functional value of these two satellite systems is obvious. What is not so generally recognized is the degree to which they will protect and implement our own military deterrent posture.

Midas satellites, orbiting continuously, would give us up to 30 minutes warning after launching of an enemy assault. This would extend our warning capabilities and would give us time enough so that we could guarantee the effectiveness of our retaliation. It would also provide additional warning time to civil defense agencies.

Assuming that the would-be aggressor knows this, the likelihood of an attack upon this country would be reduced.

This is why we consider that the Midas satellite would be not only a valuable means of protecting civilian lives, but also an essential part of our deterrent strength itself.

SAMOS

The Samos observation satellite—though its immediate advantages are less obvious—might well prove to be more effective in the long run. If we could see the preparations underway for a hostile attack, deep inside the borders of any country, it is highly improbable that the assault would follow as we would have many hours or days in which to get ready for it.

Since both of these satellite systems are entirely passive in nature, they represent no threat to any other nation. They will be powerful servants of world peace and security.

DYNA-SOAR

Turning now to manned space systems, we come to the Dynasoar, which is the main Air Force effort in this direction. In recent months, contracts have been let for the experimental prototype of such a spacecraft.

Dynasoar will be a boost-glide vehicle, lifted into space by an ICBM. It will be capable of circling the earth one or more times, gliding back down through the atmosphere and making a controlled landing under normal aerodynamic conditions.

The military value of an operational spacecraft of this type lies first, in the fact that there are many kinds of missions for which missiles and satellites would not be fitted. As a bomber, it could attack mobile targets of various kinds. Most importantly, systems of this type would provide a flexibility which is not characteristic of a missile. It could be recalled, if conditions changed while it was in flight. It could be kept aloft, in times of emergency, during the critical period of uncertainty at the start of an alert, thus giving us the same alternative capability, backing up our missiles, which is now provided by the jet bombers of the Strategic Air Command.

TRANSIT

Among the programs of other agencies supported by the Air Force is Transit, the navigation satellite for which the Navy has the payload development responsibility. This satellite is designed to be an all-weather navigation aid. It will be of great value to commercial transportation facilities, as well as the Navy.

TIROS

The Air Force is working in support of NASA on the Tiros satellite. It is similar to Transit, with respect to the booster which is a three-stage vehicle. The payload differs in that it is designed to record the synoptic weather situation over the Earth. The test schedule calls for launch in the near future.

EXPLORER VI

One of the highlights of the past year was the successful launching by the Air Force in cooperation with NASA of Explorer VI—the paddlewheel satellite. This satellite is now in an orbit reaching out to an altitude of about 26,000 miles at apogee, and coming within about 150 miles of the Earth at perigee. It carried out successfully 15 major scientific investigations in space.

THOR-ABLE

Scheduled for launching in the near future is a Thor-Able vehicle, which will attempt to put a satellite in orbit around the Sun, near the orbit of the planet Venus. This is also a NASA project, in which the Air Force is providing support.

MERCURY

The Air Force is also supporting NASA in Project Mercury, which is designed to place an astronaut in orbit around the Earth. We are adapting the Atlas booster for the purpose of launching the manned capsule safely into orbit. Also, we are providing bioastronautics support, required to assure that the first astronaut will be physiologically and psychologically prepared and protected on his historic mission.

X–15

An evolutionary step toward manned flight in space is the winged X–15 research vehicle—a joint project of the Air Force, Navy, and NASA. The X–15 is designed to fly faster than 4,000 miles per hour and to attain altitudes of about 50 miles, going possibly as high as 100 miles eventually. During the past year, initial phases of the flight test program were begun. These checkout flights were made at relatively low powers, pushing the airplane to what is today considered to be relatively low speed, somewhere close to 1,400 miles per hour.

What is needed to assure optimum progress in military space developments?

To take maximum advantage of our capability and realize our full space potential, we must first recognize that space is a medium through which vehicles intended for both peaceful and defense purposes can travel. We must recognize that there are many military missions and civilian services which could be performed more efficiently and more economically through the use of space vehicles than is made possible by other systems being used today.

I reiterate that I firmly believe that both civilian and military space operations actually complement each other and both are working toward a common goal, each fulfilling its respective and separate role. We have made excellent strides in this direction. As we proceed further along, the respective roles and responsibilities of both NASA and the Department of Defense become increasingly clearer. The present agreements between NASA and the Air Force and other military departments show the desire and capability of all agencies to operate in unison. The President, in his message to the Congress on January 14, 1960, proposed amendments to the NASA Act, which further clarified the roles or responsibilities of the agencies. The primary objective of the civilian program is exploratory research and peaceful uses for the betterment of mankind. The military efforts are designed primarily to maintain peace. That peace can best be maintained by a strong deterrent posture of the United States. The armed services have the responsibility to achieve this deterrent posture which contributes to and maintains peace.

As we view the importance of our military space program to the survival of our Nation, we can assume optimum progress in military space developments by using to the fullest extent possible and with maximum urgency the facilities and organizations that have been established to pursue a vigorous space program. The same managerial concepts which have brought the ICBM to operational capability should be continued and extended in the military space program.

I believe that our Nation must acknowledge the predominant importance of space for national security and survival.

This concludes my formal statement. I welcome the further opportunity of answering to the best of my ability any questions from the members of the committee and from yourself, Mr. Chairman.

The CHAIRMAN. Thank you very much, General, for a very, very fine statement. We have a short statement here by Maj. Gen. Donald N. Yates, commander of the Atlantic Missile Range. I suggest that we hear General Yates at this time and then—you sit right there, General Schriever—we are going to ask you some questions.

General SCHRIEVER. I was going to let him make the statement.

The CHAIRMAN. Whatever you desire, sir.

General SCHRIEVER. All right.

The CHAIRMAN. There are two chairs, so you can remain right there at the table.

STATEMENT OF MAJ. GEN. DONALD N. YATES, COMMANDER, ATLANTIC MISSILE RANGE

General YATES. Mr. Chairman and members of the committee, I have been requested to present a brief statement on my responsibilities with respect to the Atlantic Missile Range and to comment more specifically on the organization for support of Project Mercury. Since you and most of the members of your committee have visited the Atlantic Missile Range, have been briefed and have toured our administrative headquarters and launch facilities, I will comment in this area only to refresh your memories and bring you up to date.

Since the summer of 1954 I have been in command of the Atlantic Missile Range, which, as you know, is one of the three national ranges operated by the Department of Defense to support the Nation's missile and space programs—the other two ranges being the White Sands Missile Range, administered by the Army, and the Pacific Missile Range, administered by the Navy on the west coast. The Atlantic Missile Range, administered by the Air Force Missile Test Center of the Air Research and Development Command, was located in Florida because of the unique advantages provided by the string of islands through the Atlantic and Caribbean. Instrumentation on these islands provides solid coverage of all missile firings over the first 1,500 miles of the range. Two South Atlantic islands plus a fleet of ocean range vessels extend our coverage to over 5,000 miles. We are an outdoor laboratory designed for the development testing of long-range missiles and space boosters. All instrumentation on the range has been designed and installed to meet the specific data requirements dictated by each of the projects assigned to the Atlantic Missile Range for test. Missile systems such as the early Redstone, the follow-on Thor, Jupiter, Atlas, Titan, Polaris, and the future Pershing and Minuteman have established the range instrumentation pattern which now exists.

Military boosters developed in this environment have provided the basic vehicles for most of our space exploration to date and will continue to meet these requirements for some time in the future. We are, however, presently working on the instrumentation requirements for the NASA Saturn program—preliminary indication is that these requirements can be met in large part by existing or planned range equipment. Of course, as the vehicles become more complex so also do our instrumentation requirements become more demanding. I am proud to state that we have not fallen short to date in the field nor do we expect to in the future.

I should like to emphasize here that the range is basically a laboratory facilities for development test rather than operation of missiles, vehicles, boosters, et cetera. After completion of development, limited range instrumentation is required. Special ground service equipment is, however, needed to support military missiles and space vehicles under operating conditions. I specifically refer here to such items as the ground read-out equipment necessary for the Samos and Midas projects and the standard ground service equipment required to launch Atlas, Titan, and other military missiles. There are, however, two or three programs coming up which do require special extensions and tie-ins to the present ranges. The programs I refer to are Mercury, Dynasoar, and Centaur.

On the 10th of August 1959, I was assigned the responsibility, as Department of Defense representative for Project Mercury support operations, to prepare the overall plans for Department of Defense activities in support of NASA Project Mercury, to direct and control all DOD facilities allocated to this project, and to supervise the performance of specific missions assigned to the DOD in support of Project Mercury. Since the requirements for Project Mercury dictated a tie-in of existing national range facilities and the addition of certain stations to insure continuous coverage of the manned vehicle in low orbit, my position as commander of the Atlantic Missile Range—the planned launch point for Project Mercury—provided an ideal place from which to coordinate the development and operation of the ranges as well as the recovery support operation which will be carried out by units of the Atlantic Fleet. An overall plan for Department of Defense support has been prepared and was submitted recently to the Joint Chiefs of Staff for their approval and forwarding to the Secretary of Defense for his approval. Briefly, it involves a minor expansion and the operational tie-in of the three existing national ranges. By the addition of three land stations to be installed by NASA and the modification of two Atlantic Missile Range ships, the Atlantic Missile Range will be able to cover the area from Florida to the Indian Ocean. Australia, tying in communicationswise through the Pacific Missile Range, will operate two stations provided by

NASA, and the Pacific Missile Range will pick up additional stations at Canton Island, Hawaii, and southern California with White Sands Missile Range filling the gap with stations on the North American Continent. All ranges report their readiness in the operational phase to an overall controller at Cape Canaveral. Communications are being established by NASA for technical contact during orbit with administrative backup from our existing or augmented range communications.

All new stations are being installed on a mobile or movable basis since their requirements will be only for the duration of Project Mercury—some of these stations may be used later for support of projects such as Dynasoar and Centaur. The mechanics for range tie-in developed in support of Project Mercury will establish an ideal pattern for operational coordination in future programs requiring this worldwide type of service. The plan is workable and adequate. The DOD should have no difficulty meeting all of the NASA requirements qualitatively, quantitatively, and on time.

Summarizing briefly, the existing and planned program for installations on each of the national ranges and the system established for operational coordination of these ranges is certainly adequate to meet all foreseeable requirements. There is, however, one additional point which I feel deserves some attention; this is in the area of coordination of the development, procurement, and utilization of new range and ground support equipment. The Department of Defense and the National Aeronautics and Space Administration have been working closely in an effort to coordinate these developments to meet, with the fewest items, the largest number of common requirements. At the request of the Secretary of Defense, Mr. Walker Cisler has recently undertaken a detailed examination of this specific problem and has submitted to the Secretary of Defense and the Administrator of the National Aeronautics and Space Administration recommendations for improvement in this area. With the implementation of some such recommendations as have been submitted by Mr. Cisler the last possible gap will have been closed and I feel sure that insofar as the ground environment is concerned this country's space program will be adequate, efficient, and economical.

The CHAIRMAN. We are certainly happy to have that complete and unreserved assurance. At least the ground environment is going to be satisfactory, General.

General YATES. Thank you.

The CHAIRMAN. My thought this morning: We have two eminent witnesses here. We have until noon with them. We can waive the 1-minute rule and give everybody 5 minutes to interrogate both of the witnesses. I think they are working so closely together that they can remain there in their seats together and answer these questions jointly. I am sure there will be no conflict in their answers.

General SCHRIEVER. I am sure there won't be.

The CHAIRMAN. I will say this, too: This morning, the committee has 27 bills before it, which is a marked increase over last year and it is a very happy situation to the chairman. My thought has been and is now that the major bills should be handled by the full committee. Those that are—not less important—but more minor in their general nature, should be sent to the subcommittees 1, 2, 3, and 4.

Now, we haven't been able to do it because we haven't had the bills, but we are gradually building up a stock of bills which is comforting to the chairman and I know it is interesting to all the members. Now, if there is any discussion about it we can take that thought up at a later date in executive session. I just want to throw it out so everybody can be thinking about it.

Now, General Schriever, you have made an excellent statement and you have made an excellent impression on this committee, I will tell you that. I want to ask you this to start with: Can you tell us something about what made that last Discoverer firing unsuccessful?

General SCHRIEVER. Yes, sir; I can. I have gotten a preliminary report on it. We had a malfunction of the tower which moves the umbilical cord away at lift-off. This malfunction caused some tearing of the second stage. That is the Agena stage. Also we had a premature shutdown of the Thor booster. It shut down at about 145 seconds which was about 15 seconds early. We do not know yet why this occurred. But it could very easily have occurred because of the malfunction of the ground equipment. The failure of the umbilical tower to move away and unlatch the ground power, so to speak, to the missile, both the first stage and second stage.

Unfortunately, this has been one of our problems. We have had very excellent missile and booster operation but we have had ground equipment malfunctions. As I pointed out last July when I was here on the Atlas, three of those five failures that we had in a row were actually due to ground equipment malfunctions.

The CHAIRMAN. This is really due to ground equipment, too, isn't it?

General SCHRIEVER. Yes, sir. I would say now—without having seen all of the details which will, of course, have to be reduced—this will take a little time, but my feeling is that undoubtedly the failure will be traced to the group equipment not functioning properly on this particular lift-off. This is the first time it has occurred in the Discoverer program. On all of our other eight Discoverer flights we have had perfect booster operation, both the first and second stages. This is the first time we have had any malfunction at all as far as the booster is concerned.

The CHAIRMAN. That is the reason it did not function successfully?

General SCHRIEVER. Yes, sir.

The CHAIRMAN. It was the second stage.

General SCHRIEVER. Actually, the first stage cut off a little short, so that——

The CHAIRMAN. The second stage was torn?

General SCHRIEVER. The second stage never had a chance to get it up to orbital speed.

The CHAIRMAN. Yes.

Let me ask you this: The NASA has a Mercury program and has astronauts. Is it true the report that I hear that the Air Force is setting up its own astronauts, training astronauts also?

General SCHRIEVER. No, sir. We are making, or developing, plans for the Dynasoar, but again the Dynasoar program is completely coordinated with NASA and NASA is actually participating in it. We will not be carrying out two separate uncoordinated efforts here at all. Just like the X–15, we have Air Force, Navy, and NASA personnel who will actually participate in the flight program of the X-15.

The CHAIRMAN. That clears that up.

I will ask you this: Does the Air Force foresee a need for such vehicles as Saturn, Nova, and Centaur?

General SCHRIEVER. Yes, sir, we certainly do foresee a need for these larger boost vehicles, although at the moment we do not have what we call a firm military requirement. But we know we will need these large-boost, first stages in order to get the kind of payloads we anticipate in the future into high orbits such as are required for the 24-hour communications satellite.

The CHAIRMAN. Although they are being handled by NASA, the Air Force really has a fundamental interest in those programs?

General SCHRIEVER. Absolutely. I think it is entirely appropriate that they be handled by NASA at this particular time because they do have the first need to get the larger payloads into deep space operation.

The CHAIRMAN. Is it true, too, the report I hear, that the Air Force is interested in all space up to the Moon, we will say?

General SCHRIEVER. Well, we are, of course, interested in all space from an exploratory and scientific standpoint. I think it is a fair statement to say that at least in the foreseeable future, and I would say for this decade—and this is getting out on the limb a little bit, because we never can read the crystal ball too well—but I would say in this decade that our primary interest in space will not go beyond what we might call low satellites. The communications satellite, the 24-hour satellite, is at an altitude of some 22,000 miles, so you might not consider that as a low satellite, but in this sense it is. It is certainly not going out to the Moon or exploring Venus or Mars.

The CHAIRMAN. You are still interested in that high a satellite?

General SCHRIEVER. Yes, sir, because the communications satellite has tremendous potential for military application, and I might say also a tremendous potential for civilian use.

The CHAIRMAN. One more question, and then I am through.

Is the arrangement now with you and NASA—is it entirely satisfactory? And also I will ask you under the proposed bill, can you work with NASA, with a satisfactory result—in cooperation with NASA—if we put through a measure like that handed us by the administration?

General SCHRIEVER. You have asked two questions.

The CHAIRMAN. I wanted to do that to consume my time and then I am through.

General SCHRIEVER. Well, I will try to be brief.

First of all we have made very great progress during this past year in establishing both informal and formal arrangements with NASA. I would say that we are fast approaching the old, very good relationship that we had with the old NACA.

We get together and talk these things out and I have a number—I won't go into them, but I can supply them for the record—a number of actual arrangements that we have made with NASA which I think will back up what I have said. So I am very happy with the progress we have made and I feel that there is no real problem in working with NASA at all.

The CHAIRMAN. Mr. McCormack?

Mr. McCORMACK. Midas and Samos are both detection systems, aren't they? One after the fact and one before the fact?

General SCHRIEVER. That is true. Midas is a warning system.

Mr. McCORMACK. Yes, I know, but it is to detect, a warning system?

General SCHRIEVER. Yes, sir.

Mr. McCORMACK. The other one is to be able to go in and see the preparations?

General SCHRIEVER. It is to observe both from an electronic and from a photographic point of view.

Mr. McCORMACK. What is the time limit on either or both of these being operationally effective?

General SCHRIEVER. I think—I don't know whether you plan to have an executive session, but I would prefer not to give you that in the open hearing.

Mr. McCORMACK. All right, I understand.

What defense have we against the intercontinental ballistic missile?

General SCHRIEVER. Today we have no defense. You are speaking of active defense, I am sure.

Mr. McCORMACK. Yes, sir.

General SCHRIEVER. No, sir, we have none today.

Mr. McCORMACK. What is the importance of SAGE in this setup?

General SCHRIEVER. Well, SAGE, as a ground control system for defense against conventional systems—that is, aircraft—has no specific application to defense against ballistic missiles except as it relates to the communications network that has been established or is being established through SAGE. This communications network, of course, will also be applied to any defense system that might be derived for ballistic missiles.

Mr. McCORMACK. Are you contemplating transferring that to a civilian agency for nonmilitary purposes?

General SCHRIEVER. That would be above me. I have heard it mentioned, but I have not gotten into any considerations on this score.

Mr. McCORMACK. In other words, that would be a time when SAGE, as an important part of the military defenses of our country, would be considerably demoted.

General SCHRIEVER. Well, I think it is a relative matter. The intelligence estimates give the Soviet Union a conventional bomber capability for quite a period into the future. I think that we have a need for this type of defense system, at least for the foreseeable future.

Mr. McCORMACK. Well, it could be used in the commercial field, couldn't it?

General SCHRIEVER. Well, it certainly could, yes, sir.

Mr. McCORMACK. At the right time, I suppose from the Defense Department and the Air Force. That is an Air Force project, isn't it?

General SCHRIEVER. SAGE is Air Force, yes, sir. But the Air Force has the responsibility for putting it into being. It really works for General Kuter, who is in command of Norad.

Mr. McCORMACK. What about DEW line?

General SCHRIEVER. Well the DEW line was also the responsibility of the Air Force to put into operation, to develop and put in place. Once it becomes operational, then actually it functions directly under one of the joint commanders, which in this case is General Kuter at Norad.

Mr. McCormack. Well, when Midas and Samos become effective, what will be the contribution of DEW from a military aspect?

General Schriever. Well, the DEW line has a contribution to make only as it relates to conventional aircraft.

Mr. McCormack. I note you convey to us that ballistic missiles are going to become more and more emphasized in importance. As you say, they will be the most significant factor in deterrence to all-out war, is that right?

General Schriever. I believe that, certainly during this next decade, yes, sir.

Mr. McCormack. What effect will that have on the manned bomber?

General Schriever. Well, it is always a matter, I think, of mix.

The ballistic missile, I think, will assume a greater part of the job as far as our deterrent posture is concerned. However, I believe it would be a very serious mistake to read out the manned bomber as a system that is necessary for our overall deterrent posture. The reason for that is that one can never put all our eggs in one basket, so to speak. It isn't impossible that a very effective defense against ballistic missiles might be achieved. Now, today it is entirely true that it looks like a very difficult job. I personally think it is still some time in the future. But in the event you achieve this defense, and the ballistic missile were your only means of maintaining an offensive force, that is the ballistic missile, for our deterrent posture, we would be in pretty bad shape. Now, with the advent of air-launched missiles, higher performance aircraft, I think the manned bomber has a very important role for a long time to come. It is a matter, though, of balance of the force.

Mr. McCormack. And if they perfect and extend the air to surface—Hound Dog, is it?

General Schriever. Yes, sir.

Mr. McCormack. If they develop further——

General Schriever. We just had——

Mr. McCormack. What is that distance now? I have heard different distances. If you can disclose it I would like to get it clear in my mind.

General Schriever. I believe this is also classified—I can't give it to you now.

Mr. McCormack. All right.

General Schriever. The distances vary, of course.

Mr. McCormack. The further research and development enables us to project a longer distance, I can see where the manned bomber, the life of it as an effective instrument will be lengthened and become very important, I can see that as a layman. Is that true, General?

General Schriever. This is true.

Mr. McCormack. In other words, if you can shoot it for 200 miles that is one thing, but if you can shoot it for 5, 6 or 800 miles that is another thing.

General Schriever. We also have a follow-on to the Hound Dog. We have initiated a program for the development of an air launched ballistic missile which again goes into longer ranges which I can't disclose in open session this morning.

Mr. McCormack. Just one or two more questions. You use here with the advent of ballistic missiles which can travel more than 5,000 miles in 30 seconds.

General Schriever. Thirty minutes.

Mr. McCormack. Thirty minutes, rather. I think it would be interesting—I think the American people ought to have all the facts possible consistent with our national interest at the time, and I know you agree. I have heard various speeds, some 16,000, 18,000 miles an hour. Will you tell us how fast a ballistic missile can go now?

General Schriever. Well, of course, the speed varies over its entire trajectory. The average speed is about 16,000 miles per hour. That is for the total range.

Mr. McCormack. I think the American people ought to get that so they will be able to visualize what the problems are and what the dangers are, too.

General Schriever. That is right.

Mr. McCormack. I notice you say our national policy and moral consideration both conceded the initiative to the Soviets. I would imagine as a military man you are not happy with that, are you—your personal opinion?

General Schriever. Well, I am certainly not for preventive war or even a preemptive war. I think our democratic principles are correct and I would hate to see this Nation initiate a war which would end up with a result, I am sure, that neither side would win.

Mr. McCormack. My question didn't, of course—that is a responsive answer but I didn't have that in mind. You much prefer, I assume, to have no policy stated, that we are not going to under any conditions until we are actually attacked—suppose we saw the preparations going on? Suppose Samos becomes perfect and you are able to detect and you know we are going to be attacked, what are we going to do? Wait? As a military man, what do you say to that?

General Schriever. I would say that if you unequivocally knew that you were going to be attacked that you would be foolish not to attack.

Mr. McCormack. That is——

General Schriever. But this is going to be an awfully difficult decision to make. I mean I would hate to be the man to make it.

Mr. McCormack. I am not—I am not—I just want to get information.

General Schriever. And, of course the attacker in the future, as I see it, is also inviting a devastating attack on his own homeland. This is what really——

Mr. McCormack. Provided we can reach it.

General Schriever. Well, of course——

Mr. McCormack. I know now that we probably can, but have you any idea what defenses against our intercontinental bomber and what antimissile-missle defenses they have. Do you have any idea how far a potential enemy has advanced?

General Schriever. Well, let me say as much as I can say in an unclassified hearing. There is very much evidence that they have greatly increased their defenses against conventional aircraft: that is, if the aircraft has to penetrate through the defenses. We, of course, are always working on the electronic countermeasures, the air-launched missile, and so forth.

In the field of defense against ballistic missiles, I think we are quite certain that they do not have an active defense against ballistic missiles.

Mr. McCormack. Even on the bomber there is the question of attrition rate that comes in.

General Schriever. That is right.

Mr. McCormack. No further questions.

The Chairman. Mr. Fulton?

Mr. Fulton. General, both of you, we are glad to have you here. I want to thank you for your friendship and cooperation with this committee and the various members of it that have seen you on your duties. We are very pleased to have you as part of our team in the United States because I think you in the U.S. Air Force—as a Navy man—combined with the Navy Air, gave us the best Air Force in the world.

General Schriever. Thank you.

Mr. Fulton. Don't you think it is, too?

General Schriever. I think today we certainly do have without a question.

Mr. Fulton. How about General Yates?

General Yates. No question about it. I don't even understand the argument. [Laughter.]

Mr. Fulton. Now, you have said on page 5, General Schriever, a remarkable thing that I think should be noticed especially, it is the strategic needs of the Air Force. You state:

> As for a specific need of the Air Force our present requirements fall most urgently in the area of satellite systems which will add to the overall capability of our counteroffensive forces. I have already described the necessity for early warning and strategic observation satellites.
>
> As I have also pointed out, we should have—at the earliest practical moment—satellites for communication between our forces in all parts of the world, and for command of these forces in an emergency. These will be essential to the effectiveness of our deterrent strength.
>
> For support of these operational systems, there is a need for weather and navigation satellites in the near future.
>
> These, then, are clearly discernible military space system requirements.

I agree with you thoroughly because that means that we should get more effective systems for defense rather than merely laying up a whole, great number of this generation of operational missiles that we might use to land in an enemy country. I agree with you thoroughly on your emphasis. And you believe thoroughly in that statement, do you not, on page 5? I want to emphasize that.

General Schriever. Yes, sir. I do. I think there are two very important things, as we move into a nuclear rocket age: One is, as a democracy we have to reduce the element of surprise. Surprise becomes a very, very important factor because they have the kind of information, they have also the initiative, they have been the aggressor in the past. We don't have the kind of information they have on us. The element of surprise is almost overwhelmingly important and we have to reduce this element of surprise.

Mr. Fulton. And we must reduce it at once and therefore put the emphasis on these systems that will practically reduce that and give us the information as quickly as possible as to the action of any possible enemy?

General SCHRIEVER. That is true. The other thing, of course, is that we must also reduce the vulnerability of our retaliatory forces.

Mr. FULTON. That is right.

Now, then, we need research and development on Nike-Zeus and Nike-Zeus has not been put into operational status. I agree with that. My comment is: First, it is not proved out yet sufficiently. Second, it can be saturated very easily, and third, it has only directional coverage, and fourth, it would not be competent against submarine or IRBM missiles. Do you likewise feel that we should not expend the money now to put into operation the present status of Nike-Zeus or do you feel that we should continue with R. & D. on that as well as other allied systems of detection and early warning?

General SCHRIEVER. Well, I think we certainly should continue on R. & D. on that program, the Nike-Zeus, and possibly others.

I would prefer not to comment on whether or not we should decide at this stage to proceed with an operational system because I do not have all of the facts before me. Nor have I studied this particular system in great detail, as to the exact status of it as of now.

Mr. FULTON. Well, it is getting to be quite a political football.

General SCHRIEVER. Yes, sir, I know it.

Mr. FULTON. If you could give us a statement on it for the record later and do it as a technical statement——

Mr. MCCORMACK. I don't think I want the record to show that we should sit here and say it is a political football. Any time any of us Democrats talk about national defense and we have views of our own we are talking politics. I am not going to sit here and permit that to go by.

Mr. FULTON. Might I say that I would say that probably in another body rather than this, they are the trial balloons for the Presidency that are going up and are being shot down by people on both sides, not Republicans and Democrats. I might say that certain Democrats are likewise shooting down the trial balloons of certain people with presidential aspirations on their own side on this same subject. So it isn't between two parties. It is rather the particular year we are in, and it is in that sense I am speaking.

Mr. MCCORMACK. I think it is dangerous ground to get into when we are impugning motives of any American who has his own views about national defense. You go ahead. You can ask your question about it. I just want the record to show that any questions I ask are not asked from a political point of view. I am concerned with the preservation of this country, because everything I have and every American has is dependent upon this country and I respect you men who wear the uniform when you appear before me, because in case of attack I look to you. You gentlemen have to give us the leadership to win the war and preserve this country.

General SCHRIEVER. I think we recognize that. In the event things should happen in a military sense the military will be either the heroes or the goats and I would hate to be the goat in any future war because I think it means the end of this country. I think we have got to be right.

The CHAIRMAN. Let me say this to the general, I am thoroughly in accord with what Mr. McCormack says. This is not a political committee. We are having these hearings for the defense and protection and survival of the United States. I don't believe there is room for Democrats or Republicans in a hearing of this sort. I don't know whether the general is a Democrat or Republican or either one of them. He may be something else. But I think that we should feel, all of us, that this is a national defense hearing, where there is no room for partisan politics.

General SCHRIEVER. I can assure you one thing I am not, and that is a Communist. [Laughter.]

The CHAIRMAN. I didn't mean to infer that. [Laughter.]

Mr. FULTON. Nor a candidate for President. [Laughter.]

You see what is happening is that it certainly has gotten into a realm that is not effective, so I agree with Mr. McCormack and our chairman that it should be kept completely nonpolitical. Mine was a warning that there is a possibility and a probability that some people, across party lines, use such a thing for political purposes, but that we want it solely on a technical basis. That is why I said it.

Now, may I——

Mr. MILLER. It isn't a question that the shoe pinches, is it——

Mr. FULTON. * * *

The CHAIRMAN. We are holding the—we will not hold the gentleman strictly to the 5-minute rule since he has already passed it.

Mr. FULTON. * * *

The CHAIRMAN. We will give you credit for 3 minutes.

Mr. FULTON. * * * I want to compliment you on both the Atlas and Discoverer program because it took firm courage on the part of both of you to stand up when it fell behind for certain technical reasons and for you each to come to this committee and state that you each had a strong belief in the programs and we should proceed with them. I am glad, across party lines with all members of this committee, to have been part of that support when it was one of the hard times. So I want to again congratulate you.

General SCHRIEVER. I can assure you we appreciated the support of the committee, too.

Mr. FULTON. Could I ask General Yates: You have two caps on, actually, you are a Department of Defense representative as well as the commander of the Atlantic Missile Range, are you not?

General YATES. That is correct.

Mr. FULTON. In your capacity as Department of Defense representative on the Mercury program where can you report in? Can you report in right to the top without redtape and talk with the Secretary of Defense?

General YATES. Yes; I have authority for direct communications with anyone in the Department of Defense.

Mr. FULTON. So you have no complaint on echelons to go through in order to get prompt action on Mercury, do you?

General YATES. None whatsoever.

Mr. FULTON. Likewise you feel the Mercury should go ahead promptly and the target date should not be moved back 3 to 5 years because it is an essential element in our space program for the security of the United States, do you not?

General YATES. I feel it is extremely important.

Mr. FULTON. On the Kapustin Yar and Tiura Tam launching pads of the Russians—the Tiura Tam is the one that they launched the Pacific missile from, could I ask you on that? Actually, the Russians only have about a 3,500- to 4,000-mile landfall on that particular range, do they not, where they can closely and accurately observe the trajectory?

General YATES. Actually, with the ballistic missile for the purpose of observing the trajectory and determining the impact point they need only to track accurately for the first few hundred miles. That distance, of course, they have adequately. The missile is committed then. It is going to land wherever it was going to land when the power was cut off. So there is no need for tracking after the missile propulsion has been shut off.

Mr. FULTON. Now, on Kapustin Yar, their short range, we have just as good facilities as that, do we not, right in your Atlantic Missile Range?

General YATES. I have never visited Kapustin Yar but I am quite sure we have as good or better facilities for launching in the Atlantic Missile Range area.

Mr. FULTON. I am leading up to this: You have said that we can have worldwide range very shortly by the addition of a few station ships as well as the cooperation of Australia and that we can then have missile shots that will go clear to the Indian Ocean, for example, or we can have satellite shots that will be traced the whole way around the world from the launching on the Atlantic Missile Range?

General YATES. Actually, as the satellites go higher fewer stations are required. The most difficult shot is Mercury because the orbit is extremely low. As we go into higher orbits fewer stations will be required. So with the advent of the Mercury system I can't think of any net that would be needed more completely for any project. The later projects will require fewer and fewer stations.

Mr. FULTON. This is my last one: Therefore, our ground control and our ground installations are really ahead of Russia, because first she doesn't have them and secondly, she is making no move in the immediate future that we can see to get such a worldwide system and, thirdly, I would like to ask you: When will this system be in effect? How long will it take?

General YATES. The complete operational date? I don't know the exact target date on it, say a year approximately. It will be available for checkout well ahead of the first manned flight and we will fly several unmanned vehicles ahead of that time. I do not know what NASA has set right now as the target date for the first orbital flight. The net probably will be ready in a year.

Mr. FULTON. So when will that date be for checkout? Could I get that?

General YATES. Each station is going in on a different schedule basis which is set by NASA in their Western Electric contract. Now, I don't have available the schedule for each one of the stations. I would say that all of the net would probably be operational in a year.

Mr. FULTON. Would you put the program in the record for us? We won't ask for it here.

General YATES. I will be glad to.

(The information requested is as follows:)

The scheduled operational dates for the Project Mercury tracking and ground instrumentation stations are:

Cape Canaveral	July 1960.
Grand Bahama	Do.
Grand Turk	Do.
Bermuda	Do.
Control center (AFMTC)	Do.
Canary Islands	September 1960.
Communications and control center (Washington, D.C.)	November 1960.
West Australia	Do.
Hawaii	Do.
West Mexico	Do.
Southern California	Do.
South Texas	Do.
Indian Ocean ship	January 1961.
Mid-Atlantic ship	Do.
Nigeria	Do.
Zanzibar	Do.
Woomera, Australia	Do.
Canton Island	Do.
White Sands	Do.
Eglin AFB	Do.

The CHAIRMAN. Mr. Miller.

Mr. MILLER. You fired a Discoverer the other day that wasn't successful, so you heard a lot about it. But if I remember rightly, I think yesterday you had fired the 35th Jupiter, 22 of which had been successful, is that correct?

General SCHRIEVER. The Jupiter was fired yesterday, and, of course, this has been a very successful program. It has been carried out by the Army.

Mr. MILLER. And here is a case where we have practically worked the bugs out of it and we have an operational missile now, but that no longer makes too much front page interest reading, isn't that correct?

General SCHRIEVER. I can comment on that, because I have lived through these things for a good long while now.

We have a habit of accentuating the negative and the opposite on the positive. So when things become successful, why they are no longer of great interest. They are of great interest to me, I can assure you.

Mr. MILLER. I just wanted to bring that out that we may have a failure, but we do have successes.

General SCHRIEVER. This has been true in the Jupiter program. The Thor program also has been highly successful. Last year we had some 40 flights of the Thor. I think, only about three of those didn't perform as expected.

The Jupiter also was very successful last year. I think the Polaris fired yesterday was successful. The fifth time in a row they had a successful flight. We had about 17 straight Atlas flights in a row that were successful, 2 of them in 1 day. It got about page 19 notice.

Mr. MILLER. I would just like to get some of those successful flights into the record along with the ones where we point out your failures.

General SCHRIEVER. We are adjusted to this. I mean this is a way of life and we are adjusted to it.

Mr. MILLER. It is very nice that you are, but, nevertheless, I appreciate it.

This is my only question, other than to get that statement in the record. Are we stressing the defense against rockets or intercontinental missilery sufficiently, or are we putting all of our emphasis on the offense? Now, I think it is a military axiom that every time you develop a weapon, somebody develops a weapon that counteracts it.

Are we doing enough in the defensive field in research and development to balance off what is being done offensively?

General SCHRIEVER. I would say that in research and development we are. It is a matter of very careful judgment as to when you make a decision to go from research and development into what you might say a system program. The reason for this is you have to then commit very large funds for the operational environment, the construction of bases, you have to set up and train people, new organizations, and you commit yourself irrevocably to a very large-scale program in terms of dollars.

It is always a matter of judgment on the part of the best scientific and technical people as to just where we stand in terms of technical feasibility with respect to any of these programs that are in Research and Development. I might get up here and say: Well, I think a certain program should be committed as a system now. I feel that we have established the necessary technical feasibility that we should take the calculated risk to proceed with an operational system. Someone else may disagree with me, so it becomes a matter of judgment. I feel, further, that it is only for those systems which are of extreme importance to the national security that you should take the calculated risk to proceed toward an operational system before you have proven out that everything works properly. We did this in the ICBM. We are doing it in the Minuteman program, the Navy did it in the Polaris program. I think we will have to take risks of this kind in order to get an early as possible operational capability in some of our satellite systems.

Mr. MILLER. Of course, war is always a matter of risk. You can't sit back.

General SCHRIEVER. That is right.

Mr. MILLER. But the thing that was worrying me, I was concerned with, General, there is no glamour in the defensive end of this business? In other words, this isn't a thing, again, that lends itself to a lot of glamour, it is real hard work and hard going and I just want to know that we are not neglecting that phase of it.

General SCHRIEVER. Well, of course, in the R. & D. field, the Army has the Nike-Zeus—the Air Force has the BMEWS system which is a radar fence. BMEWS is actually in the process of being installed. The Midas is an R. & D. program. A tremendous effort is going on in studies, not only within the Department of Defense, but by industry, for other means of defense against ballistic missiles and against satellite systems.

It is just that these are very difficult things to do and we are just not ready to launch forth aggressively in a hardware program in some of these areas.

Mr. MILLER. But we are keeping abreast of it?

General SCHRIEVER. Yes, sir.

Mr. MILLER. Through research and development?

General SCHRIEVER. Yes, sir.

The CHAIRMAN. Mr. Chenoweth.

Mr. CHENOWETH. I want to congratulate both of you on splendid statements. It is certainly a great pleasure to have you here. I haven't had the opportunity to see General Yates since we were there last year. I want to again thank him for the courtesies he extended the committee. It was a very interesting experience. Just a year ago, I believe, you were before our committee for the first time after this committee was created, General Schriever. I wonder if you would tell the committee what our picture is today as compared with a year ago? What have we been doing in the past year? There seem to be some rumors afloat that there is some complacency about this whole thing, the tendency to upgrade everything the Russians are doing, downgrade what we are doing. I am interested in what we are doing, not so much concerned with what Russia is doing.

I am interested in your telling us as much as you can in open session to compare our picture today with a year ago.

General SCHRIEVER. I will confine myself to talking about missiles and space here.

Mr. CHENOWETH. Yes, yes, sure.

General SCHRIEVER. I think first of all, of course, in the missile programs—and I will talk about the Air Force programs.

Mr. CHENOWETH. Yes.

General SCHRIEVER. Without minimizing the other services.

Mr. CHENOWETH. Yes.

General SCHRIEVER. In the Air Force program we, of course, have gotten the Thor operational. In fact, three squadrons of Thors have been turned over to the RAF in the United Kingdom.

I might say that there is a fourth squadron going in and our schedule calls for turning that fourth squadron over to the RAF at a time that is considerably ahead of the schedule that we first said we could meet back in 1956, when we initiated the IRBM program.

In the ICBM field the Atlas became operational in September of this year [1959] at Vandenberg Air Force Base, Calif.

This was a couple of months later than the July 1959 schedule that we had set for ourselves back in 1955.

However, it was a year or two earlier than the best experts in the scientific and technical field thought we could do, and I am speaking of the Von Neumann Committee and other groups that met in 1954.

This beat their timetable by a year or two, and their timetable was predicated on establishing the kind of management arrangement which would not be harassed in any sense by bureaucratic redtape.

Now, the fact that we have accomplished these goals in our ballistic missile field, I do feel, have been somewhat overlooked by the fact that everyone speaks about our missiles as the missile mess. I resent this very greatly.

Mr. CHENOWETH. You have a right to.

General SCHRIEVER. Because I think that the scientific fraternity, the industry, and the military have done a remarkable job in getting where we are today. I think it should be clearly differentiated that the problem with respect to numbers is not one that we have or I have the responsibility for. Those are decisions that have to be made at higher levels. To get numbers of missiles operational requires decisions to be made 2 or 3 years in advance of the time that you will get them in the field, because of the leadtimes involved in production, training, personnel, establishing organizations, building bases, installing and equipping the bases—installing the equipment and the missiles on the bases has a leadtime of anywhere from 2 years to 3 years.

So I think that a very great job has been done. The numbers business is something that is not the responsibility of the research and development people, the production people, the scientists, and the lower military staff.

Mr. CHENOWETH. In other words, you are telling the committee that really substantial progress has been made in this past year in this missile field?

General SCHRIEVER. A year ago we were in trouble on the Atlas, as I testified here, as late as July of last year, because there was a question as to how well we were doing.

Now, I think the next day after I testified we had our first successful flight after five failures and we haven't had a failure since. So I have my fingers crossed on that.

Mr. CHENOWETH. As commander of the research and development program for the Air Force, General, do you feel that we have been going fast enough in this program? Do you feel any glaring defects have been called to our attention here? Should we be doing more than we are doing? That is what I mean.

General SCHRIEVER. I will speak in my area of responsibility.

Mr. CHENOWETH. Yes.

General SCHRIEVER. That is the research and development, in getting a system operational. I think we have been moving as fast as we possibly could move over the past 5 years. I want to excuse myself from getting into any discussion as to whether the numbers are adequate or not.

Now, in the military space area, we have also made substantial progress during the past year. We, of course, have gotten the Discoverer program going. It has been highly successful, even though the impression is that it has been a failure because we have not yet made a recovery. As a matter of fact, that is the only objective that we have not yet achieved in that program. So we have come a long way toward perfecting the techniques and the components, the equipments that will be necessary for Midas and Samos. They make direct contributions to those systems.

I feel very strongly that for the next 5-year period our big job is to exploit the hardware and the techniques, in other words, the overall resources that are available today to develop to operational status those systems which I mentioned, such as surveillance, warning, communications, navigations, meteorology, and so forth.

These can all be accomplished within the resources that we have now.

The CHAIRMAN. Mr. Sisk?

Mr. SISK. No questions.

Mr. CHENOWETH. Thank you, General.

The CHAIRMAN. Mr. Van Pelt?

Mr. VAN PELT. No questions, Mr. Chairman.

The CHAIRMAN. Mr. Mitchell?

Mr. MITCHELL. Mr. Chairman and General Schriever, I think since Zeus has been mentioned this morning that it should be pointed out that the Congress, with both Republican and Democratic support last year, appropriated some $137 million additional funds for that program and that as to this date, that money has not been made available to the Army for the further development of Zeus.

That, of course, requires no answer. But I was interested in your statement, as you concluded, General. You stated, "I believe that our Nation must acknowledge the predominant importance of space for national security and survival."

Do I conclude then that you believe that our Nation has not made such an acknowledgement?

General SCHRIEVER. I believe that there has existed over the past year or so considerable confusion as to the importance of some of the systems that were under development as to their contribution to the national security.

Specifically, the systems that I have mentioned, and I won't repeat them all again. These systems, as I have pointed out, have a great contribution to make to our deterrent posture. I think they are absolutely essential to our deterrent posture in our nuclear rocket age. And I have felt that there needs to be a better understanding as to the need and requirement for these systems as differentiated from the exploratory, scientific type of activity which is extremely important from a scientific and prestige standpoint and which is the primary responsibility of NASA.

I think that we have to recognize that from a military standpoint there is an extremely important job to be done. We look at space as a medium where we can either do a job uniquely, in other words, we can't do it anywhere else, or else we can do it better and more economically in space than we can either on land, sea, or in the atmosphere. We look at it from a very practical point of view.

Mr. MITCHELL. But we should, the American people, and that means the Government of the United States, should make this acknowledgment as you point out? I agree with your statement and concur with your views about it that we have not, if those are your views.

General SCHRIEVER. Well, it is easily understood why there is confusion. I think that some of the space firsts of the Soviets have been extremely glamorous and they are important and they are dramatic and I guess that if you can call space mundane, the kind of things that the military is doing in space would fall in that category. As a consequence we don't get the same kind of treatment at this particular stage in the game.

Mr. MITCHELL. One other question, General. You stated that it was your belief that at least 90 percent of what was being done in the Air Force ballistic missiles program could be directly applied to an astronautic or space program, but you went on to conclude that the setup we have for space today is preferable to the creation of a superagency to coordinate all space efforts.

Now, if that percentage of the Air Force space program has, or your ballistic missile program has a space application as well, why wouldn't there be greater efficiency in a single agency?

General SCHRIEVER. Well, in the first place, if you talk about the 90 or 95 percent, I was talking about the resources that existed as of that time and I think that it is true that those resources are the ones that are being primarily used today.

They are the Atlas booster, the Thor booster, the Jupiter booster, the hardware, the techniques, the launch facilities, the industry base and personnel, scientific and military as well.

Now, as we go down the line, of course, there will be other equipments required, other boosters such as the ones being developed in NASA today. Then the same percentage that I am talking about certainly will not apply. In the payload area, in the scientific payload area there will be new developments, this is a new field.

Now, in response to your question about a superagency, my feeling is that NASA will serve a very important national need by taking on the responsibility for the exploratory and scientific type of space development.

The military will certainly support NASA in this regard. I personally am quite happy to have no more than the responsibilities that we now have because I tell you it is more than we can handle now. I am perfectly happy the way the arrangements are made at the present time with NASA having their distinct responsibilities and the military retaining the authority and the responsibility for developing those systems which contribute to the national defense.

Mr. MITCHELL. Thank you very much.

The CHAIRMAN. Mr. Bass?

Mr. BASS. General Schriever. I want to make sure that I got your answer to one of Mr. Mitchell's questions and I would be glad to yield to Mr. Mitchell if I misstate his question. He asked you, as I understand it, whether you felt that the people of this country and the Government, which, of course, includes the military, has not recognized in the past the importance of this ballistic missile program and a stepped-up space program.

Now, certainly as far as the military and the Government is concerned, that is not true, is it?

General SCHRIEVER. They certainly have recognized the importance of the ballistic missile program. And they have also recognized the importance of the space program. But what I am saying is that the people generally, when they think about space, they are thinking about the more dramatic and glamorous single-shot project type of things. The lunar impact, or orbiting the Moon or going out into deep space.

What I had in mind when I said there was confusion is there has been at least a body of thought, I think you will agree, that there is no requirement, or the military has no requirement in space. This is what I had in mind. The military, as I have pointed out, in the programs that we have at the present time, have a very, very definite requirement. Space systems have tremendous potential for increasing the security posture of the country.

Mr. BASS. And that requirement has been recognized in the past, too, as well as in the present by the military?

General SCHRIEVER. It has been recognized within Government circles, it has; yes, sir.

Mr. BASS. Thank you.

The CHAIRMAN. Mr. Wolf?

Mr. WOLF. Mr. Chairman, everybody has been very kind to the two generals and I think that is very fine and I know they are fine people. I happen to be one of the people who is perhaps not critical of the military, but I am not sure who I am critical of, but I don't believe everything is quite as lovely as our two friends here have portrayed it, because there seems to be a great conflict of opinion, notwithstanding Mr. McCormack and Mr. Fulton, not withstanding the political overtones and implications.

I happen to be the father of three children, 9, 6, and 2. They are a long ways from adulthood. I am vitally concerned about this country. Perhaps that is one of the reasons I got into politics. There is a great conflict of opinion here in this missile thing and one of the real problems that we have, Mr. Chairman, is to establish what we are going to do as a committee on the basis, pretty much, of the compliments that we pay each other, and what fine people we are, rather than on any factual information.

With all due respect to my good friends here that I know personally, this is one of the real problems that we have.

The CHAIRMAN. The gentleman had better proceed to develop the facts that we can use.

Mr. WOLF. I can't develop them but I would like to read if I may, a little bit from the Washington Post and obviously they have not perhaps the scientific and military people on their force that the generals have at their disposal. I would like to read this into the record if I may. I have 5 minutes.

American preparation in defense and space matters may well be more adequate than some of the pessimists believe. Of course, these are only two aspects of national power. But the question of attitudes is basic, it is here that the largest gap exists. The President continues to say that everything is dandy, that he knows best about defense and that the demonstrated and quickening Soviet powers in various elements of national strength is no cause for alarm. It is a little more like saying that no one should worry about the smoking volcano because it hasn't erupted yet and its intentions are peaceful. In the face of a mounting and vital competition in many phases of national activity from a determined and resourceful adversary, the President invites complacency and the illusion that no unusual effort is required.

This is the essential danger—and it goes far beyond the question of whether Mr. Khrushchev plans to attack next year or at any time. Walter Lippmann has expressed the problem well:

"The peril is that in the race, not only in armaments but in overall national power, the Soviet Union is moving ahead faster than we are * * *. Because in this vast field the Soviet Union has gotten its research and development effectively organized, and because the Soviet Union is allocating to it all the resources that it requires, the gap is not becoming narrower, it is becoming wider."

If such analysis is correct, and this newspaper believes that it is, then despite the President's apologia there is plenty to worry about.

Obviously I don't imagine this was written with the secret knowledge of an R. & D. general.

The CHAIRMAN. Does the gentleman want to put the whole article into the record?

Mr. WOLF. Yes: I would appreciate having the whole article in the record.

The CHAIRMAN. Yes: it will be put into the record. Because the gentleman is consuming his time.

The article is as follows:

[From the Washington Post, Feb. 5, 1960]

THE GAP

President Eisenhower has made a plausible if unconvincing statement of his philosophy on American defense and missile programs. There is too much concern over catching up with the Soviet Union, he said in effect, when our deterrent is adequate. Much of the advocacy of increased defense effort is "parochial." This country retains a great deal of prestige abroad. Space exploration, apart from its military aspects, is purely scientific. The United States can't expect to be ahead in everything. We ought to have faith in our own system as against that of the Communists and think more about our democratic values.

This is what may be called the "don't get excited" approach. It is unlikely, however, to satisfy Members of Congress who are investigating the missile and space gaps. There is too much evidence that administration attitudes and policies toward the Soviet threat have been tailored to fit economic preconceptions. There is too much effort by administration officials to stigmatize criticism as unpatriotic. And there are too many holes in the President's own argument, as indicated by his resolute denial that American prestige is at all involved in space competition.

It seems clear enough that in current circumstances the American military deterrent is very powerful indeed. The concern is about the future—about whether American power to deter will expand fast enough to keep pace with Soviet capacity to evade or overwhelm the deterrent.

Obviously it is possible to become overly preoccupied with mere numbers. Nevertheless, there is not much comfort in the contradictions of the assertion by General Power of the Strategic Air Command that 300 Soviet missiles could destroy American retaliatory capability. General Power may be mistaken in this and in his advocacy of a constant airborne bomber force; but the recent confusion over the meaning of intelligence estimates is not reassuring. Seemingly the "downgraded" assessments of Soviet power are now being upgraded because of the accuracy of long-range Soviet rockets in the Pacific tests.

Moreover, the impression that policy is being played by ear on a transient basis is reinforced by the administration's record. For budgetary reasons the administration allowed the military aid pipeline to become nearly depleted. New ship and fighter plane procurement has been curtailed to a point where replacement is at only half the rate of obsolescence. The late start in missile development does not really explain the failure to push it, and finance it, more intensively. And there is plenty of testimony to the fact that American space exploration has been retarded by lack of funds.

The point here is that intelligence estimates, and more pertinently the policy decisions which bend them to particular purposes, can be wrong. There is a long list of wrong assumptions, and it goes well back into the Truman administration. Policymakers miscalculated the time the Soviet Union would require to produce atomic and thermonuclear weapons. They did not foresee the speed of Soviet rocket development. Sputnik caught them by surprise. They have consistently underestimated the pace and competence of Soviet scientific achievement.

American preparation in defense and space matters may well be more adequate than some of the pessimists believe; and of course these are only two aspects of national power. But the question of attitudes is basic—and it is here that the largest gap exists. The President continues to say that everything is dandy, that he knows best about defense, and that the demonstrated and quickening Soviet prowess in various elements of national strength is no cause for alarm. This is a little like saying that no one should worry about the smoking volcano because it hasn't erupted yet and its intentions are peaceful. In the face of a mounting and vital competition in many phases of national activity from a determined and resourceful adversary, the President invites complacency and the illusion that no unusual effort is required.

This is the essential danger—and it goes far beyond the question of whether Mr. Khrushchev plans to attack next year or at any time. Walter Lippmann has expressed the problem well:

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If such analysis is correct, and this newspaper believes that it is, then despite the President's apologia there is plenty to worry about.

Mr. WOLF. Not only that, there are some other folks around the world consuming time. That is the only part I intended to read.

I have just returned from a trip to the Far East and there are many people around the world who are vitally concerned with our position in the missile business and I wonder if these generals would suggest or admit that there is a possibility that there is always a political overtone to anything that we do in a scientific way either here or in Russia in our relationship with uncommited nations and other nations in the world who perhaps are friendly to us but are in a worried position relative to becoming too closely attached to us.

This is just a "Yes" or "No" answer on that, either one of the generals.

General SCHRIEVER. I think from a military standpoint, there are not.

Mr. WOLF. Any political overtones to our failures and successes?

General SCHRIEVER. Oh, there are many political overtones. What I am saying is, this does not enter into our consideration of factors in trying to get the job done.

Mr. WOLF. The next part of that is, and I know that you research and development people are sincere and are working hard and I don't mean to impugn you in anyway, and I haven't, I hope. I am just trying to present a worried position.

General SCHRIEVER. I understand.

Mr. WOLF. Do you have any really concrete method by which we are telling the story that Mr. Miller brought out about our successes to these uncommitted nations over the world? I know we have the USIA and all of that, but obviously they are not doing as good a job as the Russians are in these fields.

General SCHRIEVER. I think there is no question that the Soviet Union has exploited their successes to a much greater degree from a propaganda point of view than has the United States.

Mr. WOLF. The question is, Is there anybody or any department studying ways by which we could gain greater use of the successes we have? Our press in America, bless their hearts, they have done a great job of telling about our failures to the entire world.

General SCHRIEVER. Well, I am not sure—I imagine there are. I can assure you that we have studied it from our point of view. We have made efforts to get a little bit better coverage on some of our successes. I know General Yates and I have been working on this problem for a good many years now—he in command of Cape Canaveral and I as former head of the Ballistic Missile Division. I can assure you it was of great concern to us how we got the story across to the American people.

The CHAIRMAN. Mr. Riehlman?

Mr. WOLF. Is my time used?

The CHAIRMAN. Yes; it is 6 minutes.

Mr. WOLF. If we had a little more time, I have a couple of other questions.

The CHAIRMAN. My timekeeper here to the left tells me it is 7 minutes.

Mr. WOLF. That is fine. But if there is any time before these gentlemen leave, I would like to ask some questions.

The CHAIRMAN. I would remind the committee that Tass is sending reports back to Russia daily on the meetings here, on this committee. This is of real interest to us.

Mr. RIEHLMAN. I would say to my good colleague that the statement he read into the record would be pretty good propaganda for Tass and the other papers.

Mr. WOLF. If the gentleman would yield——

Mr. RIEHLMAN. I have my time. It gives some connotation that you might be agreeing with it.

General, let me get to two or three important things that I think I would like to have answered.

First of all, may I say to you very sincerely that I recognize the responsibility that rested upon your shoulders as leader in this ballistic missile program for the last 4 years and the great accomplishment that this country has made under your leadership in the research and development program, and bringing into being an operational Atlas missile.

Now, recognizing that very same need for greater work to be done on Midas and Samos, do you feel that——

The CHAIRMAN. Mr. Riehlman, could you speak just a little louder?

Mr. RIEHLMAN. Do you feel that the same urgency rests with those two programs as there was with bringing into being the Atlas intercontinental ballistic missile? For this reason, General: We recognize and you have well outlined it in your statement today the importance of these two projects and what they mean to our defense. Are we putting the emphasis and should we put the same urgency and emphasis on those two programs that we put on the intercontinental ballistic missile program?

General SCHRIEVER. In answer to the first question my personal opinion is yes. As for the second question I think that we are proceeding on these programs with a more cautious attitude than we did on the ballistic missile program.

Mr. RIEHLMAN. Do you think that we can telescope that time period the same as you were able to in this program of the Atlas?

General SCHRIEVER. First, let me say that we do have enough money for the research and development programs today. We have under active consideration within the Department of Defense the possibility of making a decision that we should go operational, you might say, in the Midas program.

I personally hope that that decision is to the affirmative. I feel that it should be because I think it is the kind of program where we need to take the calculated risk on it similar to what I have mentioned we have taken on other programs.

Mr. RIEHLMAN. I hope that you will use your leadership and influence in seeing done just as much as can be done.

General SCHRIEVER. I can assure you I have been hounding them for quite some time on this one.

Mr. RIEHLMAN. I have just one other question, General. Toward the close of your statement you mentioned something about this early warning program and what it would mean to our people in the civil defense agencies. What importance to you in your field of activity, do you place upon having an adequate civil defense program in this Nation?

General SCHRIEVER. Well, on this one, I am sorry that I have not had an opportunity to read all of the studies that have been made in recent years on this. My own feeling is, my own personal feeling is, and from a position of a sense of inadequacy to comment, is that we should have put more emphasis on the civil defense activities in this country.

Mr. RIEHLMAN. I am very glad to hear you say that, General, because many of us on Capitol Hill have been vitally interested in really constructive programs in civil defense and we are having a hard job selling it even to our own colleagues.

General SCHRIEVER. I think, of course, it is an expensive program from what I have seen about it. But on the other hand, I don't believe that we as a nation, should think if ever we are attacked that this necessarily would be the end and certainly civil defense could make a great contribution to our being able to rise up and move on.

Mr. RIEHLMAN. Thank you very much.

The CHAIRMAN. Mr. Hechler?

Mr. HECHLER. I have no questions.

The CHAIRMAN. Mr. Daddario.

Mr. DADDARIO. Mr. Chairman. General, you have had some nine attempts in attempting to recover the Discoverer satellite. And these have been unsuccessful. Now, what basis can we have that the Mercury capsule can be recovered, taking that into consideration?

General SCHRIEVER. Well, we have had nine attempts with the Discoverer, but not nine attempts at recovery.

Mr. DADDARIO. How many have there been?

General SCHRIEVER. I will just recollect now and then I would like to be sure that the record is straight.

I think we have had five attempts at recovery. Now, remember, three of these missiles did not go on orbit, three of the nine that we have fired. The last successful one, Discoverer VIII, we had our recovery sequence completely instrumented, we know that every step that was supposed to happen, happened in the sequence on the recovery.

We had one difficulty and that was that the attitude of the satellite. The angle of the satellite was a little off due to the fact that we ran out of gas and that is exactly what we did. We ran out of gas because we had a highly eccentric orbit so the missile was in flight longer and we ran out of the gas which stabilizes the bird.

As a result, the recovery capsule went over the recovery force in the Pacific and landed out near the equator. We are certain that it did reenter the atmosphere. We had telemetry data right on through every sequence that occurred, including the opening of the parachute.

Mr. DADDDARIO. Then these are problems that you feel can be overcome?

General SCHRIEVER. I feel absolutely confident that we will make a recovery and make it soon.

Mr. DADDARIO. I was very pleased to hear your answer to Mr. Riehlman's question on civil defense, because I believe with him that one way we can develop our capacities and overall military capability is by shielding and protecting our civilian population to the utmost.

General SCHRIEVER. Yes, sir.

Mr. DADDARIO. In your statement, General, you talk about our whole capability, and you have the phrase in a clause on your third page that, "together with other weapons of the free world," and it is extremely important in the overall picture that we take into consideration the capacity of those nations which are allied with us, is it not?

General SCHRIEVER. Yes, sir, it is.

Mr. DADDARIO. And as we develop our capacities, we develop their capacities as well, not only in the military field, but in the economic field as well?

General SCHRIEVER. That is right. I think it is extremely important that they be furnished the most modern weapons, too, in the age we are living in.

Mr. DADDARIO. Isn't one of the problems propagandawise, that in the community of the free world that we are involved, not only with the military capabilities, but also with those things that affect man, himself, a better way of life? We have certainly through our benevolence helped build up the whole European community and we are doing that in the undeveloped areas of the world and this is certainly as good propaganda as anybody can possibly get, insofar as keeping those nations allied with us, is that not so?

General SCHRIEVER. Oh, I think it is very definitely so. The military factor is only one of a number of factors that establish the overall strength of this country, and its influence on the rest of the world.

Mr. DADDARIO. And while we have here a tendency to confine ourselves to the space effort, and you have said—and I think correctly so—that we have conceded the initiative to the Soviets in this whole field, when you take the entire picture into perspective, take into consideration everything that has been done; certainly, propagandawise in the free world the United States is not in second place to the Soviets.

General SCHRIEVER. Well, I think I am inadequate or do not have sufficient information to answer that one.

Mr. DADDARIO. But there are other factors that have to be taken into consideration.

General SCHRIEVER. There are many other factors; yes, sir.

Mr. DADDARIO. And you will concede that these factors are very important in the overall picture?

General SCHRIEVER. Very important; yes, sir.

Mr. DADDARIO. That is all.

The CHAIRMAN. Mr. King?

Mr. KING. General Schriever, I believe it is conceded by all experts that a year ago the Russians were ahead of us in total space effort—and I use "space" in its broadest term—and it is conceded that they are ahead of us today.

My question to you is: Do you think they are further ahead of us today in space effort—and, again, I am using "space" in its broadest possible sense—are they further ahead of us today than they were a year ago?

General SCHRIEVER. My judgment is that—first of all, it is very difficult to just lump everything together. They are, without a doubt, ahead of us in the large booster field which has permitted them to make some dramatic firsts. Whether they are further ahead of us today than they were a year ago, I really can't say. I think overall, spacewise, if you take into account the accomplishments in the defense area, I would say they are not further ahead of us in space than they were a year ago.

And, as a matter of fact, I would not concede, in the areas that I have talked about, that they are necessarily ahead of us at all.

Mr. KING. Don't you feel that they have more ICBM's, though, operational, than we do?

General SCHRIEVER As of today?

Mr. KING. As of today.

General SCHRIEVER. Not as of today.

Mr. KING. Don't you feel that they will a year from now?

General SCHRIEVER. Based on intelligence estimates on numbers, they will have; yes, sir.

Mr. KING. Then that would give them clear superiority, at least a year from now, would it not?

General SCHRIEVER. They will have a superiority in numbers based on our firm program and what the national intelligence estimate says they will have; yes, sir.

Mr. KING Then, looking forward for, shall we say, 1 year, it would seem that the gap, if there is a gap—you question whether there is one—but, in any event, it will increase or at least it will appear? They will pull out ahead of us over the next year?

General SCHRIEVER. If our estimates are correct, they will be ahead of us in numbers; yes, sir.

Mr. KING. Numbers are quite important, aren't they?

General SCHRIEVER. They are very important, but I want to—I tried to make the distinction in that I, in the Research and Development Command, have been responsible to bring us where we are today in terms of an operational capability, in terms of the performance that has been laid down, that we are not responsible for the numbers that somebody has decided we will have in the inventory a year from now or 2 years from now or 3 years from now.

Mr. McCORMACK. Will the gentleman yield right there?

Mr. KING. Yes.

Mr. McCORMACK. What is your personal view about the difference in the numbers? Would you care to express—from a military vantage—what your views are?

General SCHRIEVER Well, I have expressed my personal views in the past on this matter, last year and the year before, after Sputnik, and I have always qualified my statements by saying that I am not in a position to evaluate the overall military posture. My own personal views have been that we should have made the decisions to put more missiles into the inventory.

The CHAIRMAN. Is that all?

Mr. KING. May I ask one other question?

General Taylor is quoted as having said that we should have $60 billion a year to really build our entire defense picture up to tiptop condition, vis-a-vis the Russians and their threat.

Would you agree with that statement?

Mr. FULTON. Is that 60 or 50?

The CHAIRMAN. Fifty.

Mr. KING. I am relying on my recollection. If Congressman Fulton remembers it as 50, I will yield to that.

Mr HECHLER. Fifty to fifty-five.

Mr. KING. Fifty to fifty-five.

General SCHRIEVER. I wouldn't want to comment on that, because he has just retired as a Chief of Staff. He has had available to him a great deal of information with respect to the total force structure and certainly has a better feel for what might be required overall than I would have, so I would not want to comment directly on his statement.

The CHAIRMAN. Mr. Roush?

Mr. ROUSH. General Schriever, do we have vehicles today with sufficient thrust to take care of these satellites you have mentioned? I am referring to Midas, Samos, Dynasoar, Transit, and Tiros?

General SCHRIEVER. Yes, sir; we do. I would like to qualify what I say. We have the Atlas and Titan boosters; we have the growth potential of both of those, plus having under development the Centaur, which is the higher energy fuel second stage.

The Centaur is not available today, but this will be an essential upper stage to our communications satellite. All the rest of them we do have available, I would say that with these boosters and with the growth that we have projected, we have the necessary hardware to do those jobs.

Mr. ROUSH. You speak of the growth potential of the Atlas. What thrust do you contemplate to develop with the Atlas?

General SCHRIEVER. The Atlas has some additional growth from the standpoint of thrust. As a matter of fact, you may recall we fired a Thor here recently with a higher thrust engine, up to 165,000 pounds of thrust. This, of course, is the same basic engine that makes up the booster cluster on the Atlas. The Atlas booster has two of these engines which are rated now at 150,000 pounds. So that uprating these engines is one way of getting growth. Of course, I was thinking more about the growth that was also related to having higher energy upper stages on the Atlas. The Atlas is the booster that is tied at the present time to Samos, Midas, and the communications satellites. It is adequate to do the job with the qualifications of the Centaur in the communications satellite program.

Mr. ROUSH. Do you contemplate using Saturn for any of these satellites?

General SCHRIEVER. The Saturn is not programed at the present time for any of these, although we have under study the possibility of using the Saturn later on with respect to, say, the communications satellite or perhaps even the Dynasoar. These are in the study phase.

Mr. ROUSH. General Schriever, it has occurred to me that there is a difference or distinction between a sufficient deterrent power and a sufficient counteroffensive force. It seems to me when we think in terms of deterrent we are trying to think in terms of what the other man is thinking.

If we are thinking in terms of a counteroffensive force, we are not only thinking of a deterrent force but a force which will give us a victory in the event of war.

Would you care to comment on that, sir?

General SCHRIEVER. Of course, our definition in the Air Force of a deterrent force is one that has as a first objective, of course, by all odds, the highest priority objective of preventing a war from beginning in the first instance.

In a sense we have already failed, if a war starts. In the second case, we feel that this deterrent posture must be strong enough so that we not only can retaliate, but, in fact, can win in the event a war is initiated.

So I think probably on the counteroffensive it is a matter of definition. It is often thought of, and I think of it along these lines, that the ideal deterrent posture would be a capability of striking and actually knocking out all of his military capability to strike us. In that sense deterrent and counteroffensive would be the same. A counteroffensive has often been looked at in that light.

Mr. ROUSH. Are we in a position today to strike with a counteroffensive force which would give us a victory?

General SCHRIEVER. I think it would give us a victory, yes, sir. I am not saying that we would not be hit in return. I think we could prevail in a war today, yes, sir.

Mr. ROUSH. No further questions, Mr. Chairman.

The CHAIRMAN. Thank you very much, Mr. Roush.

May I then ask you a couple of additional questions, General? I want to know of General Yates: Do you have suitable and sufficient range instrumentation down at the Atlantic Missile Range? Or are you in need for some additional equipment?

General YATES. Our instrumentation is continually changing depending upon the demands and requirements of the new missiles coming in. However, I think the answer to your question is we have sufficient to do the job today and have sufficient planned to do the job in the future.

The CHAIRMAN. Do you have enough support facilities and equipment in A.M.R.?

General YATES. Yes, sir, we have enough to do all the launchings we need. Sometimes it is rather difficult to get these unromantic types of facilities such as warehouses and things like that, but other than that, the usual gripe over lack of that kind of facilities, we have enough to do all the launchings that we need to do and we can get by.

The CHAIRMAN. We were told there were serious problems down there and I have heard of some criticism, too, of the A.M.R. Do you know whether or not your problems are all straight now?

General YATES. I haven't heard of this criticism you mention, Mr. Chairman. I would welcome it.

The CHAIRMAN. We got some. We sent a man down there, Mr. Beresford; he has been there several weeks. How long were you there, Mr. Beresford?

Mr. BERESFORD. Two weeks.

General YATES. I have read criticism in the columns in the newspapers that you refer to, yes, sir. I am completely satisfied that we haven't earned the criticism.

The CHAIRMAN. We are not passing judgment on it at this time because I don't think Mr. Beresford's report is in print.

General YATES. We are satisfied that we have adequate facilities to meet all of our known requirements.

The CHAIRMAN. General Schriever, I understand you to say a year from now we will be behind in the arsenal supply of ICBM's. Would that give us a blind defense spot a year from now?

General SCHRIEVER. Of course, I don't believe you can equate our total deterrent posture just to the numbers of missiles. I believe that missiles have a very important part to play in our overall deterrent posture, and having fewer—personally, I would rather have more.

The CHAIRMAN. Well, in a sense it does give us sort of a blind spot there in our defense, doesn't it? How long would you say that the supply of missiles is going to be heavier with the Soviets than with the United States?

General SCHRIEVER. Well, there are other things that have to be done. Until we have warning and until we have enough missiles, I think our strategic air force will have to—I am talking about our bomber force—will have to go on to an air alert. Exactly when that is, I can't say. It is based on when the intelligence estimates indicate the danger is the greatest. But I think——

The CHAIRMAN. Well, I think we rely defensively on the SAC air force, which is the greatest air force of that kind in the world, in the history of the world. We rely on them, of course, for preventing war and we rely on missiles, but in the sense that we need missiles we will have a blindspot in our defense, won't we, for a while?

General SCHRIEVER. Well, I wouldn't call it a blindspot. It certainly is a weakness and there isn't anything, of course, that can be done today to get more missiles by 1961. The leadtime just doesn't permit it.

The CHAIRMAN. Well, you have a great man in the Air Force there in charge of SAC. I have with pleasure met him and visited Omaha, and gone over his program, and he has very strong views on that. Do you have similar views?

General SCHRIEVER. Well, of course I have a great regard for General Power.

The CHAIRMAN. We all do.

General SCHRIEVER. He was my boss at one stage and I work for him in a sense now, a lot of the work that we do in ARDC——

The CHAIRMAN. From what you say, you are really following his idea that we will not have a sufficient number of ICBM's in our arsenal—I don't know how long that will last, you didn't tell us—but to that extent we are missing in one fundamental element of preventing a war and winning it when it comes; isn't that right?

General SCHRIEVER. Well, of course there is an air alert planned and programed for. I think it is a question of timing and whether it is enough. General Power, I think, has indicated that he doesn't think it is enough. This is his responsibility and I respect his views.

The CHAIRMAN. You have a terrific responsibility, too. We are looking to you, to you gentlemen, for proper defense of this Nation and you surely have some ideas on that.

General SCHRIEVER. Well, I agree, completely in principle, with General Power. Now, I am not, I can't really say that I agree in every detail, because I don't have available to me all of the war planning information that he has as Commander of the Strategic Air Forces and working directly for the Joint Chiefs of Staff.

The CHAIRMAN. I think you have answered the question when you say you agree in principle.

General SCHRIEVER. Yes, sir.

The CHAIRMAN. Because that does put you squarely behind a strong defensive posture and an arsenal full of missiles.

Mr. BASS. Would the chairman yield?

Mr. FULTON. * * *

The CHAIRMAN. I am going to withdraw here and I will recognize Mr. Fulton. He asked me first.

Mr. SISK. I passed on the first round.

The CHAIRMAN. If the gentlemen will stay here, I will recognize you and Mr. Riehlman.

Mr. BASS. You mean Mr. Bass?

Mr. SISK. How much time is the gentleman going to use?

Mr. FULTON. * * *

The CHAIRMAN. That is all right. He is my timekeeper on——

Mr. FULTON. * * *

The CHAIRMAN. I think he is a little strict when he asks the Chairman to tally, himself, the time there, but that is all right, Mr. Fulton.

Mr. FULTON. * * *

Mr. MILLER. I will keep the time. On your mark, go.

Mr. FULTON. * * * I might say when the patient has doctors who disagree, God help the patient. I have never heard so many generals disagree on so many things, on so many questions that are much beyond their own level of responsibility, as I have in the last few weeks. For example, it would seem that many generals are trying to say what overall posture of defense of the United States should be, when, as a matter of fact, that is under the President of the United States, the Commander in Chief, after consulting with the Joint Chiefs of Staff and the National Security Council, Department of Defense, and the various services down the line. And that is a much different thing from a bunch of generals popping off who want everything they can for their own particular posture.

The CHAIRMAN. I think the gentleman is a little severe with General Schriever. General Schriever——

Mr. FULTON. No, I didn't say this general.

The CHAIRMAN. I don't think he is popping off a bit.

Mr. FULTON. Just a moment.

Mr. MILLER. Let him have his time.

The CHAIRMAN. All right.

Mr. FULTON. Just a moment. I am commenting on certain generals——

The CHAIRMAN. But not General Schriever?

Mr. FULTON. But neither my good friend General Schriever.

The CHAIRMAN. Nor General Yates.

Mr. FULTON. Nor General Yates.

The CHAIRMAN. Let's have that understood.

Mr. FULTON. I know him well, yes. But if you read the papers and hear them quoted here they would have a 25-percent increase in personal income taxes or a $10 billion deficit in the budget in order to have a complete emphasis on their particular jurisdiction. I asked the general, General Schriever, is it not a question of the defense of this country overall rather than any particular field where the responsibility must be placed? Is that not right?

General SCHRIEVER. There is no question about that.

Mr. FULTON. All right.

Now, you said this about the capability, on page 3, that is, the capability in space and to defend, economically and efficiently on land, sea, or in the atmosphere, and you say this: "I feel certain if we have this capability"—and notice especially—"and the Soviet Union knows we have it, we can continue to maintain the peace. The Air Force ballistic missile program has established the base for achieving this capability in space not only to serve the military requirements but also national needs."

Now, you have evidently made a good plan and you say it is able to achieve this capability in space, not only to serve the military requirements but also national needs. Would you please say whether you firmly believe that?

General SCHRIEVER. Yes, sir; I do.

Mr. FULTON. All right. Then the next thing is this: You had made as an equal statement that the Soviet Union must know that we have the capability and if the question comes up so that there are serious doubts of the capability of the U.S. Air Force, U.S. Navy, the U.S. Army, the U.S. Marine Corps, if there are serious doubts of the U.S. ability to defend itself, and these are generated in an atmosphere that has no technological basis, then one of the main factors of defense of this country which you have pointed out has been weakened, because then the Soviets will not know we have the capability; is that not right?

General SCHRIEVER. This is true.

Mr. FULTON. All right.

One other thing: I had been in the Navy on active duty as a Reserve officer in World War II and had some experience on the aircraft scheduling units, scheduling planes that I believe you were dealing with, for the U.S. Air Force, the Navy, and the British.

Now, our problem was always there: At what level, on a modification, was there a cutoff point where we went into production of numbers. That brings up the question on this generation of missiles whether we should have the cutoff point at this point because of something almost certainly happening in 1961, or whether we should keep on placing emphasis on research and development as you are doing and giving you every capability for that research and development and I might say putting into effect what you say should be operational. So I hope this committee will strongly endorse you on the operational capability of the Midas. But you see, the point is: Shall we cut off at an early generation stage of missiles and lay up 3,100 or 3,200 of them as has been suggested by somebody, or shall we proceed on research and development with fewer numbers and have, at a later date a much greater capability. What is your answer to that?

General SCHRIEVER. Well, that is an answer that I can't make categorically, because this is exactly in the field that you had indicated before. These are the kinds of decisions that have to be made on the basis of considering all contributions to our overall military strength. These are very hard decisions to make.

Mr. FULTON. So really the question of numbers is a question of the Joint Chiefs of Staff of the U.S. Forces, and also of the National Security Council, based on the strategy the President of the United States lays down as Commander in Chief of all the forces, is that not right?

General SCHRIEVER. That is correct.

Mr. FULTON. So the ultimate decision, then, is the decision of a man by the name of Gen. Dwight D. Eisenhower who is President of the

United States of America at the present time and voted that by all the people, and so it is not at your level that you decide the numbers nor recommend numbers on a mission that is not yours, is that not right?

General SCHRIEVER. That is right.

Mr. FULTON. That is all.

The CHAIRMAN. Mr. Sisk?

Mr. MILLER. The gentleman took 9 minutes.

Mr. FULTON. * * *.

Mr. MILLER. Maybe some of us will insist on taking 9 minutes if that is the way the gentleman——

The CHAIRMAN. Mr. Sisk, you are recognized for 5 minutes.

Mr. FULTON. * * *.

Mr. SISK. General Schriever, I would like to get back to something I think is a little bit nearer in your line and that has to do with your research and development—Mr. Chairman, could I have a little order? I can't seem to understand myself.

The CHAIRMAN. If the gentleman will suspend until we get order here.

Mr. FULTON. * * *

Mr. SISK. If the gentleman from Pennsylvania would be quiet for a minute some of us may have a chance to talk. I think he is doing all the talking here.

The CHAIRMAN. These witnesses are fine witnesses and we don't have them every day.

Mr. SISK. General Schriever, I am interested in the problem of defense and what is being done to defend against these missiles.

Now, our committee, members of our committee, have from time to time been briefed on certain proposals with which I am sure you are familiar. I wonder if you are free to comment to what extent you might or might not endorse a proposal that has been made for further experiments in the field of using energy? Dr. Salisbury, for example, and certain others—I don't know to what extent this program may be classified. I do not wish to get into a matter that is classified. But I am sure you, as head of ARDC, are aware that a lot of study has been done and there are those who feel that it is completely feasible. Are you familiar with what I am referring to?

General SCHRIEVER. Yes, sir, I am, but not in detail and I feel that I couldn't comment on it in open hearing. However, I would like to, if you desire, give you some feel for the kind of things that are going on in the overall area of looking toward the defense picture against ballistic missiles.

Mr. SISK. I appreciate having that, if you might, because, as I say, there have been two or three presentations made to the committee or various members of the committee which look impressive to us as laymen. But we are sincerely desirous of seeing these programs funded if, in your opinion, and others who are responsible, feel that this is an opportunity, because this seemingly could be the real answer, where these missiles could be struck down early, almost from the time they departed from the pad. After all, if we had 100 percent defense, or let's say even 90 percent defense, then I think we would have little to worry about. I think you agree with that.

General SCHRIEVER. I think if we should get a breakthrough that would provide an adequate defense against the ballistic missile type of threat, this would be a major advantage to the country making this breakthrough. I think we recognize this. Actually ARPA has the responsibility in the Defense Department to review all of the proposals and all of the thinking that is going into the matter of ballistic missile defense. They have been extremely active in it and each of the services have been contributing to ARPA. Industry, particularly, has come up with some interesting proposals in the past 6 or 8 months that are being evaluated. We have used the Rand Corp. out on the west coast to look into active ballistic missile defenses. We have also used the Lincoln laboratories and Miter, up in the Boston area, to look into it.

We have had a number of proposals made to the Air Force that are being evaluated by the Ballistic Missile Division because they involve satellite types of systems for active missile defense.

We are to get a result of their particular study here very soon. None of these proposals that I have seen to date have advanced to the point where I think they warrant a large-scale effort relating to hardware. Some of them, however, look promising enough that we should pursue them quite vigorously from a research standpoint.

I think perhaps during this year certain programs, additional programs over those which are now in being, such as Nike-Zeus, BMEWS, and Midas will probably be undertaken. This would be my estimate of the situation at the moment, because some of these things do look quite promising.

Mr. SISK. As a last question, do you anticipate any problem of funding. Because this, of course, is something that we down here could help you on if there is a need.

General SCHRIEVER. Yes.

Mr. SISK. And I think those of us who have seen some of these things would be most desirous of supporting you in getting the funds to carry it through.

General SCHRIEVER. Well, here is what happens in a situation of this kind, and it has happened in my experience a number of times in the past: If, in fact, a program looks extremely promising, as to constitute a breakthrough, so to speak, we have invariably either reprogramed or taken money out of emergency funds or have come back to the Congress for a supplemental.

The budget cycle being what it is you just can't, you can't accommodate these kind of things when suddenly something very promising appears on the horizon in research and development.

We didn't have nearly enough money in our ballistic missile program when we accelerated it in 1954, but the moneys were made available through reprograming actions and emergency funds. It took us about 2 years really to catch up with the budget cycle, but we were never underfunded in this program. I think the same thing might well result in this area, and I can assure you that I would press strongly for coming to the Congress for additional moneys if such a breakthrough appeared to have great potential.

Mr. SISK. Thank you.

The CHAIRMAN. Mr. Bass?

Mr. BASS. General, following the line of inquiry of Mr. Fulton, I just want to make sure that I understand what you have been saying. You have testified earlier that as of now there is no so-called missile gap between us and the Russians as far as operational missiles are concerned. Is that correct, as of today?

General SCHRIEVER. That is as of today, but these are very dynamic things and you can't—the number of missiles that you have in your operational inventory isn't subject to turning the faucet on and off. You have got to make the decision several years back. So we are committed without a question as to the numbers of missiles that we will have in our inventory at least during the next 2 years.

Mr. BASS. And in the future, say a year from now, you have testified that from your best information the Russians will have some more operational missiles than we will.

General SCHRIEVER. Based on intelligence estimates; yes, sir.

Mr. BASS. And you have just told us that in your opinion you think we should match the Russians missile for missile, is that correct, and that we made a mistake in not doing so?

General SCHRIEVER. I did not say that. I said that I had in testimony back in 1958 and also in testimony last year, had advocated that we provide for more missiles in our inventory, yes, sir, I said that. I did not ever say we should match missile for missile.

Mr. BASS. Doesn't it amount to the same thing? You feel we should program more missiles than we are programing; is that not correct?

General SCHRIEVER. At the present time there is a great question as to whether or not we should increase the first-generation missiles, but again—this is because of the leadtimes involved. It would be late 1962 or 1963 before we could increase our inventory.

Mr. BASS. General, do you think we should have programed more, of these first-generation missiles?

General SCHRIEVER. Yes, sir; I definitely do.

Mr. BASS. So you dis——

General SCHRIEVER. That is my personal opinion.

The CHAIRMAN. Will the gentleman yield?

How many more should we program? Is it all right to ask that question? If the gentleman objects——

General SCHRIEVER. I am not saying—I am merely stating that I had said this in my previous testimony. I am not saying today that we should. I said that because of the leadtimes involved that there is a question whether or not we should today, because it is going to be late 1962 or 1963 and other missiles will be coming into the inventory at that time. I am under oath here and I am merely repeating what I said in 1958 and 1959, that I advocated at that time that we increase our missile inventory. I am merely stating a historical fact.

Mr. BASS. Do you think we should program more missiles now than we have?

General SCHRIEVER. I don't—I feel that this decision is above me at the present time and I will not state that we should program more at the present time.

Mr. BASS. General, how can you say that when you have just said earlier that we should have programed more than we did?

General SCHRIEVER. Well, there are two reasons. First of all, the critical period in my personal view, based on projections of Soviet missile strength, may well be in the 1961 and 1962 time period. If we had made decisions 2 years ago or even 1 year ago, we could have had more missiles, as part of our overall deterrent posture in 1961 and 1962. If we make this decision today, we cannot increase the numbers until late 1962 and in 1963. And in that period there are other programs that will be becoming operational and will provide additional missiles into the inventory. So there is a very, very difficult judgment here to make which I don't feel that I, with the information available to me, can make at this time.

Mr. BASS. Is this personal opinion of yours based on the overall picture, or just from your own program in the Air Force?

General SCHRIEVER. It is based on what is available to me and this certainly is not the overall picture.

Mr. BASS. So is it fair to say, then, that you disagree with President Eisenhower in his recommendations in this ballistic missile field?

Mr. MCCORMACK. Don't you think—might I suggest to my friend that he is giving his testimony and we appraise it.

Mr. BASS. That is a perfectly proper question.

Mr. MCCORMACK. I didn't say it wasn't a proper question.

Mr. BASS. I would just like to know——

Mr. MCCORMACK. It is not——

General SCHRIEVER. No, I am not disagreeing with President Eisenhower today. I said—when I mentioned what I had said 2 years ago and 1 year ago, I am merely stating a fact, that this is what I said at that time.

Mr. BASS. So you disagree with the President's program.

The CHAIRMAN. Any further questions? You don't want to get the man in trouble just by——

Mr. FULTON. I wouldn't ask that.

The CHAIRMAN (continuing). By asking him if he disagrees with the Chief.

Mr. BASS. Mr. Chairman, what is wrong with that? [Laughter.]

Mr. FULTON. Getting him into trouble or disagreeing? I don't think he should——

The CHAIRMAN. He stated what he knows and I think that is it.

Mr. FULTON. I think Mr. McCormack is right.

The CHAIRMAN. He came here at our request and he has been a good witness.

Mr. BASS. I think we ought to call a spade a spade, Mr. Chairman, and I don't see——

The CHAIRMAN. I think so, too, but you don't want to crucify your best men. And General Schriever is one of the best we have.

Mr. BASS. Why is this crucifying him? He has chosen of his own accord to testify before this committee as to his own personal beliefs.

The CHAIRMAN. He has testified as to his beliefs pretty well.

Mr. BASS. Now, I have one other question, General. Referring to General Power, you just said earlier that you supported him and his statement that we are not doing enough on this airborne alert, is that correct?

General SCHIEVER. I said I supported him in principle on the airborne alert. I further said that I did not have available to me the same detailed information that he has in terms of his position with respect to timing. It is really a position he has taken on timing. I don't think there is any question in anyone's mind as to the desirability of air alert. I think he is advocating that we move faster and get more on air alert. Now, I would prefer not to comment specifically on things because I do not have the same kind of information available to me that he does.

Mr. BASS. General White said yesterday, and I quote him—

To order an airborne alert at this time is one condition which we do not see is needed as of now, but it could well be a situation which would make an airborne alert prudent in the future.

Would you agree with that?

General SCHRIEVER. Well, General White has a great deal more information available to him than I do. And I certainly wouldn't disagree with General White.

Mr. BASS. Thank you.

The CHAIRMAN. Mr. Hechler has a question to ask?

Mr. HECHLER. I have a short question that is exclusively within your jurisdiction, General Schiever. [Laughter.]

General SCHRIEVER. Thank you.

Mr. HECHLER. Wouldn't your job be easier if all of the American people had a fuller understanding of the serious nature of the threat which confronts us and were willing to make the necessary sacrifices in order to meet that threat? Wouldn't your job be easier?

General SCHRIEVER. Well, I am not sure that the American people do not know of the seriousness of the threat in the nuclear rocket age. I think that they do understand that we are living in a period that—or we are moving into an era where the world has shrunk by many orders of magnitude and for the first time in history this Nation will be placed in a position where the oceans no longer afford any protection. I think the people understand this pretty well.

Mr. HECHLER. I tried to couch my question so it related to your job rather than your appraisal of what the people thought. But I appreciate your answer.

The CHAIRMAN. Are you through?

Mr. HECHLER. Yes.

The CHAIRMAN. Mr. Miller?

Mr. MILLER. General, adverting back to first-generation missiles, the decision to go into production on them, first let me say, unlike my colleague, Mr. Fulton, I am not a Navy man, I am an old Army man. So I am neutral here. But the Navy made the decision to go into production on Polaris, we have built the submarines, they just launched another Polaris down at Canaveral the other day that was successful. We have just got the bugs out of it. By the time they go into production, are prepared to go into production in a big way on it, this gives us a great deterrent power, one of the things that the enemy could be very much afraid of, at least I believe so—a lurking submarine armed with a missile that can go a thousand to 1,500 miles is an ace in the hole. Now, wouldn't we have been very foolish if the Navy hadn't take a chance, although this is a first-generation missile, to go into production on them when it did?

General SCHRIEVER. Absolutely, I think this is the very way to do it. We have done the very same thing in our ballistic missile programs. It is just a question of how much program.

Mr. MILLER. I have in mind that there is a factory ready to go into production on Polaris.

General SCHRIEVER. This is right and we have factories that are producing Atlases today, we have factories that were in production on Thor and are on Titan. We are already building operational bases for the Titan which you might say is analogous to the submarine. They are already under construction now, even though a Titan will not be operational until sometime next year, but we had to make that decision several years ago.

Mr. MILLER. So you are justified. In all the war we went through first-generation, second-generation planes, artillery pieces, everything else——

General SCHRIEVER. We must be on the 50th generation of airplanes, I am sure.

Mr. MILLER. Sure.

The CHAIRMAN. Who was next here? Mr. Fulton? I have agreed to recognize Mr. McCormack last , I will tell you that.

Mr. WOLF. I had a question just to address to the chairman.

Mr. FULTON. I will yield for a question.

The CHAIRMAN. No, the gentleman has a car waiting to take him away. He has to leave this meeting in just a moment. As a matter of fact, we didn't have the afternoon session because Mr. Fulton will be out of town. We really ought to have an afternoon session.

Mr. MILLER. No, we are doing very well.

Mr. WOLF. My question, while we are figuring out what we are going to do, simply was that the most significant thing in my opinion that has been said here is that we actually have no defense against the intercontinental ballistic missile and I believe we will have to delve very deeply into this question of what we are going to do about it very shortly. It seems to me this is our most serious problem. I am wondering if we have any executive session planned within the day or so on this.

The CHAIRMAN. We have no executive session planned.

Mr. WOLF. I would like the record to show that I think this is a very serious matter and I hope in the very near future we can bring the general back to discuss defense against missiles.

The CHAIRMAN. That is one of the most serious matters this committee has approached.

Mr. WOLF. That is all.

The CHAIRMAN. Mr. Fulton?

Mr. FULTON. I would like the record to show that on the Discoverer program alone we have 50 separate study contracts and projects now being worked on. Secondly, on the defense for the ICBM that we do have research and development on Nike-Zeus and on some others that I am not allowed to give in public, several types of projects. Is that not right, General?

General SCHRIEVER. Yes, that is correct.

Mr. FULTON. Likewise, Project Defender—I had said Discoverer, I meant Project Defender. Now, you fellows——

The CHAIRMAN. The committee will be in order.

Mr. MILLER. Go right ahead.

Mr. FULTON. Our counsel, Mr. Feldman, of the select committee, had passed this up to me: When the nuclear missile comes the saying will be that "all men will be cremated equal," because there will be no defense at all. The point I would like to make is on the range of Atlas, vis-a-vis the last Russian missile that landed in the Pacific Ocean. On our last Atlas shot, if I recall, we had a 6,800 mile range and still had 10 percent of the fuel remaining, did we not?

General SCHRIEVER. Not the last one. We have fired the Atlas on several occasions beyond 5,500 miles. The last one that we fired was—the last one of that range which was beyond Ascension Island, was 6,200 miles. We did have—I don't remember the exact amount, but there was about 10 seconds fuel remaining, which means quite a lot in additional miles.

Mr. FULTON. Yes.

That would probably run the range of that particular missile, had it been used, rather than targeted on a certain CEP to an 8,000 mile range, would it not?

General SCHRIEVER. We can fly the Atlas that far.

Mr. FULTON. The Russian missile that plopped in the Pacific here recently, actually was a missile that—I am trying to think of the distance from the Tiura Tam missile base of Russia in southeastern—near the Caspian Sea, would be about 7,600 miles away, would it not. on a great circle route?

General SCHRIEVER. That is about right.

Mr. FULTON. So that it was a 7,600-mile range with a target CEP of maybe a mile and a half or 2 miles and we would have equal to that or greater with the Atlas missile at the 8,000-mile range, would we not?

General SCHRIEVER. Well, of course, we have no way of accurately determining whether they actually had that accuracy. We just have to take their word for it. We have very adequate accuracy in the Atlas and I would say it is certainly equal if not better than the Soviet accuracy.

Mr. FULTON. That means that you might not be able to put the Atlas up in the reserve seats but you can certainly hit the ball park, can't you?

General SCHRIEVER. We certainly can. We can actually put it in the reserved seats, I think.

The CHAIRMAN. Now, I am going to recognize Mr. McCormack for the last questioning here.

Mr. McCORMACK. I take it, General, that you attach great importance to the next 2 years in this period of world history?

General SCHRIEVER. I think that the next few years are very important; yes, sir.

Mr. McCORMACK. Particularly important?

General SCHRIEVER. Yes, sir.

Mr. McCORMACK. Is there any opinion in the Defense Department on the higher level that there is no defense against ICBM's?

General SCHRIEVER. No one accepts the fact that there is no defense. We do not have it today and everyone accepts the fact that it is a very difficult, very difficult job.

Mr. McCORMACK. Well, is it the opinion that a defense cannot be perfected against it and for that reason we are only wasting money to go into research?

General SCHRIEVER. No, sir.

Mr. McCormack. I see. There is no such opinion?

General Schriever. No, sir; not that I know of.

Mr. McCormack. I want to ask you about this "overall"—I read always the overall defense, that is the word that interests me.

Now, SAC, I have been told, and we have had testimony and I have read in the papers, particularly in the select committee we have had testimony, and that was public, and I have read it in magazines. I have asked questions about it, constituted about 90 percent of our attacking power, is that right?

General Schriever. Yes, sir.

Mr. McCormack. I won't say now but I am talking about a year or 2 years ago?

General Schriever. Yes; that has been generally——

Mr. McCormack. It is the same attacking or deterrent power that is our defensive power against sudden—anyone wanting to go into a general war——

General Schriever. This constituted the bulk of our retaliatory strike force; yes, sir.

Mr. McCormack. Now we have no definite knowledge what the Soviets—how far they have gone in the defense against our intercontinental bombers?

General Schriever. There is quite a bit of intelligence information available which I think permits us to make a reasonable estimate as to their capabilities; yes, sir.

Mr. McCormack. Is that something you would want to state in public? I prefer you to resolve it against stating it if you think you shouldn't.

General Schriever. No, sir; I don't believe I should state it in public.

Mr. McCormack. All right.

But assuming they perfect a defense against our intercontinental ballistic missile, SAC is the kernel of our defensive and deterrent power now?

General Schriever. Of our—yes, sir.

Mr. McCormack. I am not downgrading any other activity or any other service, but we have to look at the kernel, the main thing, and if we should lose that during any period where SAC cannot hit because of their defenses or the attrition rate is too great and they perfect the intercontinental ballistic missile before we do, with perfection, in other words, if we lose our deterrent power, that would be a rather dangerous situation, wouldn't it?

General Schriever. Yes, sir.

Mr. McCormack. So when we talk about the world overall, at least for the next 2 years we have to attach that word "overall" in connection with SAC and the ability of SAC, is that right?

General Schriever. I would, in my own personal opinion, primarily SAC, yes, sir.

Mr. McCormack. I am just a layman and I am trying to grope, trying to perform my duties as a legislator, a summary responsibility.

General Schriever. Well, SAC has been recognized as the primary retaliatory force; yes, sir.

Mr. McCormack. So above all, we can never at any time lose our retaliatory power?

General SCHRIEVER. I would say if we lose SAC, we would be in bad shape during the next couple of years; yes, sir.

Mr. McCORMACK. Or if they perfected a defense against SAC, really effective, maybe one gets through, but if the attrition rate is too great, that would be dangerous?

General SCHRIEVER. Yes, sir, it would; but we think we can get through.

Mr. McCORMACK. I am not saying that—I am just here asking questions and I know all you and your associates have it in mind, and I respect the uniform and I respected the uniform which I wore in the Army which was a private's uniform and I respected all others. I don't refer to people as you privates or you generals or anything else. I know my friend didn't mean it to be derogatory, but I think it is a mistake, my personal opinion. We have to have respect. We may differ, but we have to always say things and conduct ourselves in a manner where there is respect for those who wear the uniform. That is my opinion.

General SCHRIEVER. Thank you.

The CHAIRMAN. Thank you very much. Now, just before adjourning, I want to say this: We are holding over four witnesses from NASA that we lost in an effort to hear them about a week ago and we did it because we took up some other matters and sidetracked them.

I would like to get those witnesses before the committee before adjournment for the Lincoln birthday weekend. And then we have Monday the Secretary of the Navy, and I thought—Monday afternoon, of course, we are on the floor with the Sisk bill, so probably Tuesday afternoon, and I hope you gentlemen will stand by to be available on Tuesday morning, Tuesday afternoon, so we can clear up these witnesses.

Mr. HECHLER. Will this cover project Mercury?

The CHAIRMAN. Yes, that is exactly what it is. You have been queried about it and I thought I had better make a statement.

General, I personally think that you and General Yates are doing a great job. We are lucky to have men like you. I don't know who else we can look to in times like this, but the men who have spent their lives trying to protect this country. So the committee will adjourn until 10 o'clock Monday morning. Thank you very much.

(Whereupon, at 12:42 p.m., the committee adjourned to reconvene at 10 a.m., Monday, February 8, 1960.)

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