MISSILE DEVELOPMENT AND SPACE SCIENCES

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND ASTRONAUTICS,
Washington, D.C., Wednesday, February 18, 1959.

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

The CHAIRMAN. The committee will please come to order.

This morning we have as our first witness Dr. Abe Silverstein, director of Space Flight Development.

Dr. Silverstein, we are certainly pleased to have you here this morning on what I consider to be a most auspicious occasion. You are going to tell us a little bit about what has been going on at Cape Canaveral and what is going on up there 3,000 miles above this world.

Dr. SILVERSTEIN. Yes, Mr. Chairman. Let me say first I am very happy to be here, to be invited to talk to you folks about the satellite. Dr. Hagen is with me. I will make a few general remarks. I have a statement, and he will continue telling in a little more detail about the satellite and its flight.

Shall I read the statement?

The CHAIRMAN. Surely, if you will.

STATEMENT OF DR. ABE SILVERSTEIN, DIRECTOR, SPACE FLIGHT DEVELOPMENT, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Dr. SILVERSTEIN. As you know, we launched a 21½ pound Vanguard weather satellite yesterday morning. From all indications, it is transmitting valuable cloud cover data which can be related to the overall meteorology of the earth.

This is a very exciting historic experiment. It represents a first step toward obtaining continuous, 24-hour-a-day weather mapping of global scope. At the present time, by means of weather ships, balloons, and so forth, we are able to map only 10 percent of the world's weather, so it's not hard to see why we are excited about this experiment.

I would like to review, briefly, the history of Project Vanguard because I feel there has been considerable misunderstanding about this project from the very beginning. And at the outset, I'd like to pay tribute to Dr. John Peter Hagen, chief of NASA's Vanguard Division, whose faith in the Vanguard rocket, and the project in general, has never wavered.

On July 29, 1955, the White House announced that the United States planned to launch earth satellites as part of this country's contribution to the International Geophysical Year which ended formally on December 31, 1958. Project Vanguard was the name assigned to that part of the satellite program which was under management of the Chief of Naval Research, Adm. Rawson Bennett. The Naval Research Laboratory (NRL) in Washington, D.C., under the leadership of Capt. P. H. Horn, had responsibility for technical aspects of the program.

Here, I would like to emphasize a fact that is too often forgotten: The Navy set out to produce, essentially from scratch, a satellite launching vehicle in a remarkably short time. The very production of this vehicle was to be, in a sense, one of the most significant contributions of the IGY. The Vanguard vehicle is an advanced rocket, parts of which are in use in other U.S. rockets and missiles.

On October 1, 1958, the President by Executive Order 10783 transferred "all functions (including powers, duties, activities, and parts of functions) of the Department of Defense, or any officer or organizational entity of the Department of Defense with respect to * * * the U.S. scientific satellite project (Project Vanguard)" to the National Aeronautics and Space Administration.

Under authority of this Executive order, 133 members of the Vanguard group at the Naval Research Laboratory and 25 persons in other divisions of the Naval Research Laboratory devoting substantially full time to the Vanguard project, a total of 158 persons, were transferred to NASA on November 30. Of these, 86 are scientists, 42 technicians, and 30 administrative and support personnel. Project Vanguard developed not only the Vanguard vehicle but also the IGY radio tracking net (Minitrack) which has been used not only for Vanguard but for observation of every active satellite so far launched, United States and Russian. With the transfer, responsibility for this network passed to NASA.

At the time of transfer to NASA the engineering and manufacture of the vehicles was essentially completed. Seven three-stage vehicles, i.e., test vehicles TV–3, TV–3BU, TV–4, TV–5, and satellite launch vehicles SLV–1, SLV–2, SLV–3, had been launched. Modifications which resulted from study of records from each launching attempt were being incorporated in the remaining vehicles. Additional preflight operations intended to eliminate the causes of low performance of the second stage in previous flights, had been adopted and were being applied to SLV–4, which is the satellite launched yesterday. There remain four vehicles to be fired.

When responsibility for the Vanguard program was given to NASA, we reviewed the complete history of the project. The Vanguard vehicle is comparable in complexity and application of advanced techniques to military ballistic missiles. Its early flights experience is substantially the same as that of the other missiles, whose failures and successes were not made a matter of public record. The personnel of the Vanguard group are highly competent, and we are pleased that their services have been made available. They have joined in the overall activity of NASA with highly cooperative spirit and are active in the formulation of the national space program.

As a result of administrative review of Vanguard history, NASA decided to postpone the Vanguard firing scheduled for December 1958 to February 1959 to provide time for an objective technical review of the vehicle to determine whether any additional steps might be taken to increase the probability of success. A working committee composed of experts having no previous connection with Vanguard studied in detail the systems involved in the vehicle and vehicle launching. The committee examined all pertinent data from the Vanguard launchings and from the use of Vanguard components in other vehicles such as the Thor-Able reentry and moon-probe vehicles. Numerous modifications in the system and operational practices were made as a result of the work of the review teams and the Vanguard and industrial teams working together.

Whether any of these modifications definitely helped in achieving success of Vanguard II is difficult to say. Definitely the conservative engineering approach that led to a deliberate look by all the participants at their equipment and operating practices was correct in principle.

Prior to yesterday's successful experiment, one Vanguard satellite had achieved orbit—a 3¼-pound test sphere which was launched on May 17, 1958. Its 50-pound third stage rocket casing also went into orbit. Vanguard I, as it was christened, is still aloft, with an expected lifetime of hundreds of years. Its solar batteries are still doing their job and the Army Map Service has been making electronic observations of the satellite from Pacific islands to pinpoint their location more exactly. The satellite is also being used for more exact determination of the earth's shape.

The Vanguard II cloud cover satellite is the first in a series of meteorological satellites to be launched by NASA during the next few years. These satellites should gain information about the weather and how it develops. Substantial economic returns—to say nothing of returns in the form of lives saved by accurate forecasting of hurricanes, typhoons, etc.—can be expected as the technology is developed.

Before closing, I would like to note the contributions of the U.S. Army Signal Research and Development Laboratory, Fort Monmouth, N.J., which developed the instrumentation in the cloud cover satellite; also, the contributions of the industrial firms which have been associated with Project Vanguard under the Martin Co. as prime contractor. The General Electric Co. provided the first-stage rocket. The Aerojet General Corp. provided the rocket for the second-stage booster, and the Grand Central Rocket Co. made the third-stage rocket. The guidance and control equipment was developed from contributions by the Minneapolis-Honeywell Regulator Co., Designers for Industry, Air Associates, and the Martin Co. The fine contributions of these industrial teams are representative of the high level of the Nation's industrial technology and lead us to a feeling of confidence in the future of our programs.

The CHAIRMAN. Thank you, Doctor. Now, I think it would be wise to have the statement of Dr. John P. Hagen next and then we would like to ask you gentlemen a few questions.

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STATEMENT OF DR. JOHN P. HAGEN, DIRECTOR, VANGUARD DIVISION, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Dr. HAGEN. Very good, sir.

Mr. Chairman, before giving you some of the technical background and statistics on yesterday's successful launching of the Vanguard II satellite, I would like to state for the record my deep respect for and admiration for the men and women who have been associated with me on the Vanguard team during the past 3 years. Their competence, loyalty, and untiring efforts have allowed us to achieve the very difficult goal we set for this project not too many months ago. I am sure you join me in expressing these sentiments to the group. As a part of the NASA organization we will apply the same diligence to more advanced efforts that has been applied to the Vanguard program.

The Vanguard II satellite 1959 alpha, the fourth in the series of satellite launching vehicles of the Vanguard program, is the second Vanguard satellite to be placed in orbit. The first, Vanguard I, which was carried in the third in the series of three-stage test vehicles for this program, was launched on March 17, 1958, to become the highest, longest-lived satellite yet placed in orbit. The present Vanguard II satellite carries a cloud cover experiment to record the cloud formation over the surface of the earth in the sunlight beneath its orbit, and to read-out this recorded data upon command from one of the minitrack tracking stations over which it passes. This data, in the form of magnetic tape, is then sent to the U.S. Army Signal Research and Development Laboratory at Fort Monmouth, N.J., where it is reduced to form a picture of the earth's surface over which the satellite has passed, showing the gross details of the cloud formations that existed at the time of satellite passage.

The launching vehicle for Vanguard II was the standard Vanguard vehicle, consisting of three stages and the satellite payload in a finless, bullet-shaped configuration about 72 feet long by 45 inches in diameter at the base. Gross takeoff weight, including first- and second-stage propellants, was 22,600 pounds. Total weight placed in orbit was over 75 pounds. This can be compared to the weights placed in orbit by previous satellites to understand the relative "fineness" of design exhibited by this vehicle. As an example, the Explorer vehicles weighed about 50,000 pounds at launch to place a total of about 31 pounds in orbit. As an additional consideration, none of these satellites produced nearly as high and long-lived an orbit as did Vanguard II.

Martin Co. is the prime contractor for the vehicle. The first-stage engine is manufactured by the General Electric Co., the second-stage engine is manufactured by the Aerojet-General Corp., and the third-stage engine is manufactured by the Grand Central Rocket Co., although a second company, Alleghany Ballistics Laboratory also has contracts for a third stage. They have produced an alternate third stage which has superior performance. The guidance components for the vehicle are provided by the Minneapolis-Honeywell Regulator Co., Air Associates, and Designers for Industry.

The first stage is a liquid propellant rocket, utilizing kerosene and liquid oxygen as propellants. This stage uses a gimballed engine controlled by the guidance system in the second stage to provide a guided "boost" for the second and third stages.

The second stage is also a liquid propellent rocket, employing white fuming nitric acid and unsymmetrical dimethyl hydrazine as fuels. This stage contains the brains of the entire launching vehicle—the complete guidance and control system used during three periods of flight: (*a*) the first-stage powered flight, (*b*) the second-stage powered flight, and (*c*) the second-stage coasting flight. It also carries the third stage and the satellite package within its nose, protected by a special nose cone that breaks away halfway through second-stage powered flight, after the rocket has emerged from the denser layers of the earth's atmosphere. This stage also contains the mechanism for spinning the third stage prior to its ignition.

The third stage is a solid propellent rocket, without any steering controls of its own. This stage was alined at the proper angle by the second-stage guidance system while it was still within the nose of the second stage at the conclusion of the coast of this stage to its peak height. At this peak height, the third stage was spun to about 50 r.p.m., and ignited. After about 30 seconds of thrust it burned out, and the satellite was separated from it with a separation velocity of perhaps 3 to 5 feet per second. This velocity is sufficient to cause the orbit of the empty third-stage bottle and the satellite package to drift apart at a rate of about 60 miles per day. In other words, there are two satellites there and they become separated at this slow rate. The total weight placed in orbit was thus over 75 pounds—over 23 pounds of satellite components consisting of 20.75 pounds for the cloud cover satellite package, 1.1 pounds for the spin retard mechanism, and 1.3 pounds for the separation mechanism, including the heat shield, plus about 54 pounds of empty third-stage bottle.

The satellite payload on Vanguard II is a 20-inch diameter, 20¾-pound sphere, with a highly reflective surface designed to provide a balance between the heat from the sunlight and the internal batteries and the radiation from the satellite that tends to cool it off. This package contains a cloud cover experiment that is now measuring the distribution of the cloud cover over the daylight portion of the earth's surface over which the satellite is passing, plus a minitrack radio transmitter that provides a radio signal to the minitrack radio tracking network. The cloud cover instrumentation package was developed by the U.S. Army Signal Research and Development Laboratory, Fort Monmouth, N.J.; the minitrack transmitter, the command receiver, and the satellite shell by the Vanguard Division of the National Aeronautics and Space Administration.

The cloud cover experiment transmits its data to ground recording stations whenever it is interrogated from a ground station. Radio transmission of the cloud cover data is at 108.03 megacycles at a power level of 1 watt, modulated by signals from 2,500 to 12,500 cycles per second. Expected lifetime of the batteries for both the experiment and its radio transmitter are at least 2 weeks. The minitrack transmitter transmits a continuous, unmodulated signal of 108.00 megacycles at a power level of one-one hundredth of a watt. The frequency of this transmitter is controlled by a quartz crystal that varies as a function of temperature, thereby permitting a ground determination of the internal package temperature by measurement of the received frequency. Estimated lifetime of the batteries for this transmitter is at least 4 weeks. Unlike the Vanguard I satellite, which is still transmitting a strong tracking signal after 11 months, no solar batteries are used to power the transmitters in this satellite.

The cloud cover experiment utilizes two photocells at the focus of two optical telescopes aimed diametrically opposite each other at an angle by 45° from the satellite spin axis. These photocells pick up the sunlight reflected from clouds, land masses, and ocean areas of the earth as the satellite passes over the earth's surface. The spin of the satellite—at about 50 r.p.m.—causes the axis of the photocells to scan the earth in successive lines as the satellite moves forward in its orbit, producing a lined picture not unlike a television picture. The signals from these photocells are stored on a tape recorder within the instrumentation package. By means of separate solar batteries, the recorder is turned on only when the earth underneath the satellite is in daylight resulting in 50 minutes of data per orbit. Sufficient recording tape is provided—a 75-foot loop—so that all of the photocell scanning data obtained from the sunlit part of a single orbit can be accommodated. Once each orbit, a selected ground station is chosen to interrogate the satellite by means of a command receiver carried within the satellite, thereby causing the entire tape to be "played back" at a rate sufficient to read out all data in 60 seconds. At the ground station this data is recorded on a wide-band magnetic tape recorder, the tapes from which are immediately forwarded via airmail to the USASROL for analysis and conversion into cloud cover pictures.

Radio tracking for this satellite is provided by the minitrack network, including stations at Blossom Point, Md.; Fort Stewart, Ga.; Havana, Cuba; Quito, Ecuador; Lima, Peru; Antofagasta, Chile; Santiago, Chile; Antigua, B.W.I.; San Diego, Calif.; Woomera, Australia; and Esselen Park, Union of South Africa.

These stations, in addition to their radio-tracking equipment, also are equipped with special telemetry receivers, recorders, and ground interrogation transmitters. For the special signals expected from this satellite, the Army Signal Corps has installed special FM subcarrier units at the stations selected to interrogate this satellite—Fort Stewart, San Diego, Lima, Antofagasta, Santiago, and Woomera.

The tracking data from the minitrack stations are transmitted by teletype messages to the Vanguard Control Center of NASA at the Naval Research Laboratory here in Washington, and thence to the NASA Vanguard Computing Center, where the orbital elements, station predictions, and ephemerides are produced. These reduced orbital data in turn are transmitted to the control center for distribution to the USASROL, to the tracking stations, and to the other user groups, including the Smithsonian Astrophysical Observatory which has the responsibility for the optical tracking of this satellite, and to the spacetrack center for distribution to various military groups. The functions of the integrated minitrack network-Vanguard Control Center-Vanguard Computing Center as applied to this satellite are typical of all such operations to be provided for all future NASA satellite operations.

Now a word or two about the operation of the vehicle. The Vanguard launching yesterday was a highly successful scientific operation. The launching vehicle itself performed extremely well—in excess of the minimum performance required to achieve a successful orbit, in fact, performance was above nominal—or predicted—performance and approached the maximum achievable. All three stages of the vehicle, guidance, retro, and spin rockets, plus the satellite itself functioned in an optimum manner. The vital statistics below recount the sequence of events in the launching. Two sets of figures are given. The first column indicates the nominal or predicted performance. The second column shows the performance actually received. Although the figures are preliminary and therefore approximate, it is evident from these figures that our expectations were exceeded.

In the table you have before you, you will find that the first stage burned 145 seconds, or 3 seconds longer than anticipated; its velocity and burnout was a little over 6,000 feet per second, whereas it was predicted a bit under 6,000. The altitude at which it burned out was 40 miles, as opposed to a predicted 38.

The second stage also burned some 5 seconds longer than anticipated or a total of 261 seconds. The second stage burnout velocity was 13,650 feet per second; we had anticipated 13,000. The altitude at which the second stage burned out was 155 miles, where predicted was 146, and the period of second stage propulsion was 116 as against 114 seconds. The velocity increment of the second stage was 7,500 feet per second as against predicted 7,100, and the altitude increment, that is the added altitude due to the second stage burning, was 115 rather than 108 miles.

The velocity at projection, this is the velocity that put the satellite in orbit, was 26,954 feet per second, as compared with our predicted 26,505.

Finally the projection direction, that is the satellite has to be sent along a line quite parallel to the surface of the earth, that guidance was better than one-quarter of a degree whereas our predicted guidance was one-quarter degree.

The time was 11 hours 4 minutes 41 seconds.

Now, the orbit achieved has these figures attached to it. The perigee, or closest approach to the earth, is about 330 miles. We had anticipated 311. The apogee, or its greatest separation from the surface of the earth was 2,085 miles whereas we had predicted 1,548. The period of motion in the orbit, 126 minutes; for the smaller orbit it would have been 116. The velocity of the satellite changes, of course, as it goes around. It is most rapid when it is close to the earth. There it is 18,379 miles per hour. The velocity when it is out at apogee drops to 13,040 miles per hour.

Finally the inclination of the orbit to the equator is about 33°.

The CHAIRMAN. Thank you very much, Doctor. I want to say those are splendid statements. They give the committee exactly what the committee wanted, which is specific details.

Mr. FULTON. Those are fine statements and I am sure that is what the public wants.

The CHAIRMAN. I think, too, we can say that your action in sending Vanguard aloft is entirely successful, from your point, in every detail. I, for one, feel that medals indicating the civilian achievement could well be awarded to those who took the key positions in this great and historic accomplishment. Your satellite, this time, is intended for a definite utility purpose. This is the first time that a satellite has ever been placed in orbit with the idea that we would actually get some financial advantage or economic advantage out of the action of the satellite.

Now I am wondering, however, and I want to ask you a question: Why was it planned to have an elliptical orbit rather than simply a circular orbit?

Dr. HAGEN. Well, sir, I think that can be answered this way: One plans a circular orbit, but in order to get one he has to have the operation of the vehicle predicted to a small fraction of a percent. Now, the elliptical orbit is just as useful for this purpose as the circular and therefore it is to be advised that he builds in a little extra performance to get the safety that comes with that extra performance, and this is what gives you then the elliptical orbit. It would require added equipment in the vehicle to cut off the propulsion at the right time to get a truly circular orbit. This is a degree of sophistication to which we will go some day, but we are not there now.

The CHAIRMAN. I know, Doctor.

In your statement you referred to the fact that it was planned to have an elliptical orbit rather than a circular orbit?

Dr. HAGEN. Yes, sir.

The CHAIRMAN. You didn't plan on a circular orbit?

Dr. HAGEN. That is the cushion, the safety margin that we built into the equipment.

The CHAIRMAN. Why were the solar batteries left out of this particular satellite?

Dr. HAGEN. Well, for two reasons: One, this would require a much greater or much larger power from the solar cells than our Vanguard I satellite has.

The other thing is we have to remember there is a long leadtime in building these complex satellites. This was started a long time ago, early in the program. At that time the art of solar batteries had not progressed to the point where one could safely predict that in the time element available he could have really reliable solar cells, and it was therefore planned at that time to use the batteries.

Mr. MILLER. Mr. Chairman, may I make a comment?

The CHAIRMAN. We saw those solar batteries down at Redstone, I believe.

Dr. HAGEN. Yes.

The CHAIRMAN. We were very much impressed by them. If the satellite were designed now, you would assume, would you not, that they probably would use a solar battery in this particular experiment?

Dr. HAGEN. Yes, sir, we can say in our going-on programs we are planning the use of solar batteries.

Mr. MILLER. Mr. Chairman, may I make an observation at this point?

The CHAIRMAN. Mr. Miller.

Mr. MILLER. I think they are to be congratulated on the fact that they went ahead with this and didn't wait until they had perfected the solar battery. This is a true scientific achievement that would not have been possible in the time element had we waited for perfection in all of these things, and I think that contributes greatly to the success. We have it in orbit now, whereas, if we had waited, we would still have found something to do, and we wouldn't have it in orbit.

The CHAIRMAN. My question was not in any way intended as a criticism.

Mr. MILLER. I know.

The CHAIRMAN. I was merely inquisitive as to why it wasn't used. Do you have something to say on that?

Dr. SILVERSTEIN. Just on the same point:

Currently we are just now at the position of being able to provide 1 watt of power with solar batteries. It takes over a year to initiate a package like this and build it up to its environmental testing. That takes 6 months.

The CHAIRMAN. Have you received any pictures of cloud coverage yet?

Dr. SILVERSTEIN. The data has been received. It is received in the form of electrical pulses on a tape in the ground. These have been forwarded to be converted from these electrical pulses in almost the same way that you convert a television picture from pulses into a picture at a laboratory.

The CHAIRMAN. Is it similar to the method newspapers use in transmitting a picture by telegraph?

Dr. SILVERSTEIN. Yes; a facsimile.

The CHAIRMAN. When do you think those pictures will be available?

Dr. SILVERSTEIN. That is a guess, because the method used is electronic computing machinery, and the program needs to be checked to see whether it is corrected to the job, and this has not been done yet.

I would say if everything works well, that within the next several days we ought to have an idea.

The CHAIRMAN. Well, if everything works well and those pictures come out satisfactorily, we would be able to ascertain the cloud coverage and masses over the whole world—that is, the Northern Hemisphere—within a short period of time, wouldn't we?

Dr. SILVERSTEIN. Yes.

The CHAIRMAN. Then the Weather Bureau could go to work right away on the question of weather forecasts, using those pictures, is that correct?

Dr. SILVERSTEIN. Yes.

I would like to modify that in this way:

We look upon this as being the first step. This is establishing the technology of the use of the satellites to study cloud cover and weather information.

In our program we have advanced vehicles that will not only include infrared equipment such as this but will include equipment to take actual television pictures of the clouds and will include temperature measuring devices of the cloud temperatures, instruments to measure the content of the clouds, the water vapor level, the temperatures at the different levels.

Now, this is the advanced picture we will need before in truth, on a real time basis, the Weather Bureau will be able to predict weather.

The CHAIRMAN. What I want to do is tie it down, immediately, as to some economic benefit to the people of the United States for the money expended.

Am I correct in saying the data will be immediately available for the Weather Bureau, and the National Science Foundation (which testified here the day before yesterday) for the purpose of studying the idea that we can better forecast the approach of weather, can forecast wet or dry weather, and can economically take steps—within our own country—to reduce our damages from loss due to drought and floods, is that right?

Dr. Silverstein. This is the intent, Mr. Chairman.

The Chairman. Mr. Fulton.

Mr. Fulton. I am certainly glad to have you gentlemen here.

I would yield to Mr. McCormack first.

Mr. McCormack. No, go ahead.

Mr. Fulton. May I compliment you too, Dr. Silverstein and Dr. Hagen, both doctors, on the form of statement which you have used.

I have had some criticisms as to previous witnesses—they were so indefinite. I am sure the overwhelming majority of the public wants to know just what information you have given, and possibly in the propaganda or psychological warfare we are in, this is one of the best things we can have happen. I would join with the chairman, too, in saying to you that you have been a great help to the United States, and really, while it is a civilian program, it nevertheless has a great effect on our U.S. security.

I want to compliment you too on the fact that through this program we are the first people in the world to get away from the visual tracking and the simple kinds of tracking and moving into a Minitrack transmitter system.

Dr. Sheldon and some of us were in Amsterdam last year, and we had the Russian scientists explain how the students and people on the hilltops had cameras which were passed out to track satellites.

I think the public should know we have advanced on a broad field rather than in the narrow field of track and height. These are tremendous advances.

When you think of the photocells producing instantly repeated signals, it is really the first step toward television.

Likewise, for reconnaissance weather purposes, it is the first time that, for peacetime purposes, there has been something developed generally for the economic benefit of mankind. It is a tremendous step forward in peacetime use.

Russia does not have such a program, does it, as far as we know?

Dr. Hagen. As far as we know, that is right.

Mr. Fulton. So it is about time Russia spoke up on peacetime use.

Another point is on guidance and control as well as on instrumentation. We on the committee can see that you have progressed a great deal further than the Russians have. Our secret and open testimony, as well as our inspection trips have shown that.

Now, there is one question.

The Chairman. Could I interrupt the gentleman just a moment? I want to announce to the committee that we are pleased this morning to have 10 representatives from the Argentine Congress from faraway South America. We are certainly pleased to have them here this morning. We hope that they will take seats here and stay with us as long as they so desire.

I want to recognize them and say on behalf of the committee we are pleased that they have honored us with their presence. [Applause.]

Mr. ANFUSO. Mr. Chairman.

The CHAIRMAN. I interrupted Mr. Fulton.

Mr. ANFUSO. Will Mr. Fulton yield to me?

Mr. FULTON. I will be glad to yield.

Mr. ANFUSO. Mr. Chairman, I had the pleasure of meeting most of these gentlemen in Argentina and also last evening. They are contributing greatly in promoting good relations between the United States and Argentina, and I too want to join you in welcoming them this morning.

The CHAIRMAN. Mr. Fulton.

Mr. FULTON. We Republicans want them to know they are welcome here. There are still some of us left.

May I publicly thank Dr. Hagen, who several years ago was one of those who ignited me as an "eager beaver" in the satellite-missile field; so your influence has gone much further than just the physical.

Secondly, I want to thank Dr. Abe Silverstein for his interest in putting up with me on many many questions, off and on at times, and that also got me interested in many of these projects that are now in the course of coming into operation.

So you men are a sort of beacon light to us in this country and are doing much more than you think—more than just coming up with certain results. It is implementing our peacetime program; and, as our good chairman, as well as the chairman of our select committee previously, Mr. McCormack, has said, we are entering into space by peaceful means and dedicating it to peaceful purposes, and this is the best illustration of that point this morning.

May I ask, on the first page of Dr. Hagen's testimony, with the chairman's permission, at the end of the first paragraph it says:

> It has reduced to a form of picture the earth's surface over which the satellite has passed, showing the gross details of the cloud formations at the time of satellite passage.

Obviously that brings out the question, to any reasonable person's mind: How big a cloud can you pick out or how small a cloud?

Secondly, if you can go into small- or medium-sized clouds that might be in upper altitudes, it is obvious then that you could pick out larger nuclear atomic clouds or dust formations.

Is that possible with our present satellite? Are you able, for peaceful purposes, to pick out any nuclear or atomic explosions that might occur at any place on the earth's surface and do it instantaneously?

Dr. HAGEN. I think we would really prefer to wait until we have seen the reduced information from this satellite to know or to be able to say with any surety what the size, how much resolution in the cloud cover we will really attain.

The size of the spot which sweeps across the earth's scope is on the order of a few miles in diameter, but that depends on how high the satellite is.

Now, when these strips of view across the earth are put side by side, then one can assimilate a picture, and I think it is only in the doing that we will really be able to tell how much detail we can garner out of the picture.

In answer to your second question, I think you can say this: Anything which is of sufficient magnitude and will have a different reflection coefficient from the land mass or sea mass will certainly be detected.

Mr. FULTON. So that from the periphery of 330 satellite-miles that you have achieved, you would then obviously while not being able to tell the details of it note the disturbance caused by any large nuclear atomic explosion, and you would be able to transmit it immediately?

Dr. HAGEN. I would think so, yes.

Mr. FULTON. And with your previous predictions having been carried out above 90 percent, I think that your prediction this time might be taken to be 90 percent true by an interested observer. This really outflanks the discussions that have been taking place on the control and inspection procedures of nuclear and atomic explosions, which have been pretty well bogged down at present.

Possibly we in the United States don't need an agreement now, because we have the method to do it where Russia doesn't, as far as we know, is that not true?

Dr. HAGEN. Well, it could be true, yes, sir.

Mr. FULTON. Well, I am very hopeful that it is true and want to congratulate you on that, because it certainly will give us immediate knowledge of anything that has happened either before or behind the Iron Curtain in the nuclear or the atomic field.

Might I ask you this: Is it possible, through some sort of an ion-emission tracking—say by some electronic means—to pick up the trail of missiles which might be going through the atmosphere near the level of this satellite? A satellite may be at its perigee, where the missile is at maximum ordinant. Do you think that is possible with the use of this kind of instrument? This would be a tremendous breakthrough and really it would outflank the Zeus system—we might not need it.

Dr. HAGEN. I think that is a matter than can only be answered by experiment. There have been some attempts in observing motions of satellites, here from the surface of the earth, to look for disturbances in the ionosphere, to look for their passage. But that work has not progressed to a state that we could say whether it was practical or not.

Mr. FULTON. But if we had a system of satellites that were orbiting, so we could get rather accurate coverage within a short period of time, we could pretty well have a network that would pick up any missiles that are going within the range of up to 1,500 miles, is that not right?

Dr. HAGEN. Provided one could detect the trail.

The CHAIRMAN. Provided one could detect what, Doctor?

Dr. HAGEN. Could detect the trail of the missile through the atmosphere.

Mr. FULTON. Well, the Navy is working on that, and if we get advances there, we might be able to have tracking for every kind of missile in the intermediate and ICBM range.

Thank you very much again.

I compliment you highly.

The CHAIRMAN. Mr. McCormack.

Mr. McCORMACK. No questions.

Mr. RIEHLMAN. Mr. Chairman.

I don't have any questions, but I would like to join with you and the other distinguished gentlemen who have complimented these two distinguished American citizens for the accomplishment that has been brought forth by their efforts, and those that they have been associated with. I think that we are moving in the direction that all of us are vitally interested in, and I think that this accomplishment is one which we can look forward to for peaceful purposes and which can be used for military purposes if necessary and valuable information along those lines, I am sure.

Mr. McCORMACK. I might say for the record, Mr. Chairman, how happy I am having been chairman of the select committee that reported the bill that created NASA—that this marked contribution shows what we have always contended: We have the brains; we have the facilities, and the question is the leadership. Not only as a member of this committee but as chairman of the select committee last year, I not only congratulate you but express my personal and official thanks.

The CHAIRMAN. Mr. McCormack did a magnificent job as chairman of the select committee, and we are glad that the genius of his judgment is now seen in the formation, organization and active work of the NASA.

Mr. RIEHLMAN. Mr. Chairman, could I be recognized just for one second, more because I want to pay my compliments to the distinguished majority leader of the House for his interest in this field, not since he became chairman of the special committee but several years prior to that while working with me on a special committee on research and development. Mr. McCormack, more than once, said to me that we were delving into one of the most important phases of the Government's activities that we could possibly be in, and his diligence and his interest are bearing fruit today in what we are seeing transpire before us and what has transpired in the last few months in our endeavors in research and development.

The CHAIRMAN. I am most happy that we recognize his contribution to this work.

Mr. Miller.

Mr. MILLER. Mr. Chairman, I too want to join in congratulating these gentlemen of NASA for what they have accomplished, naturally, and to pay my respects to the distinguished gentleman on my left for his contributions.

Doctor, I was struck by your statement, starting on page 4, where you say as a result of administrative review of the Vanguard history, NASA decided to postpone the Vanguard firing scheduled for December 1958 until February 1959 and provide time for objective technical review of the vehicle to determine whether additional steps might be taken to increase the probability of success, and continuing over where you say, whether these modifications definitely helped or not is questionable, but it was a good conservative engineering approach. Taking that second look—I don't know whether it developed anything or not—by disinterested people or people who apparently were not interested the first time apparently did have some contribution, and I think you are to be congratulated, as this is a mundane thing, when you think of the romance of getting this thing into space. But it takes the mundane things to get it there. This is one of the things you are to be congratulated for doing, because I feel that that contributed greatly to the success of this undertaking.

I think we all owe you a debt of thanks for making assurance doubly sure by taking the second look before we started the countdown.

The CHAIRMAN. Mr. Anfuso.

Mr. BASS. Mr. Chairman.

The CHAIRMAN. I was ready to call on Mr. Bass, but he was not here. We passed him by.

I will call on Mr. Anfuso, and then go back. It will be tracking back, but I will be glad to do that.

Mr. Anfuso.

Mr. ANFUSO. Congratulations, gentlemen, and I want to say as a less-ranking member, how proud we are to serve on this committee with our distinguished chairman and with the majority leader.

We are very honored to be able to sit on a committee with the majority leader and our distinguished chairman.

Gentlemen, the Soviet Union as well as other nations can track the data from this satellite, isn't that right?

Dr. HAGEN. No, sir, it isn't. They can track the satellite by observing the Minitrack unmodulated transmitter, but the data from the satellite is only taken from the satellite on command.

Now, the transmitter which transmits the data is a higher powered transmitter and puts a fairly heavy drain on our batteries, and so in order to minimize the battery wear and to assure that the data is taken only by the groups that are capable of reducing it, we have not made public the means of triggering off the data transmission.

Mr. ANFUSO. I am glad to hear that, because I had heard differently.

Now, it is true that satellites will be able to spot airborne nuclear explosions, but can a satellite detect an underground nuclear test?

Dr. HAGEN. I think that depends upon the instrumentation, but in general one would say only if there is a visible disturbance up above the surface of the earth. Something would have to be changed to be seen.

Mr. ANFUSO. Thank you.

The CHAIRMAN. Mr. Bass.

Mr. BASS. I would like to ask one or two more questions about the characteristics of this new Vanguard.

Could you tell us more about the type of picture you expect to be reproduced? How will it compare to an actual photograph of the earth's surface? Will it be just like it?

Dr. HAGEN. Well, you know, when you look at a large-screen television, you see the lines in the picture. This will be similar to that. Now, I wouldn't want to give you the impression it will be a television picture of the earth in that sense. It isn't really, because the spot size is fairly large, but there will be presented in the reduction the equatorial band around the earth plus 40 degrees above and below the equator, and this will be crossed by these lines generated as the satellite spins. There will be light and dark portions on those, and when you stand off from this presentation, you should in effect see a map of the earth with the superimposed cloud cover.

Mr. BASS. Would you see land masses and oceans?

Dr. HAGEN. Possibly. We would like to wait until we actually reduce the data before we say for sure that you can, but possibly you will be able to distinguish land masses and oceans and see the cloud cover over that.

Mr. BASS. You don't expect it to be as accurate as a photograph, then?

Dr. HAGEN. No; it will not be in that fine detail.

Mr. BASS. I gather this satellite will not be visible to the naked eye?

Dr. HAGEN. No; it will be about the brightness of one of the faintest stars that you could see, but since it will be moving, it will be very difficult to acquire with the naked eye. It would be much better to have a pair of binoculars and know just where to look.

Mr. BASS. Will it cover the entire world in its——

Dr. HAGEN. Between the latitude limits plus 33° and minus 33°. Now, you can see it a little bit further north because of its great height.

Mr. BASS. So it would not cover the two polar regions, the Arctic and the Antarctic?

Dr. HAGEN. No; it will not see the poles at all.

Mr. BASS. Thank you.

The CHAIRMAN. Mr. Sisk.

Mr. SISK. I want to go back a moment, Doctor, to the discussion a few moments ago between the chairman and the gentleman from California, Mr. Miller, as to the solar batteries.

Now, you had solar batteries in your first instrument that you launched. Now, I don't think it is a matter of waiting to develop the solar batteries. Could you give me a specific reason why solar batteries were not used?

Dr. HAGEN. The solar cells in the Vanguard I satellite are connected just through diode elements to the transmitter so that the transmitter receives power only when it is in sunlight. The kind of solar power supply one would put into a device like this would have a storage system, and so the added problem of developing the kind of battery that will take this intermittent charging and discharging and still be available to run the experiment on demand, that is the kind of thing that had to be developed, and that does take a little bit of time.

I think Dr. Silverstein put his finger on the real reason why we didn't bundle something together quickly and put it in. The policy in the IGY satellite series has been never to fly something unless it has had and has passed very exhaustive ground tests. We try to fly only those things that are proven. So there just was not the time to get this complex battery system going.

Mr. SISK. Well, that was the point that I wanted to make, whether or not there was some reason which I was not aware of or which had not been brought out, some specific reason for not using solar batteries or some particular reason why they would not do the job for this particular type of operation.

I think I understand now your explanation on the matter.

I appreciate, by the way, Dr. Hagen, and you, Dr. Silverstein, being before us again this time. We are very happy to see you.

Thank you, Mr. Chairman.

The CHAIRMAN. Mr. McDonough.

Mr. McDONOUGH. Dr. Hagen, this last shot must have some rejuvenating qualities about it. You look to me to be about 10 years younger than the last time you came before the committee.

Dr. HAGEN. It might have.

Mr. McDONOUGH. I just want to add my congratulations to you for the successful shot, and I am curious to know if we could get any better observation if this satellite were going north and south instead of east and west?

Dr. HAGEN. In some ways; yes. If it were going north and south, then during the course of a day, one would have a complete coverage picture of the earth. However, it would take a half day in order for the earth to turn under the orbit to get this picture. As it is now, we get a complete picture of the equatorial belt in the 2 hours that it takes the satellite to go about.

Mr. McDONOUGH. Now, if you can discern on the screen after you have had the return information from the satellite a cloud formation, can you then spot that on the globe as to where it is located?

Dr. HAGEN. Yes, sir; and we can then, by observing it in future passes, watch its motion, and this is the real point behind the experiment, to see how these cloud masses do move.

Mr. McDONOUGH. That is the next time around, and make a continuous study of it as it goes around, how these cloud masses move?

Dr. HAGEN. Yes.

Mr. McDONOUGH. Do you plan on shooting one north and south?

Dr. HAGEN. Not in the IGY or Vanguard series, but in the going-on program; in the NASA future program, there certainly will be polar satellites.

Mr. McDONOUGH. In the radio broadcast concerning it, I think the statement was made that the equipment that you have in this satellite is crude and can be refined and bettered.

Now, if we know that, why don't we have it? Why didn't we put it into this satellite?

Dr. HAGEN. Well, I would take exception to the word "crude." This is an experiment, and Dr. Stroud and his people, who developed the apparatus, have developed a very refined piece of gear. It does a very specific thing, however, and the experiment is one with limited objectives.

The reason is that that is all of the weight that was available for this kind of thing. Now, once this experiment begins to pile in its information, we will be guided by it in the kind of gear that will be put in the following going-on weather satellites.

As Dr. Silverstein pointed out, we already are planning to put not only this kind of detector but to put several of this kind, and also to put actual television cameras in these future satellites.

Mr. McDONOUGH. Was the thrust that you used in this shot more than enough to put this weight into orbit?

Dr. HAGEN. Yes, sir; within limits. We had this safety factor. We could probably have put almost twice the weight, but we then would not have had our safety cushion.

Mr. McDONOUGH. In other words, to me, the weight of it and the equipment and the performance as described seems to be rather miraculous because to accomplish that in such a small object, it seems you could accomplish more if you had a larger object and larger equipment.

Would that improve it?

Dr. HAGEN. Yes, sir. This is very definitely our aim, and we are in the middle of preparing just such a thing.

Mr. BASS. Would you yield, Mr. McDonough?

Mr. McDONOUGH. Yes.

Mr. BASS. Dr. Hagen, why was it decided to put this satellite in an east-west orbit rather than a north-south orbit?

Dr. HAGEN. For several reasons. Remember that this was a whole program, with many different experiments in it. The people in the National Academy discussed the relative merits of polar and equatorial orbits. The decision that came out of these discussions was that an inclined orbit, one that wasn't truly equatorial but one that had a middle inclination, that would be a compromise between the equatorial and the polar orbit, was chosen. There was another factor that made that choice easy, and that is we had one good place from which to launch a rocket of this size, and that was Cape Canaveral in Florida. We are there under very strict range safety controls. No missile can be launched there that can possibly do damage to personnel or property, and so there is a very narrow range of azimuths over which one can launch. If we were to launch a polar orbit from there, the missile would have to pass over either South America or New York City, and this is ruled out. So we go over the Atlantic Ocean and get this intermediate orbit.

Mr. McDONOUGH. Can't you use Vandenberg? You wouldn't have that danger there.

Dr. HAGEN. Yes, sir; that is one of the prime reasons for using Vandenberg.

Mr. FULTON. But you might hit the Russian hydrographic ship wandering around the Pacific missile range.

Dr. HAGEN. The chance is probably one in a million as to that.

The CHAIRMAN. Mr. Mitchell.

Let me say this before the gentleman begins his questioning:

We had here this morning, set to hear in executive session, Dr. York, Mr. Roy Johnson, and Mr. Holaday. Of course, the satellite has intervened, and that is one of the numerous interruptions, no doubt, we will suffer from satellites in the future.

As a result of it, I think it might be wise if we release Dr. York and Mr. Johnson and Mr. Holaday.

Could you come this afternoon at 2 o'clock? We could have that executive meeting this afternoon, if you would be able to be here.

Dr. York, would you be able to be here this afternoon?

Dr. YORK. Yes, sir.

The CHAIRMAN. How about Mr. Holaday and Mr. Johnson?

Mr. JOHNSON. Very well.

The CHAIRMAN. Thank you.

The CHAIRMAN. As far as we are concerned we can release you this morning.

Mr. HOLADAY. I will have to change my schedule around a bit. I have made appointments for all afternoon. I could change it around if the committee desires.

The CHAIRMAN. Mr. Ducander, can we have them in the morning?
Mr. DUCANDER. Yes.
Dr. YORK. Tomorrow morning would be just as bad.
The CHAIRMAN. Then we will have them this afternoon, because that will speed up our schedule. So if you can be here at 2 o'clock this afternoon, we will appreciate that. We will use you first, sir, so you can get back to your appointment. Thank you very much.
Now Mr. Mitchell.
Mr. MITCHELL. Thank you, Mr. Chairman, I have no questions, but concerning the interrupting, I am sure that the Chairman would welcome any interruptions of this nature during the session of Congress when we have such a successful event. I just want to join with you, Mr. Chairman, in extending my congratulations to both Dr. Silverstein and Dr. Hagen and all of your team. It certainly is a remarkable accomplishment. I think you sense the pride that each of the individual members of this committee feel in your mission and the success of it and I think that the pride that we feel is merely a reflection of all America and I only have this comment to make: You know I have been thinking about the contrast in your appearance here some 12 hours after this successful launching, the contrast between your appearance today and what it would have been had the missile burned out and collapsed on the pad, but I am certainly glad it did not.
Congratulations.
Dr. HAGEN. Thank you.
The CHAIRMAN. Mr. Quigley.
Mr. QUIGLEY. Mr. Chairman, I have two questions.
Dr. Hagen is there a Mrs. Hagen?
Dr. HAGEN. Yes, sir.
Mr. QUIGLEY. I would like to pay tribute to her and to all of the wives who have been involved in this Vanguard program. I suspect that they are the unsung heroines of the space age. I suspect they have had a pretty rough 15 months. The chapter closed as of 10:55 yesterday morning.
Mr. MILLER. If you will yield a minute, there are also Peter and Christoper Hagen, too.
Mr. QUIGLEY. I am glad to hear that, but I want to pay tribute to Mrs. Hagen and to the wives who I believe have been under tremendous pressure for the past year or year and a half.
The CHAIRMAN. Mr. Wolf.
Mr. QUIGLEY. I have one more question of Dr. Silverstein.
The CHAIRMAN. I am sorry.
Mr. QUIGLEY. Doctor, on page 4 of your testimony, you said that the Vanguard vehicle is comparable in complexity and application of advanced techniques to military ballistic missiles. Its early flight experience is substantially the same as that of other missiles whose failures and successes were not made a matter of public record. In the light of that and in the light of the whole experience we have had in connection with the Vanguard program, do you think that there would be a certain wisdom and a certain prudence if in the future we did not give too much advance publicity as to what we planned to do and to hold that publicity and give it to our accomplishments after they become a reality?
Dr. SILVERSTEIN. I would agree with that wholeheartedly.

Mr. QUIGLEY. Because I suspect that the great heat that you two and this whole program have been under has been increased by the fact that we publicly announced what we were going to do. Actually it was what we hoped to do, but in the minds of the general public this becomes what is expected and when we do not do it, you people are on the pan. That is all, Mr. Chairman.

The CHAIRMAN. Mr. Wolf.

Mr. WOLF. Mr. Chairman, gentlemen, I would like to concur with Mr. Quigley in the trials and tribulations of the family and to say I wish to add my congratulations too. I have no questions, Mr. Chairman, but I have a statement I would like to put in the record if I may.

I would like to say that I hope that our committee will encourage our Radio Free Europe and Voice of America and other media which submit and transmit material to the captive peoples to tell them the great progress that we have made here in the use of this satellite for peaceful use. I think this particular Vanguard II demonstrates our desire to help civilization in a very positive way and I hope that as a committee we can make some recommendation of this kind, that these things will be transmitted.

The CHAIRMAN. I think that is an excellent idea.

Mr. Karth.

Mr. KARTH. Mr. Chairman, I have no questions but I should like to join my distinguished colleagues in expressing thanks and deep appreciation to you two gentlemen who have contributed—undoubtedly quite creditably, too, I might say—to the prestige of the United States of America in the eyes of the free world in this accomplishment that has been made. I think that it is a real debt of gratitude that the American people and we owe you two gentlemen. Thank you very much.

The CHAIRMAN. Mr. King.

Mr. KING. Mr. Chairman, yesterday several questions were asked by committee members relative to the distribution of information, the dissemination of technical information, here in America. We had some good answers to those question, but it has been called to my attention that on December 7, the President's Science Advisory Committee issued a statement on that very matter, a very thorough and adequate statement signed by Dr. James R. Killian, Chairman, and the other members of that Committee, including Dr. York. I should like to request that this be made a part of the record.

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

(The statement referred to is as follows:)

IMPROVING THE AVAILABILITY OF SCIENTIFIC AND TECHNICAL INFORMATION IN THE UNITED STATES

A report of the President's Science Advisory Committee

WHAT THE PROBLEM IS AND WHY IT IS SERIOUS

The long, hard look we have recently taken at the state of science and technology is this country has brought to light several areas that need to be strengthened and improved. Some of these, notably in the field of education, have aroused nationwide concern. But another area—also in great need of attention—has attracted little or no public interest. This is the matter of scientific information—the technical data that a scientist needs in order to do his job. Yet our progress in science may very well depend upon the intelligent solution of problems in that area.

All of us use a wide variety of information every day of our lives. We glean it from newspapers, conversation, radio and television, magazines, clocks, books, meters, mail, maps, and so on. The scientist, however, is interested in the specialized information that results from scientific research. The publication of of research information is absolutely essential to every working scientist for two reasons: (1) It is the means by which he announces significant results in his own work, establishes priority where appropriate and invites the evaluation of other scientists; (2) it is also the means by which he keeps abreast of what others are doing in his field.

The extent to which the working scientist depends upon the work of others has been clearly stated by one of the greatest of all scientists, the atomic physicist, Ernest Rutherford. As quoted by James Newman in a recent issue of "The Scientific American," Lord Rutherford said:

"I have also tried to show you that it is not in the nature of things for any one man to make a sudden violent discovery; science goes step by step, and every man depends on the work of his predecessors. When you hear of a sudden unexpected discovery—a bolt from the blue as it were—you can always be sure that it has grown up by the influence of one man on another, and it is this mutual influence which makes the enormous possibility of scientific advance. Scientists are not dependent on the ideas of a single man, but on the combined wisdom of thousands of men, all thinking the same problem, and each doing his little bit to add to the great structure of knowledge which is gradually being erected."

The reason scientific information has become a major problem, particularly since World War II, is that the rapid rate of scientific progress has multiplied the volume of scientific information to a point where it can no longer be published and handled within the framework of existing methods. When one considers, too, that much of what is significant in science is being published in unfamiliar languages, it is clear that the working scientist is faced with almost insuperable problems in attempting to keep himself informed on what he needs to know.

Some idea of the volume of increase may be had from the fact that the science and technology periodical collections of the Library of Congress have doubled approximately every 20 years for the past century and now contain approximately a million and a half volumes, a significant fraction of the Library's total bound collections. The Library is receiving journals in science and technology at the rate of about 15,000 annually, and 1,200 to 1,500 new periodicals are appearing each year. Yet the Library receives less than a third of the 50,000 scientific periodicals that appear in the world list of 1952 and it is expected that by 1979 the total world output will reach 100,000 journals.

The language difficulty is reflected in the fact that Russian-language publications are estimated to account for a tenth or more of all the scientific literature being published in the world today. This Russian total is second only to English.

Reduced to simple terms, the scientist's problem with respect to information is: How can the present volume of research results be published promptly? What is being published now? Where is it? and How can I get at it? The purpose of this paper is to examine these problems and to suggest possible ways in which they can be solved. In particular, it will consider the question of what should be the responsibility of the Federal Government in meeting this crisis.

THE PRESENT SYSTEM

The system by which scientific information is disseminated is the result of evolution rather than any preconceived system or plan. Its defects stem largely from its inability to keep pace with the increasing volume of scientific results and literature and the absence of techniques geared to the newer forms of scientific information, such as Government reports. The situation is further complicated by the fact that a large and important proportion of the world's scientific literature appears in languages unknown to the majority of American scientists, such as Russian and Japanese.

Scientific information appears in several forms. Most significant are the highly specialized technical periodicals, called primary journals, because it is in these that new scientific results are first published. The Physical Review, Journal of the American Chemical Society, and the Aeronautical Engineering Review are examples.

Another important primary source is the monograph, an exhaustive study of some highly specialized phase of science. Because it is of interest to only a limited number of scientists, and because it often includes elaborate charts and plates, the monograph is almost prohibitively expensive to publish. The result is a lack in this country of monographs on many exceptionally important scientific subjects that should be so covered.

A second important category is the abstracting journals, such as Biological Abstracts and Chemical Abstracts. These contain summaries of synopses of papers that originally appeared in primary journals. When adequately indexed, they permit a searcher to locate previously published papers on any given subject. If an abstract is sufficiently informative, it may serve the scientist in lieu of the complete paper. It should be noted parenthetically, however, that the 14 major scientific abstracting services in the United States recently indicated that the almost half a million abstracts that they issue annually constitute only about 55 percent of what they should be publishing in order to cover the literature in their combined fields reasonably well. Other important secondary sources include critical reviews, special indexes and indexing services, bibliographies, title lists, collected tables of contents, handbooks of data, and compendia of various kinds.

A recent trend of special interest is the establishment of data centers. When the quantity of research data in a given field becomes too great for book publication to be practical, the data center offers a solution. Such centers compile, correlate, standardize, and organize numerically, data representing the properties of materials or the characteristics of phenomena. Examples of such centers include the Thermophysical Properties Research Center at Purdue University; American Petroleum Institute Research Project 44 at the Carnegie Institute of Technology, which is concerned with the physical properties of hydrocarbons; the Nuclear Data Project of the National Research Council; and the National Bureau of Standards Center on Selected Values of Chemical Thermodynamic Properties.

Falling outside scientific information that is published, cataloged, and indexed in the normal way, is a steadily mounting volume of Government research reports. It is conservatively estimated that upward of 50,000 scientific reports (at least half of which bear no security classification) are issued annually by the private and Government laboratories that conduct federally sponsored research. Many of the newest and most significant scientific data are to be found in these reports.

A smaller body of scientific information not covered by the normal processes is to be found in such material as research findings submitted in satisfaction of Ph.D thesis requirements, industrial reports and papers presented at scientific meetings and symposia.

At the present time it is not even possible to answer the question with any degree of completeness, "What is being published now?" One would assume that, somewhere in the world, there must be a composite listing of the world's scientific—publications—perhaps even arranged by subject fields—but no such compilation exists. The establishment of such a list and its maintenance on a current basis obviously would be a very expensive undertaking, and this is one reason why it has never been done.

The basic answer to "Where can I find it?"—as far as journals are concerned—is the "Union List of Serials," in the libraries of United States and Canada. Such a compilation lists periodicals alphabetically and names the libraries where each can be found. But no such union list of scientific journals now exists. A joint committee on a union list of serials covering all fields has estimated that the science and technology portion of a new union list would cost approximately three-quarters of a million dollars. It could be kept up to date only in a relative sense, since such a list is constantly changing. It follows, of course, that no comprehensive listing of the principal secondary publications is in existence either.

Then there is the problem of "How can I get it?" The scientist who needs a particular journal may find himself (if the journal is rare) far distant from the location of the nearest copy as indicated by the union list; or he may find that the article he is seeking is in a language he does not read.

In summation, then, it may be said that both inside and outside the normal channels of scientific communication a mounting flood of scientific data threatens to swamp even the most zealous research investigator. The implications go far beyond the inability of one man, or even a group of men, to keep abreast of development in their field. Our very progress in science is dependent upon the free flow of scientific information, for the rate of scientific advance is determined in large measure by the speed with which research findings are disseminated among scientists who can use them in further research.

HOW ARE WE GOING TO MEET THIS PROBLEM?

The situation has evolved over a lengthy period of time, during which the developing problems not only have been recognized, but have been the subject of attack on a number of separate fronts. These efforts have been handicapped, however, by the lack of overall coordination and sufficient funds with which to support really effective remedies.

What is already being done?

All along the line there have been sincere efforts to cope with the problems. Primary journals have expanded substantially in recent years and the scientific societies have helped to cover the increased costs by raising dues and subscription prices. In an effort to conserve space, greater and greater condensation of papers is being required, with the result that there is danger of few people besides the author and his immediate colleagues being able to understand a paper. There is constant search for cheaper production methods and many journals levy page costs upon the authors, so that scientists must pay for the privilege of having their research findings published. Such financial help as the Government has given has been limited, consisting largely of short-term emergency grants made to tide a particular journal over a rough spot or to launch a new journal that is badly needed in order to fill a gap. Some agencies pay page costs for their employees and their contractors' employees when they publish.

Federal aid has also been provided in the form of temporary assistance to commercial abstracting and indexing services, including funds to support the establishment of a National Federation of Science Abstracting and Indexing Services, designed to bring cooperative efforts to bear upon mutual problems. A few Government agencies publish or partially support certain secondary publications in subject fields of particular interest to them.

It is generally agreed, however, that the magnitude and seriousness of the problem are such that a long-term solution requires fundamental research into the problem and widespread application of machine methods and techniques. In other words, science must look within itself for a new system that will meet present-day requirements for the location, storage, and retrieval of scientific information.

A number of industrial firms have developed, and are using successfully, mechanized storage and retrieval systems tailored to their own needs. Large manufacturers of business machines and computers are becoming increasingly interested in the application of their equipment to information-processing problems. A dozen or more universities are carrying on research in the information-handling field, including studies of existing patterns of scientific communication in various subject fields, research in mechanical translation, development of procedures for determining how scientists use technical information, and research on actual mechanical systems for information storage and retrieval. Within the Government, the National Science Foundation has supported research on scientific information problems to the extent that available funds have permitted.

Efforts are also being made to improve the availability of foreign scientific information. The emphasis is on Russian research results because Soviet scientific publications are second only to our own in number, and because so few scientists in this country read Russian. Of the 61 Soviet journals available here on subscription in cover-to-cover translation, about 34 are being supported principally by the National Science Foundation, with assistance from the Atomic Energy Commission and the Office of Naval Research. Nine are supported by the National Institutes of Health; the rest are issued commercially.

In the field of unpublished documents the Office of Technical Services, Department of Commerce, lists some 7,500 such documents each year in its abstracting journal "U.S. Government Research Reports." Copies of all items so announced can be obtained in original form or in photoreproduction. The Library of Congress is building in its Science and Technology Division an open reference collection of unclassified reports. The National Science Foundation maintains a clearinghouse for Government research information to provide scientists information on Government-supported research in their fields and the reports that are available.

Thus a considerable amount of work is being done on serious scientific information problems. From the standpoint of national welfare, however, these efforts are on far too small a scale to deal with the overall problem. The question then remains as to how it can be met.

What should be done for the future?

Two alternative possibilities have been advanced. One would be the establishment of a large and highly centralized scientific information agency, financed by the Federal Government or by Government and private industry. A second would be the establishment of a science information service of the coordinating type, which would strengthen and improve the present system by taking full advantage of existing organizations and the specialized skills of persons with long experience in the field. Let us examine the respective merits of these alternatives.

A single large operating center? The proposal to solve existing problems in the field of scientific information by the establishment of a single large operating center, financed wholly or in part by the Federal Government, may have been suggested by the experience of the Soviet Union with its All-Union Institute of Scientific Information. The organization and operation of the institute implies that the Russians recognize the magnitude and importance of the problem by their decisive and aggressive attempts to meet it. Available evidence indicates that the institute operates effectively in meeting the needs of Russian science. But it must not be overlooked that in planning the establishment and operations of the institute, the Russians could not call upon the services of scientific information organization such as we find already in existence in the private enterprise structure of our country, and which have been in operation many years.

The solution the Russians have developed for meeting their own problems in our judgment would not be equally effective in meeting ours. The Russian institute is organized along the lines that are basically compatible with the organization and administration of research in the Soviet Union which, of course, is controlled by the Central Government. Our own research efforts are organized and administered very differently, and it is illogical to suppose that a highly centralized organization for the dissemination of research information would serve our purposes equally well. Whatever its faults may be, our present system has developed along the lines of individual initiative and private enterprise that are very basic to our institutions.

The primary journals, as well as the abstracting services, are published under the benign auspices of the scientific societies who are in a better position than anyone else to appreciate the information problems of scientists. Existing services, moreover, represent a considerable investment of private capital. "Chemical Abstracts," for example, which has operated without Government subsidy, had a 1957 budget of approximately $1.5 million. Although most of the journals and services have smaller budgets and many do receive some Government support, the total private investment in the publication and dissemination of results of scientific research runs into many millions of dollars. The mere mechanics of transforming the existing decentralized system of private enterprise into a strong central agency are enough to stagger the imagination.

From a purely practical point of view, it must be remembered that much of the day-to-day work involved in the dissemination of scientific information—that is, the writing, editing, abstracting, translating, and so on—is done either by scientists or people with technical skills of a very high order. Many of these people perform such chores in addition to their regular scientific work and it is quite inconceivable that they could be induced to affiliate themselves on a full-time basis with a centralized agency. Put the matter another way: The case for a Government-operated, highly centralized type of center can be no better defended for scientific information services than it could be for automobile agencies, delicatessens, or barber shops.

A science information service? The second alternative, however, could lead to an integrated, efficient, and comprehensive scientific information service that would take advantage of privately supported programs as well as the very extensive work being done by the Federal agencies—that is, it would strengthen rather than supplant them. Specifically, this solution calls for the establishment within the Government of an organization that might be called a Science Information Service. Such a Service would assist, cooperate with, and supplement the many existing scientific information programs but would take over none of them. It would retain the benefits of the existing complex of scientific information services while working at the same time toward remedying its defects. Such a program would be in the best American tradition of private enterprise and Government working together voluntarily for the national good.

The Service would have two important functions: (1) Through effective coordination and cooperative effort of public agencies and private organizations to capitalize upon and improve existing facilities and techniques in such a way as to afford immediate relief to short-term problems of a pressing nature and (2) to encourage and support a fundamental, long-term program of research and development, looking to the application of modern scientific knowledge to the overall problem through the application of machine techniques and through yet-undiscovered methods.

Under the first category the Service would help to answer the scientist's fundamental questions: How can the present volume of research results be published promptly? What is being published now? where is it? and how can I get it?

In the area of primary publication, the Service would provide financial assistance where needed for the publication of journals and monographs. It would encourage publishers and scientific societies to experiment with new and streamlined methods of publication designed to increase efficiency, improve services, and decrease costs. Similarly cooperation would be encouraged among the producers of secondary publications, and financial assistance provided when necessary.

The Service would provide the answer to "What is being published now?" by sponsoring, and if necessary supporting, the immediate preparation of worldwide lists of both primary and secondary scientific research publications, subject classified and indexed. It would perform a similar task with reference to a union list of scientific and technical periodicals and provide a clearinghouse of information on abstracting and indexing services throughout the world. It would review the newly developing field of data centers, compiling information on those that now exist, analyzing overlaps and duplications, and defining areas where new centers are needed.

The whole area of foreign scientific information would be scrutinized and the translation of Russian science expanded to the extent needed to provide full coverage. Additional translation program in Japanese and other languages would be initiated as needed.

The Service would give special attention to the area of Government scientific reports by expanding the existing announcement system to include every significant unclassified report. It would also expand and improve facilities for making copies of these reports available upon request. It would foster cooperative projects among the agencies to promote greater efficiency in the preparation, processing, and dissemination of Government reports.

It would seek to expand and improve interlibrary exchange agreements throughout the world, photocopying processes, and other ways and means of bringing to the scientist copies of items unattainable through normal channels.

All of these things, the Service, with sufficient funds and backing, could proceed to do at once. For the longer term, the Service should support a continuing program of research and development through grants and contracts, looking to the widespread application of machine techniques to such problems as storage, retrieval, indexing, and on a higher plane, to such problems as translation and abstracting.

CONCLUSION

It is clear that in the realm of scientific information, the scientist has neglected his own needs. As a nation we have readily applied modern scientific knowledge to the solution of much more difficult problems. If the Federal Government will establish a national coordinating service of the type that has been described, we can move toward solution of a problem that is vital to our progress in science.

Fortunately a new agency will not be required to meet this need. The National Science Foundation, whose enabling act charges it with specific responsibilities for scientific information, already has a pilot program in this field and hence useful experience and special competence. The Foundation plays a coordinating role with respect to basic research and policy matters within the Federal Government. The establishment of the Science Information Service within the Foundation could be easily achieved by the extension of the Foundation's present program.

The Committee therefore recommends that the National Science Foundation expand its scientific information program to constitute a Science Information Service that would serve to aid and coordinate existing governmental and private efforts.

Dr. James R. Killian, Jr., Chairman;
Dr. Robert F. Bacher,
Dr. William O. Baker,
Dr. Lloyd V. Berkner,
Dr. Hans A. Bethe,
Dr. Detlev W. Bronk,
Dr. James H. Doolittle,
Dr. James B. Fisk,
Dr. Caryl P. Haskins,
Dr. George B. Kistiakowsky,
Dr. Edwin H. Land,
Dr. Edward M. Purcell,
Dr. Isidor I. Rabi,
Dr. H. P. Robertson,
Dr. Paul A. Weiss,
Dr. Jerome B. Wiesner,
Dr. Herbert York, and
Dr. Jerrold R. Zacharias.

MEMBERSHIP OF THE PRESIDENT'S SCIENCE ADVISORY COMMITTEE

Dr. James R. Killian, Jr., Chairman, Special Assistant to the President for Science and Technology, the White House.
Dr. Robert F. Bacher, professor of physics, California Institute of Technology.
Dr. William O. Baker, vice president (Research), Bell Telephone Laboratories.
Dr. Lloyd V. Berkner, president, Associated Universities, Inc.
Dr. Hans A. Bethe, professor of physics, Cornell University.
Dr. Detlev W. Bronk, president, Rockefeller Institute for Medical Sciences and President, National Academy of Sciences.
Dr. James H. Doolittle, vice president, Shell Oil Co.
Dr. James B. Fisk, executive vice president, Bell Telephone Laboratories.
Dr. Caryl P. Haskins, president, Carnegie Institution of Washington.
Dr. George B. Kistiakowsky, professor of chemistry, Harvard University.
Dr. Edwin H. Land, president, Polaroid Corp.
Dr. Edward M. Purcell, professor of physics and Nobel laureate, Harvard University.
Dr. Isidor I. Rabi, professor of physics and Nobel laureate, Columbia University.
Dr. H. P. Robertson, professor of physics, California Institute of Technology.
Dr. Jerome B. Wiesner, director, Research Laboratory of Electronics, Massachusetts Institute of Technology.
Dr. Herbert York, Chief Scientist, Advanced Research Projects Agency, Department of Defense.
Dr. Jerrold R. Zacharias, professor of physics, Massachusetts Institute of Technology.
Dr. Paul A. Weiss, Rockefeller Institute for Medical Science.

The CHAIRMAN. Mr. Daddario.

Mr. DADDARIO. I wish to add my comments and compliments to everything which has been said here. I think the achievement has been a stimulating one for each of us. The committee has listened to some fine reports and these are the finest we have received. I want to add to what Mr. Miller has said, the gentleman from California, about the delay that you had from December to February. I think the idea of submitting this whole program to the eyes and review of others is a great thing and one which should be carried out to the other various stages of the program all of the way down the line because this objective type of criticism, this objective type of help certainly can be of great assistance, as you have pointed out here, and as you have proven. It shows that you have not only the scientific capacity but also a great administrative ability within the program which you are running.

I wish to thank you especially for that. That is all, Mr. Chairman.

The CHAIRMAN. Any further questions? Mr. Ducander, do you have any questions?

Mr. DUCANDER. No, sir; no questions.

The CHAIRMAN. Mr. Fulton.

Mr. FULTON. Dr. Silverstein, as you know, I have been interested in the radio telescope at the University of Manchester and have previously expressed my interest in the experiments being made by Dr. Lovell at that installation. I likewise am interested that any place in the world that we have these scientific installations that they be used to the full, so that in the free world we use our scientific installations.

Secondly, it eliminates the expense of duplicating the installation. Are we working out anything with the University of Manchester at using that radio telescope time that seemed to be vacant last year? Has anything been done on that?

Dr. SILVERSTEIN. Yes, sir; we have worked out something with them. We are also talking currently with the Australians who have a radio telescope and will expect to move in some direction here.

Mr. FULTON. So that the financial difficulties, then, have been overcome for the telescope. The Parliament of Britain had recommended against spending too much money on experiments. That problem has had U.S. help.

Dr. SILVERSTEIN. I believe it is still in the hands of the contract people. I believe the decision has been made to go ahead. I do not know personally at the present time what the state of the experiment is from a contractual standpoint.

Mr. FULTON. Those experiments are to go out 2 billion light years, 6 trillion miles each in tracking stars and making outer space research, so I feel they should be continued. Don't you, too?

Dr. SILVERSTEIN. Yes.

Mr. FULTON. Thank you.

The CHAIRMAN. If there are no further questions——

Mr. MCDONOUGH. Mr. Chairman.

The CHAIRMAN. Mr. McDonough.

Mr. MCDONOUGH. Just one further question. Has the orbit of this satellite confirmed the fact that the earth is not a sphere or is a pear-shaped as has been indicated?

Dr. HAGEN. We would have to wait quite some long time before we could answer that. We would have to observe the orbit and then observe the changes in the oribt which take many months to develop so that this will add to our knowledge of the shape of the earth, but the experiment is probably going to take a year to do.

The CHAIRMAN. If there is no further business, the committee stands adjourned until 2 o'clock this afternoon.

(Whereupon, at 11:40 a.m., the committee adjourned, to reconvene at 2 p.m., the same day.)

AFTERNOON SESSION—EXECUTIVE SESSION

The committee met at 2 p.m., in room 356, Old House Office Building, the Honorable Overton Brooks, chairman, presiding.

The CHAIRMAN. The committee will please come to order.

This afternoon we have the program which had been planned for this morning, and the first witness this afternoon is Dr. York.

Then we have Mr. Roy Johnson, and then Mr. Holaday.

Now, Dr. York, any way that you wish to present your security hearing this afternoon will be satisfactory with the committee. Do you wish to be the first witness or Mr. Johnson or Mr. Holaday?

Dr. YORK. Well, it is at the committee's pleasure.

Mr. Johnson does have a presentation to make. I don't. I am here to answer questions which I couldn't answer yesterday that came up in the course of the hearing. Whatever is the committee's pleasure is fine with all three of us, I am sure.

The CHAIRMAN. Well, I would personally feel if we had a program to be put on, we should get to that as soon as we can, so we will have the program that you people have to present to us. Then we could question the several witnesses.

Dr. YORK. Well, the questions you asked me yesterday that I couldn't answer were about the Nike-Zeus and that is not a part of the program that Mr. Johnson would give.

The CHAIRMAN. Well, if you wish to proceed that way, Doctor——

Dr. YORK. With the space program first, is that what you would like to hear?

The CHAIRMAN. Whatever you say you want first is all right. I would say we better proceed with the program that is set up in the regular course and then ask the questions afterward, because I know myself, and I know the members of the committee well enough to know if we start asking questions to start with, we will not get to the prepared program.

We have a bill on the floor, and we now have permission to sit during the general debate. When that general debate is terminated, we will have to leave and go over to the floor. So why not put on your regular program and then we will come to the questions.

Mr. JOHNSON. Thank you, Mr. Chairman.

We have with us some associates, Colonel Lay, one of our chief technicians in ARPA, Mr. Godel, and Mr. Gise, and I would like Colonel Lay to identify those men from DOD who are here.

The CHAIRMAN. This is classified hearing. Is everybody here cleared?

Mr. JOHNSON. Well, we will take responsibility for DOD people.

Would you identify us?

Colonel LAY. Yes, sir.

There are three gentlemen here in the back that are ours, and these gentlemen right here are ours [indicating], and we are all cleared.

The CHAIRMAN. Mr. Ducander, are our people cleared?

Mr. DUCANDER. Yes, sir.

The CHAIRMAN. All right, we are formally in executive session.

Mr. JOHNSON. Colonel Lay and several others will assist with the charts.

STATEMENTS OF DR. HERBERT F. YORK, DIRECTOR, DEFENSE RESEARCH AND ENGINEERING, DEPARTMENT OF DEFENSE; ROY JOHNSON, DIRECTOR, ARPA; WILLIAM M. HOLADAY, DIRECTOR OF THE OFFICE OF GUIDED MISSILES, DEPARTMENT OF DEFENSE, CHAIRMAN OF THE CIVILIAN-MILITARY LIAISON COMMITTEE, NASA; ACCOMPANIED BY COL. D. L. LAY, W. H. GODEL, AND L. P. GISE

Mr. JOHNSON. ARPA has been assigned projects under three broad categories: Military space technology, propellant chemistry, and ballistic missile defense.

Mr. SISK. Mr. Chairman, is it necessary to take this down? I know we are recording this.

Mr. DUCANDER. Yes, Mr. Sisk, we usually take it. These are kept in accordance with official security rules.

The CHAIRMAN. What we do, Mr. Sisk, is Mr. Ducander takes the transcript, submits it back to the witness, and we delete what is secret and then if there is anything else that can be released to the public, it will be released, after it has been screened.

Mr. SISK. That is fine with me, Mr. Chairman. I just simply wanted to—I know I have some questions later on that are going to be dealing with a new proposed program that I understand is top secret and——

The CHAIRMAN. Go ahead, sir.

Mr. JOHNSON. Military space technology accounts for a significant proportion of the total ARPA effort.

In the early part of its existence ARPA was primarily concerned with the direction of scientific space endeavors, such as the Vanguard, and the Explorer satellites and the lunar probes. These projects were transferred to NASA in October 1958.

Now, a consolidation of our present military space programs, with funding, is shown on this chart.

The CHAIRMAN. The sum total is $331 million for 1958 and——

*   *   *   *   *   *   *

Mr. JOHNSON. Discoverer was separately identified in December 1958, and is designed to develop a number of systems and engineering techniques as well as provide component reliability measurements for new satellite vehicles.

The vehicle dimensions payload and funding are shown on this chart.

You will note here that Discoverer funding in 1959 and 1960 was roughly the same, and this, as I have said previously in open testimony, is the largest single expenditure within the military space program.

All vehicles to be launched in this program will be fired from the Pacific missile range. Later satellites in this program will contain biomedical experiments to seek data on environmental conditions which will be useful to the man-in-space program being carried out jointly by ARPA and the National Aeronautics and Space Administration.

As part of this program, mice, and perhaps a small primate will be launched, and their recovery attempted.

The vehicles to be used in the Discoverer program consist of a Thor, first-stage booster, combined with an upperstage called the Bell-Hustler. Later phases of this program may use the Atlas booster for larger payload capabilities, and parenthetically later I would hope it would include the clustered booster.

The present schedule provides for the launching of approximately one vehicle per month, beginning this month. The date for launching now is the 25th of this month, next week for the first experiment, and continuing through the calendar year. * * *

The need for such a large number of launchings is predicated on the fact that the satellites will orbit for only short periods of time at relatively low altitudes. It is hoped that through this program an all-purpose vehicle with a wide range of application, covering a variety of military space payloads, can be developed and placed in space in stabilized condition.

* * * * * * *

Another important military space program is the communications satellite. The communications satellite program will provide vitally needed expansion of intercontinental trunking capacity together with greater reliability and speed of service.

Existing capacity is likely to be saturated within a decade.

The communications satellite offers the most promising answer to these extremely important problems. It is currently planned that the initial part of the communications satellite program will be the Courier delayed-repeater system.

Project Score, initiated in August 1958 and successfully accomplished on the 18th of December of last year, is dramatic evidence of the potential offered by orbiting communications relay systems. Score demonstrated the utility of putting into orbit communications equipment capable of receiving, storing and retransmitting messages. Since, through sufficiently high-flying satellites containing radio relay equipment, broadcasts can be made from a single point to half the earth, we can obviously help the military with all its communication problems under hot or cold war circumstances. A development program has been undertaken for the prototype of an operational delayed-repeater satellite communications relay system. This work is further refinement of the work initiated under Project Score.

The R. & D. system is to have a capacity equivalent to 20 continuously available hundred-word-per-minute teletype channels available at ground stations located around the world.

The transmission system will be capable of integration with existing communications systems.

Now, a later phase of the communications satellite program is the 24-hour orbit repeater. Here I parenthetically say we would have, I think, for the first time, the circular orbit which the chairman this morning discussed. It is the attempt here, and this is quite a sophisticated job, to get a truly circular orbit, 22,300 miles out.

This phase will provide satellites capable of receiving and retransmitting messages on an instantaneous basis from 6,000- and 19,000-

nautical-mile orbits. At the 19,000-mile height they will complete one revolution around the earth every 24 hours, hence their characteristic of maintaining position over a given point over the globe when launched equatorially.

For point-to-point service, the equatorial orbit appears to be optimum with three or four satellites equally spaced around the world.

* * * * * * *

The schedule for the Courier delayed-repeater system calls for initial tests in late 1959, this year, and early 1960. It is planned that operational tests will be initiated in * * * 1961.

The schedule for the higher orbit, real-time, repeater satellite calls for launchings in 1960 and 1961 of vehicles containing a nonoriented system, with limited operational capability for point-to-point or ground-to-air communication. Flights in 1960 and in 1961 will be made to develop the launching and the stabilization system.

Finally, there will be flights in 1962 and 1963 to test a stabilized, completely stabilized, 24-hour orbit and a satellite with broad-band communication equipment for point-to-point, ground-to-air and ship-to-shore capabilities.

This would be the ultimate sophisticated system, which I hope would be operational by 1963.

The presently planned programs for use of satellites for military communication purposes are based on active radio release. However, ARPA plans to follow the work of NASA and others in use of spheres or other types of reflectors, such as chaff, in orbit, or possibly passive repeaters.

* * * * * * *

Use of satellites for navigation amounts to a practical utilization of the satellite similarity of the stars. The important navigational difference, however, is that a satellite can be fitted with a radio source which can be heard or detected by any ship or plane, day or night, regardless of weather. This will be of particular value to combat aircraft and ships and ballistic missiles submarines and ships. * * *

The navigation satellite program is planned to provide an instantaneous, all-weather system for determining position at any point on the globe by passive means.

In principle, the receiving station will listen to radio frequency signals transmitted by the satellite as it comes over the horizon. This signal is initially shifted up by the Doppler shift due to the satellite rate of approach to the receiver.

The satellite will relay to the receiving station the signal for the Doppler shift, a coded signal of synchronous time and coded signal signifying the orbital diameters in effect.

By using this system, the position may be located within four-tenths of a mile.

As precise knowledge of the satellite orbit and times are known, accurate geographic positions can be determined.

The tactical cloud-cover satellite was undertaken as part of the navigational satellite program, with the objectives of investigating the utilization of television techniques in acquiring weather data. It is planned that the navigation satellite program will provide an answer to the present difficulties resulting from the lack of immediate weather information in inaccessible areas.

Three cameras, strategically positioned in the satellite, will feed pictures into separate magnetic tape recorders for playback when the satellite is interrogated.

The processing of this information will provide weather information. This is a more sophisticated version of the satellite that you discussed this morning.

A thousand pictures will be produced every 24 hours, each picture carrying its detail in 500 television lines per millimeter. This is far more sophisticated than the present television camera.

It is planned that four tactical cloud-cover satellites will be delivered by May of this year, plus six others to be used in laboratory environmental and other tests.

The first launching, with an estimated life of 5 months, will be attempted in July or August of this year, and the second in February or March of next year.

I have mentioned several satellite programs with dates of launching.

This chart is a consolidation of the programs.

Now, I would like to say this schedule may change as we investigate the development plans for various programs.

Mr. FULTON. Could I ask you, have you deep probes planned?

Mr. JOHNSON. No, sir; deep probes are a part of the civilian scientific oriented work, and we hope to gain the benefit of the knowledge acquired by NASA to use in our programs, but—well, I would like to say this, Mr. Chairman: In the military program I personally am concerned about the 600 miles above the earth, and at the moment I don't think that militarily we need to concern ourselves beyond 600 miles.

Now, this is a dangerous statement to make.

The CHAIRMAN. It certainly is.

Mr. JOHNSON. But I would guess that in time we will have to concern ourselves with the space outside of the 600-mile area, but for the immediate future, we are concentrating our effort in building military hardware to maneuver and to orbit in the first 600 miles.

The CHAIRMAN. What about the navigational satellite you just named, that will take an orbit of 18,000 miles?

Mr. JOHNSON. The 24-hour satellite will go out to the 22,000-mile area; yes.

The CHAIRMAN. You are not concerned with that?

Mr. JOHNSON. Well, yes. I am talking now about the basic work, outside of the 24-hour satellite, this is true, yes. The basic work will be in the shorter area beyond the earth's natural atmosphere.

This program here, you will note, builds up the payloads in successive—on a progressive time scale. * * * Obviously, as time goes on, there will be many satellites in orbit at one time. There undoubtedly will be many radiating as well as nonradiating satellites. For this reason, ARPA has been assigned the task of formulating a tracking and a data read-out system.

For radiating satellites and space programs, there is the Minitrack IGY network, a 60-foot antenna in Hawaii, which was built for the lunar probe program, and others in Hawaii and Vandenberg Air Force Base for the Sentry program.

Additionally, there is an 85-foot dish at Goldstone for lunar probe work and several research facilities, such as the Millstone Radar, the British Jodrell Bank Radar, have assisted us in other programs.

The IGY moon-watch organization is available on a worldwide basis and has a number of specialized telescopes. However, since moon-watch is limited by certain technical and weather factors, it was decided last June to modify and extend the Minitrack system to produce the capability of detecting, identifying, and orbit predicting nonradiating objects in space.

A Doppler system complex will operate in cooperation with Minitrack. Construction of a Minitrack Dopler fence across the southern United States is under completion. This fence, which is primarily for research purposes, has begun limited experimental operation, and data from the fence will be transmitted to a central station for reduction and transmission to interested agencies.

* * * * * * *

For the future, ARPA visualizes a need for a national space data coordination center which will serve the entire U.S. requirement. It would be responsible for categorizing all space vehicles. This program should also set broad goals for data acquisition as well as in data read-out analysis and dissemination, and parenthetically here is my personal opinion, that ultimately this center should be one to serve NASA, ARPA, any organization engaged in space activities and truly be a national center.

In order to assure a well-integrated system of facilities, equipment, operating frequencies, communications, nets, and so forth, required for an effective worldwide ground-based surveillance system, a decision was made in October to undertake a comprehensive study of the subject. In early January an agreement between NASA and the Department of Defense was reached on joint implementation and use of worldwide space tracking data acquisition and communication networks.

The tracking facilities of both agencies, planned or in being, will be used by the other agency until the load increases to the point where this arrangement is no longer practical.

A joint technical committee will monitor this program for the two agencies. To keep pace with the urgent requirements to place large payloads into orbit, ARPA has initiated the development, as I said yesterday, of a million-and-a-half-pound-thrust booster, using a cluster of available rockets. This is what it looks like.

This may be repeating information that you received at Huntsville. It was decided that pending development of a single-chamber booster of equal force, which is a long-term research and development effort, we should exploit the capability existing within the state of the art as rapidly as possible to meet immediate requirements.

To that end, the first major goal in this program is to demonstrate a full-scale captive test firing by the end of calendar 1959. Booster flights are to begin in September of next year, 1960.

In conjunction with the clustered rocket, ARPA issued a work order for the development program to provide a high energy, upper stage for us with the Atlas or the Titan.

The engine will use liquid hydrogen as propellants to achieve a nominal thrust rating of 35,000 pounds. This is the program we call Centaur.

* * * * * * *

There are other programs which ARPA is evaluating, one of which involves an electronic countermeasure satellite. Others can be grouped under the heading of "Exploratory Research" and include such items as recovery systems, power supplies, materials research, et cetera.

ARPA is interested in the man-in-space program called Mercury. In 1959 ARPA funded $8 million for this purpose, although we are not planning any funding in 1960.

Solid propellants constitutes a second category of ARPA projects. Solid propellants now available on the shelf are not high enough in performance to allow optimum design of ballistic missiles, ballistic-missile-defense systems, or other guided missile and space systems. ARPA has embarked on a major program in this area in order to bring about major improvements and advances in solid-propellant chemistry. The overall objective of this program is to discover new chemicals, the development of practical methods of synthesis and the knowledge required to utilize these materials in highly efficient solid propellants.

A major aspect of this objective is also the supporting research necessary to make effective use of these high-energy materials and propellants when they do become available. The initial objective is to make available for the development solid propellants having specific impulses 10 to 20 percent higher than now available. In order to achieve this objective ARPA has established four approaches. First on the basis of proposals from major chemical organizations, four contracts were awarded for comprehensive research endeavors in solid propellants. This work, broad in scope, involves ingredient synthesis studies, thermochemistry, thermodynamics and performance calculations, propellant formulation, property investigations, and necessary related chemical engineering and research.

Two, small industrial research contracts are also being sponsored with the intent to exploit some particular specialized skill on the part of the contracting organization in the field of high-energy ingredients and propellants synthesis, combustion, kinetics, and high-temperature tolerance of inert compounds, performance calculations, and the supporting research necessary to permit effective use of new high-energy materials when they become available.

Third, here the approach has been pursued through contracts with universities and nonprofit organizations. In this area ARPA is supporting basic research in the field of solid propellants to obtain information concerned with the necessary chemistry and physics for achieving the desired objectives. These studies are required since basic chemistry and thermochemistry of elements most likely to be used in high performance solid propellants are not today well understood.

Four, and finally, Government in-house programs have also been established. Work being carried out in these laboratories includes synthesis, engine-cooling techniques, detonation studies, thermochemistry, and new compound evaluation and characterization. These four approaches are competitive in character with respect to the allocation of available funds. The overall objective is the discovery of new chemicals, the development of practical methods of synthesis and the knowledge required to utilize these materials in practical and highly efficient solid propellants. * * *

The third category of research assigned to ARPA is the defense against ballistic missiles. This program comprises all those advance phases of the ballistic-missile-defense program which are not included in the Air Force ballistic missile early warning system which we know as BMEWS and does not include the Army Nike-Zeus system. Our objective is to do those things which would make it feasible to build a defense of North America against ballistic missiles at greater ranges and from all directions.

Over the past several years there have been a number of elaborate studies of complete ballistic missile defense systems which have considered the detailed components necessary for detection, identification, tracking, and the kill of ballistic missiles. Without exception we believe that these studies have left as unknowns major questions concerning the actual characterization of the signals which would be obtained from the ballistic missiles flying above the atmosphere and then reentering the atmosphere. Also there are a number of unresolved questions concerning the feasibility of such things as kill mechanisms. For this reason the initial ARPA ballistic missile defense program is directed chiefly toward answering as many of these questions as possible, the area of research and funding for 1959 and 1960 being shown on this chart.

This is a little known fact in our concern over ballistic missile defense. I think this committee and the public at large is not aware of the fact——

Mr. McDONOUGH. Can you enlarge this?

Mr. JOHNSON. No; I will read this. The fiscal year 1959 effort is $80 million. In fiscal year 1960 we propose to increase this to $128 million if the Congress approves our budget. * * *

The CHAIRMAN. Now, Mr. Johnson, I have asked the staff to prepare an analysis of just what you are giving us. Of course it will be confidential and private for the committee, but your people will work with our staff in getting that compilation.

Mr. JOHNSON. Mr. Chairman, we would be happy to, certainly.

The CHAIRMAN. One thing disturbed me a little bit, and I did not ask you, was the first chart there that showed an actual falloff in the amount of financial interest you have in the first chart which you gave us.

Mr. JOHNSON. At the conclusion of this presentation I would like to go back and refer to this chart. I did not pause sufficiently to point out that we are transferring several programs to NASA which account for part of the difference and then I am taking time out now to mention the fact that I hope that the fiscal year satellite program for missile defense will increase from the $18 million that you see here to a number larger than that by reprograming. I hope that it will be double this figure.

The CHAIRMAN. You are going back to explain the original charts?

Mr. JOHNSON. I would like to at the conclusion of this presentation; yes.

The CHAIRMAN. Just proceed.

Mr. McDONOUGH. Mr. Chairman, a question.

The CHAIRMAN. Well, we thought we would wait until he was through.

Mr. McDONOUGH. Well, it is a pertinent question to something he just brought out.

The CHAIRMAN. Mr. McDonough.

Mr. McDONOUGH. You said this detection system would inform us, when it is operating in full, when the rocket is on the pad ready to be launched in Russia.

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The CHAIRMAN. Now the Chair will recognize Mr. Sisk and then we will go back to the program.

Mr. SISK. I did not quite understand your explanation as to why Nike-Zeus is not included in this program here, on this chart. You gave some explanation.

Mr. JOHNSON. I said Nike-Zeus is not an assignment of ARPA. ARPA has been assigned advanced research beyond the Nike-Zeus research.

Mr. SISK. Thank you. That is what I wanted to get straight.

Mr. JOHNSON. The first area of research phenomenon of ballistic missile flight is concerned with taking measurements on nose-cone reentry in the Atlantic missile range and the NASA range at Wallops Island. An example of this is Project Dam. This has instrumentation on a converted liberty ship, the *American Mariner*, which was launched recently for the observation of firings from the Atlantic missile range. It is being funded jointly by ARPA and the Army Nike-Zeus program.

Another program concerns the motor yacht *Acania* which has been equipped with a large variety of research radar and equipment. * * * This bears on the subject Congressman Fulton was discussing this morning.

Mr. Congressman, you were right at the heart of a very important scientific area. Research radars are also being installed at Wallops Island to observe small rocket firings and aircraft are being instrumented with optical and infrared instrumentation. All of these projects should give us a good picture of what atmospheric processes take place during launch and reentry of a ballistic missile.

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System components in which major state-of-the-art improvements are necessary include radar and data processing. In radar particularly it is considered necessary to develop high-capacity, high-resolution, high-accuracy systems of very large range. To be useful for ballistic missile defense, radars must have a very long range. * * * The laws of physics state that a 10-times increase in range requires a 10,000-fold increase in power of the radar. Thus, these radars are both very large and very powerful. As a consequence, they are also very expensive.

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In addition to radars, we are sponsoring a number of investigations in radar techniques. These include studies of ways to measure very small differences in distances while at the same time using very high

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power, also methods of handling the tremendous amount of data coming from long-range radar * * * and which can distinguish between objects a few feet apart.

Now the data-processing problem includes a high-speed reduction of vast amounts of radar and other sensory data, calculation of trajectories, weapon assignment, transmission of data over large distances at high speeds, and AICBM guidance. One of the most serious phases of the data-handling problem is that of deciding when to release the defensive missile. Within a very few minutes of first warning a determination must be made whether an enemy attack is in process and carry out all necessary actions. The relations between machines and men under such circumstances is a very important part of the problem.

In addition to advanced defense against missiles, ARPA has the responsibility for defensive work against space weapons. Feasibility studies are now in progress on this problem.

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This completes the briefing. If you wish to, now we could return to the first tabulation chart.

The CHAIRMAN. Would you explain that first chart why the amount for fiscal 1960 is lower than fiscal 1959?

Mr. JOHNSON. Sir, I would like to point out in fiscal year 1959 we have $15 million for the tactical cloud cover, and this is being transferred to NASA and you will note therefore in fiscal year 1960 there is no money allocated to this project. You will also notice that the high energy upper stage, Centaur, which I referred to as being essential to go with the million-and-a-half-pound cluster if we are to get these high loads into orbit, is being funded at the amount of $16 million. This is being transferred to NASA at the end of the year. Therefore, the amount in 1960 becomes zero.

You will also note that in the manned satellite, the program called Mercury, we funded $8 million and this is being transferred to NASA with no funding for 1960. So if we add 16, 8, and 16 we come to $40 million of program being directed in the Department of Defense in 1959 and being transferred to the civilian agency. Therefore you should, if you want to make this comparison proper, either deduct $40 million from 1959 or add it to 1960, so the relationship would be more in balance.

The CHAIRMAN. There is a big difference in the first item, too, the Discoverer. Is that because that will be completed or nearing completion?

Mr. JOHNSON. The Discoverer program reaches its peak this year and begins to phase out as we learn more about the recovery techniques. The program then would become operational for other purposes and would phase out, that is correct.

The CHAIRMAN. So substantially the program is the same this fiscal year and next fiscal year with the exception that three of your projects are sent over to NASA.

Mr. JOHNSON. Leadtime, Mr. Chairman, has an important bearing on this. This is the money that we will commit in 1959. This does not necessarily mean that this is a measurement of the output. Mr. Gise, could you give us any idea what leadtime might be involved here and the money that we will commit in 1959 but which will actually produce hardware in 1960?

Mr. GISE. It is 9 months at a minimum.

Mr. JOHNSON. The lead time is 9 months, so our effort in 1960 on that basis would be considerably greater than 1959.

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Mr. JOHNSON. * * * You see, ARPA is in the R. & D. business only. Once a satellite program or any program becomes operational, it will be assigned to one of the military departments for operation. * * *

The CHAIRMAN. Of course the military departments have the R. & D. program as well as the operational parts of the program?

Mr. JOHNSON. R. & D. in space is entirely in ARPA.

The CHAIRMAN. What about the Zeus program?

Dr. YORK. The R. & D. of the military space programs is entirely in ARPA. Nike Zeus is not a space program.

Mr. FULTON. Really, on your figure, the 1.5 million pounds thrust clustered engine that you have for fiscal 1959, the 23 million, the conclusion of your negotiations with ABMA will mean that will be revised as well.

Mr. JOHNSON. Yes; as I pointed out earlier in my presentation yesterday, we already decided to put $10 million into the million and a half pound cluster above the 23 million. My guess is we will put another $10 million at least to the $50 million in fiscal year 1960. * * * This is fluid. All I can do is report the status at the moment.

Mr. FULTON. On the $40 million the ABMA wants for the one and a half million pounds thrust clustered engine for 1959, could you correlate that figure for us on that chart to show what may be deducted from fiscal year 1960? How much will actually go in extra in 1959 and what might be deducted from fiscal year 1960?

Mr. JOHNSON. In 1959——

Mr. FULTON. How much are you moving ahead?

Mr. JOHNSON. We are moving ahead in that total column about $15 million, but some of this is coming out of the Secretary of Defense's emergency fund.

Mr. FULTON. I see.

Mr. JOHNSON. In 1960 if we can bring the program along to the point where we can sell the Secretary of Defense and Dr. York that additional funding is appropriate, it is hoped we would get additional emergency funds which we cannot now state because we are not far enough along in the art to budget it. But there probably would be additional money. * * *

Mr. FULTON. When Redstone and ABMA feel they are well treated—I think they do—the negotiations are going well and there is no dispute, and then they say they need the $40 million extra for fiscal 1959, what is the reason they are not getting the whole amount?

Can I have Mr. Quigley join with me on that one?

Mr. QUIGLEY. Yes; I would like to be associated on that question.

Mr. FULTON. Why are they not going to get the whole amount?

Mr. JOHNSON. The reason that there is an ARPA, the Secretary of Defense wanted to have one space program, not three. Each of the services has capabilities in narrow bands and the factories that are associated could turn out a lot more hardware than might be intelligently used.

Mr. FULTON. So you do not want them to make the 16; you are going to limit them.

Mr. JOHNSON. I do not know how to use the 16, Mr. Congressman, and I have to have a few weeks.

Mr. FULTON. That is the nub of the question. They think they can use them and they are worthwhile and you disagree on a policy point, so it really is a determination of policy where there seems to be a disagreement of opinion between ABMA and Redstone on their R. & D. there with the policy group at ARPA and above.

Now I would like to have it not here but in the record sometime, why is that. I think Mr. Quigley would join in that, too.

Mr. QUIGLEY. Very much so.

Mr. FULTON. Because we were pretty well sold on the fact that they ought to have it.

Mr. JOHNSON. Well, I am not disagreeing with that, sir. The whole problem here is when ARPA decided we had to have a million and a half pound cluster, we got hold of General Medaris and Dr. von Braun, and said what can you do? They came back in 6 weeks with the proposal that we then bought and in August I had General Medaris in and I said "What is the fastest timetable that you can get us a minimum number of vehicles," and in the period to October, I believe it was, he came in with a program that I approved. I then said "Now what can you do to better this." I received the program on Monday. You saw it on Friday. What can I do between Monday and now? I am only told on Monday you see that he could better the program that he revealed to us in October, in response to my request. This is my request, because I visualized the 24-hour communications satellite. I visualized the other needs for this big booster.

Now they have said they can develop and they can produce within their facilities with a modest addition more launching vehicles than we had discussed. I have to now find out between us and NASA how can you intelligently in this time frame use the 16. It may well be that we can do that. Now they have ideas, of course, that are not military. * * *

Mr. FULTON. You see, when you limit yourself on policy to 600 to 800 miles above the earth's surface, that, of course, is a factor we had not known. So rather than have it get to where there is a "No" on the policymaking level in ARPA which shuts off these extra vehicles which can be used in the space agency, maybe we ought to be making a move in the NASA budget for the part you will not pick up.

Mr. JOHNSON. ARPA is not making any decision with regard to the total capability of Huntsville. They are presumably informing NASA of the same data they are giving us.

Mr. FULTON. Why do you not get in touch with NASA and between the two of you pick it up?

Mr. JOHNSON. This is a regular procedure with us. I am meeting with Dr. Glennan at 5 o'clock this afternoon.

Mr. QUIGLEY. Will the chairman yield to me for a comment so you will appreciate the concern of the members of this committee?

The CHAIRMAN. Mr. Quigley.

Mr. QUIGLEY. Both General Medaris and Dr. von Braun indicated to me and to other members of this committee that, in their judgment, this clustered program was this country's best, and perhaps its only, bet to get to the moon ahead of the Russians.

Now rightly or wrongly as laymen, as representatives of the great mass of the American people, I think all of the members of this committee feel that there is a great importance psychologically, legally, in vast ramification of our getting to the moon first if we can. Maybe we cannot. But we feel that no stone should be left unturned.

Mr. JOHNSON. I happen to know, Mr. Congressman, that NASA is seriously considering this. As to the booster vehicle program, they are as intensely interested in it as we are, and they are planning to use it in their deep space probes. I suggest as to the probe question that the interrogation be of NASA. I have to point out that there is no military reason to send probes into the outer reaches beyond the area that I have described. We have no military reason for doing this. I agree with you, however, that——

The CHAIRMAN. But let me say this to you, sir: The information and the know-how that you achieve in a million-and-a-half-pound-thrust rocket will help you with your other programs; will it not? It will help you, for instance, with your Sentry program. It will help you with your communications program. It will help you with your navigation program; will it not?

Mr. JOHNSON. Mr. Chairman, this is the reason why we authorized it. This is the reason why, in August, we told Huntsville to give us a program to do this.

The CHAIRMAN. Well, now when they make a request for that additional money, it is true the request has not been here very long, but every delay in handling that request is going to have a direct effect upon the production of the completed product, and it is going to have a direct effect upon who is ahead in this race for control of space.

Mr. JOHNSON. Mr. Chairman, I would like, if I may, to get this in the proper context. The first four vehicles that they propose to deliver will not be speeded up by any more funding. The four vehicles that we have placed an order on will give us the earliest capability for putting these big payloads into space.

Their request for funding is incremental leadtime money to produce the other 12. I have had the request since Monday. We are now debating how we will use that.

The NASA is also studying this new availability which has been just revealed, and I am quite sure that between NASA and ourselves, payloads will be determined and that this funding will be forthcoming.

The CHAIRMAN. Could you let the committee know when you make a decision on that, to give them additional money?

Mr. JOHNSON. Yes, sir; I would be glad to.

The CHAIRMAN. We would be interested in the timing of it there and the result, too.

Mr. RIEHLMAN. Mr. Chairman, I think Dr. York had a comment he wanted to make here. He has been trying to get recognition.

Dr. YORK. I think probably Mr. Johnson has covered all of the points, but by last year's Space Act the responsibility for doing such things as getting to the moon was given to the NASA, so it is not quite fair to ask the Department of Defense why it does not take action to do that.

The CHAIRMAN. Then why, I will ask you, does Redstone still have that project if it has been given to NASA entirely? As I understand it, you are allowing the departments to continue with the programs that they had already begun. Is that not it?

Dr. YORK. No, sir; those programs that ARPA wants then the various military installations are to do.

The CHAIRMAN. Does Redstone still have that program of a million and a half pound thrust?

Dr. YORK. Yes, but not for getting to the moon, and that is what I understood the question to be, these extra boosters and so forth. ARPA does have the program; Redstone is carrying it out for the million-and-a-half-pound booster.

The CHAIRMAN. If they get the million and a half pound thrust and there are enough protoypes created, then we can use them for the purposes best adopted at that time?

Dr. YORK. But it is up to NASA to buy them and use them for that purpose.

Mr. FULTON. ABMA is the equipment supplier on that program.

Mr. SISK. Mr. Chairman.

The CHAIRMAN. Mr. Sisk.

Mr. SISK. I just wanted to say you are talking about Redstone having that program, but they are doing contractural work for NASA already and, of course, this would simply be—if NASA wanted to enter into a further contract for, let us say, four or six or eight of these vehicles, they would be in a position to do so, provided they had the funding to do it; is that not correct?

Mr. JOHNSON. That is correct. This is their intention, I am sure, and they have asked for a supplemental appropriation, and I believe part of this request is to cover this. This is again a matter of money.

I would like to point this out, though: I do not think the committee is clear that it was ARPA that conceived the idea of and the need for this program for a million-and-a-half-pound thrust. We are the ones that asked Huntsville to develop this.

There was skepticism in Huntsville. They wanted to engage in other booster programs beyond this. We sold them the idea that they had a unique capability to cluster the Redstones to do this job, and we have led this program.

We initiated it in August. We would not be where we are had not ARPA conceived this.

The CHAIRMAN. Let me say this to you, Mr. Johnson: I for one believe that ARPA is doing a good job and I recognized it because I carried over from my old committee assignment on Armed Services a good deal of the information that we have had here in this committee since.

Now, I don't want anything done to disrupt the program done by the Defense Department in the name of ARPA. On the other hand, the Redstone has that project now, and it seems to me everybody ought to get together and try to push it over and forget about petty differences as to whether or not ARPA has it, Redstone has it, NASA has it, or another agency has it. Is that right?

Mr. JOHNSON. Mr. Chairman, I assure you that there is none of that feeling. I would give an oath to that.

The CHAIRMAN. Fine, we will accept your statement there.

Mr. JOHNSON. There is no feeling of proprietary rights with regard to this cluster on the part of any of the three of us.

The CHAIRMAN. Now, are there any further questions there? Mr. Mitchell?

Mr. MITCHELL. Mr. Johnson, as I gathered it, since the new Space Act, what it is you are saying is it is a question of whether or not it is proper under the laws that exist for Redstone, for Huntsville, to be asking you for this additional money rather than that they should be asking NASA for it. Is that right?

Mr. JOHNSON. No; not entirely.

Mr. MITCHELL. Since in your program you feel that——

Mr. JOHNSON. Well, the people of Huntsville understand perfectly well what the military requirements are. They understand what NASA is trying to do. I think the problem here right at the moment is the fact that since we issued the contract, we have done the funding to date, but they have chosen initially to convey this first message to us expecting that we would then convey it to NASA.

And I want also to make clear that what we got on Monday was not a technical program. It was merely a one-letter statement that in view of the changing situation they had in new capability.

We have now asked them for the technical backup. We are now giving this information to NASA. I am quite sure that you will find that if there is a requirement there that there will be no problem of their placing their orders directly in Huntsville for * * * their needs.

We know we have a need for four. The chances are that we will need immediately 4 more, as I said yesterday, and take 8 of the 16.

Mr. FULTON. So, really, who we pressure on this is Dr. Abe Silverstein?

Mr. JOHNSON. Yes; I think that would be a good idea. I want to see these 16 produced, too.

The CHAIRMAN. Mr. Miller.

Mr. MILLER. Mr. Johnson, I would just like to clear up in my own mind something that you said; that you got a letter, that the letter was not a technical submission or proposition, and that you had to examine it from the technical viewpoint.

Aren't ARPA, ABMA, and NASA so coordinated that you know their capabilities to know the competency of the people down there, that every time they are going to come to you you have to make a deal and say: Wait a minute, we have to stand back and examine your technical competence to make sure what you are doing is what we want—is there that difference?

Mr. JOHNSON. No, Mr. Congressman, this is not a second guessing of their technical competency. This is an examinaton of what these satellites can do in terms of the kinds of payloads, the kinds of orbits, the distances out they can go.

You see, it isn't as simple as saying: Here is a vehicle composed of 2 or 3 stages that we can make available, because all of our missions are different.

I think you heard in the testimony this morning the technical problems of circular orbit, and we have to get this technical explanation of what kinds of payloads and what kinds of orbits they can achieve with this configuration. Then we have to decide if our payloads will match the vehicle.

Mr. MILLER. Then you are so far apart, isn't that a confession that there is a lack of interchange of knowledge or coordination, that you have got to go in and check one against the other in this field?

You know the chairman of the committee spoke of bringing information over from an old committee. I served with him on that old committee. One of the things that was always bothersome to us was trying to get the services together and to get away from service jealousies. It looks to me from the statement you just made, that this sort of thing is like saying: This is my little tower, I am not going to let anyone come into it.

And so, if somebody else comes to me and says: We have this capability, we can always hide behind the curtain, well, I haven't examined your technical competency to do this, when I was hopeful that in this new agency, with the pressure that is on us, we could get away from that. I was hopeful that you were close enough to know pretty well without the necessity, each time you wanted to buy a piece of hardware from an agency engaged in the same field, that you had to go through all of this technical submission of data that slows up the program.

Mr. JOHNSON. Well, I think the only answer to your question would be for you to interrogate Dr. von Braun and General Medaris, and ask if they have received prompt decisions from ARPA on submissions they have made.

I do believe it was reported back to me that these two men have so stated to this committee.

If a record was kept of that, I think that would be the fact, and if it hasn't been, I think the answer would be to summon General Medaris and Dr. von Braun to testify to that. They could give you a better answer than I as to the adequacy of ARPA responsibilities.

The CHAIRMAN. I don't think that is necessary, sir, if I may interpose there, because you are going to tell us when you make a decision on that. We will know from your own actions and your own statements.

Mr. ANFUSO. Would the gentleman yield?

The CHAIRMAN. Mr. Anfuso.

Mr. MILLER. I had the floor, but I suppose it is taken away now.

The CHAIRMAN. Mr. Miller.

Mr. MILLER. No; it is your's, you took it. I have no questions.

The CHAIRMAN. Mr. Anfuso.

Mr. ANFUSO. Mr. Johnson, I am a little worried about this use of decoys. A decoy would have to be a missile, wouldn't it?

Mr. JOHNSON. No; it could be just chaff. What they could do would be to explode the casing after the warhead was let loose and fragment it, and it would burst out into a mass of chaff. It would cover a large area, maybe a thousand pieces, and we wouldn't know by radar techniques which one was the warhead, and in order to get the warhead we might have to shoot and kill a hundred or a thousand objects.

Our problem is a very, very difficult one, if they threw a lot of chaff at us, on the radar screen they would all look alike. The profiles would be the same.

Mr. ANFUSO. Would it be a very expensive proposition, however, to use decoys?

Mr. Johnson. No; a decoy is a very inexpensive thing. You just put a little detonation in the casing and blow it up. It doesn't cost anything.

Mr. Anfuso. May I ask Mr. Holaday a question now, or should we wait?

The Chairman. We are going ahead now, if there are any further questions, let's dispose of them.

Mr. Anfuso. May I ask Mr. Holaday now, then?

The Chairman. Well, let's wait and let him testify. Mr. Sisk.

Mr. Sisk. I had another program I want to question Mr. Johnson about. Is this the appropriate time to do that?

The Chairman. Yes.

Mr. Fulton. Before we start on a new line, may I clear up a question, with your permission?

Mr. Sisk. I will yield to the gentleman.

Mr. Fulton. I believe we should say to Mr. Johnson that both General Medaris, as well as Dr. von Braun, have stated very definitely in my hearing the fine and hearty cooperation they have gotten from ARPA, from you, from Dr. York, and the whole crowd, and that there is really no dispute on it. And it was rather our questioning and our interest in trying to get the program moving fast that brought this whole thing up.

They were really not part of the movement on it and rather said, Well, hold back, and we said, Well, we will do it on our own, so there is no dispute as far as I saw it on the question by my good friend, Mr. Miller, as to whether there was such a dispute. There was no such evidence.

Mr. Miller. Will the gentleman allow me to make a statement?

Mr. Sisk. Mr. Chairman——

Mr. Miller. You have the floor.

Mr. Sisk. I will yield to you.

Mr. Miller. I may say that I was not one of the party, to keep the record clear, who went to Huntsville and talked to Dr. von Braun or General Medaris on this subject, nor have I discussed it with them or heard it discussed in my presence. I want to keep that very clear. I am concerned, naturally, with trying to see that we don't get this thing into pigeonholes.

Mr. Sisk. Mr. Chairman——

The Chairman. Mr. Sisk.

Mr. Sisk. I wish to concur in the feeling that my colleague from California has about keeping down any controversy. I will at the same time say that I heard the same statement that my colleague from Pennsylvania indicated.

In fact, I think General Medaris had some hesitancy in even bringing this up, because he felt that the cooperation you had given him had been so good that he didn't want us to bring any pressure here, so you blame us for any of this, and we are not considering it pressure. We are just vitally concerned to see this program go ahead, as I am sure you people are.

Now, I want to discuss with you another program which I feel very strongly about, particularly as to the timing of the program, and that has to do frankly with certain geodetic surveys that I feel are important. In other words, it appears to me that failure accurately to pinpoint military targets for our missiles would require a greater expenditure from our rather limited resources than possibly what we are doing to insure the destruction of the target.

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The CHAIRMAN. If you do not wish it to be recorded at all, we won't even have it taken down.

Mr. JOHNSON. I would like to have it not recorded.

(Discussion off the record.)

The CHAIRMAN. Are there further questions?

Mr. CHENOWETH. Mr. Chairman.

The CHAIRMAN. Mr. Chenoweth.

Mr. CHENOWETH. I want to ask a general question as to the total amount you are spending in 1959 and the total amount you expect to spend in 1960, roughly, approximately. I am just curious to know. There seems to be some criticism we are not going fast enough. Will more money make us go faster, more accelerated, or what is the picture?

Mr. JOHNSON. As to the money, I am of the opinion that within the DOD budget we will find ways to reprogram close to $50 million in 1959 of new money for space work, I think as we are able to establish the need that there is going to be made available, as I said earlier, something like $100 million in 1960 of additional money over that which has been requested.

We cannot budget it now, because this is a very fluid situation, and I am not one that is going to advocate the spending—for example, there was a point here, a time a month ago when I was bent on spending $25 million on this satellite application. Then I did my homework and I found out information not available to me normally and not available to my staff. This information we now have. I could have very foolishly—as a matter of fact, I did ask for emergency funds of $20 million, and I have withdrawn it because it isn't necessary to proceed with this.

We can modify the Centaur to do it. I don't believe that just money alone is going to speed this up. We have to have a purpose with these satellites. We are not just putting them up there as basketballs. They have to have missions as far as the military is concerned. For science, I can't speak as to what you do with rockets for science.

Mr. CHENOWETH. I was thinking, Mr. Johnson, of the overall program. You were just talking about one specific program. I would like to know if you have the figures available what the Air Force, the Army, the Navy, all of them are spending?

Mr. JOHNSON. The whole program, yes, I believe it is adequate.

Mr. CHENOWETH. How much would it run?

Dr. YORK. About $800 million, including NASA.

Mr. CHENOWETH. Well, I have heard much larger figures than that.

Mr. JOHNSON. We are talking space only.

Mr. CHENOWETH. Missiles and everything.

Mr. JOHNSON. You are talking about the whole Defense Department.

Dr. YORK. Missiles and space together, $4 billion, I suppose.

Mr. CHENOWETH. I have heard 5½ or 6.

Mr. FULTON. The overall program is $6.7 billion.

The CHAIRMAN. Our committee checked it originally and they came to a military program of $5.5 billion and an overall program for all agencies of $7.1 billion.

Mr. CHENOWETH. That is for 1960?

The CHAIRMAN. Yes.

It is very difficult to figure it out, though. I will say this: what we want to get and our committee staff is working on it, is an analysis of the program from ARPA and from the military departments. We want to know exactly how much we are putting into research and development and in those departments.

Mr. JOHNSON. We will be happy to furnish that.

Mr. CHENOWETH. You have about four different groups here spending money.

Mr. JOHNSON. That is right.

Mr. CHENOWETH. Maybe it is five, you and NASA and the three military departments.

Mr. JOHNSON. That is five right away.

Mr. CHENOWETH. Is there more than that?

Mr. JOHNSON. The National Science Foundation and other groups spending money on research.

Mr. CHENOWETH. But not in the amounts you are spending.

Mr. JOHNSON. No, these are the big ones.

Mr. CHENOWETH. I would be interested in those figures, Mr. Chairman, when you get them.

The CHAIRMAN. When we have them worked up, they will be submitted to the committee on an executive basis, that is, a confidential basis.

Mr. CHENOWETH. I would like to say this, Mr. Johnson, in closing. I made the trip with the committee last week to Cape Canaveral and Redstone Arsenal. I was very favorably impressed with what I saw. I think you are doing a good job. As a layman and one completely uninformed on what I saw, my impressions were very favorable.

Mr. JOHNSON. We think this is the most competent group of people in the country, and we believe they are using their capabilities effectively.

We recognize the fact that they have productive facilities beyond what is being used. We would like to use them intelligently, but I for one am a taxpayer who believes that we shouldn't be doing this just because it is available.

We should have a purpose, and when those purposes are established and we can fund them, we will continue to use their capabilities to an even greater degree.

Mr. CHENOWETH. Well, it is something more than just spending money that is involved.

Mr. JOHNSON. Much more than spending money. I think we have become too enamored in recent weeks in trying to measure things in terms of spending money.

I have been guilty of waste myself, by being precipitous. I don't know how many millions of dollars of the taxpayers' money I have wasted by being precipitous.

Mr. CHENOWETH. Well, the general temptation is to move along faster than we have any right to express.

Mr. JOHNSON. There is, yes.

Mr. CHENOWETH. I think you are making pretty good progress, yourself.

The CHAIRMAN. Any further questions?

Mr. MILLER. I would like to make one statement off the record.

(Discussion off the record.)

The CHAIRMAN. Mr. Fulton.

Mr. FULTON. You people have spoken of the methods of intercepting or knocking down ICBM's or satellites. My feeling on it has been—I have been thinking about it a little bit—rather than trying to stop them or fragment them, why don't you boost their acceleration or just divert them? They may be easier to catch up with and just give them a push and that destroys their aim, than it would be to try to block them or fragment them.

Mr. JOHNSON. That is a good idea. I hadn't thought about that.

Mr. FULTON. The question comes up where there is no atmosphere or anything which would respond to a detonation or impact. Possibly we are on the wrong end of it. We should perhaps chase them and increase their acceleration or velocity when they start, than to try to knock them down when they are coming in.

May I say to you if you know where the installations are, you get a very much narrower arc of initiation than you do of reception, and it is a much smaller problem.

As a matter of fact, when you are catching them on the upgrade, you then chase them into the apogee rather than have a blank space and then try to receive them with those advanced radar receptions.

Mr. JOHNSON. The ideal way, as I pointed out in my presentation, is to invent a death ray which you just point; and explode them.

Mr. FULTON. You are more advanced than I. When the Russians have already had a scientist announcing a program for putting an unmanned tank on the moon 8 years ago, why do you people abandon the strategic area of the moon when as good an authority as General Boushey of the Air Force believes that that is part of our strategic defense?

Mr. JOHNSON. I haven't a requirement from the Joint Chiefs of Staff which tells me we should begin to deploy military vehicles to reach the moon.

Mr. FULTON. You do not, or you do?

Mr. JOHNSON. We do not.

I think at this point in time, it is the intention of the Space Council and the decision of the President who transferred the moon shots from ARPA by Executive order to NASA. This was a clear intention that probes in the area of the moon were to be civilian conducted, and the Congress did set up the Space Council to make these decisions. The Council recommended them to the President and these decisions are his, not mine.

The CHAIRMAN. Now, if there are no further questions, I would like to ask a couple of questions.

A U.P.I. dispatch of February 15th quoted Dr. York as stating that the Defense Department may soon reconsider its decision against starting early production of a missile designed to shoot down enemy intercontinental rockets.

That is correct, isn't it?

Dr. YORK. I don't know where I—I am afraid I am lost. Where did they quote that from?

The CHAIRMAN. Dr. Herbert York. The date is February 15.

Dr. YORK. I have no question, I am just trying to think of where on earth they would have gotten the information.

The CHAIRMAN. They quoted you twice there as giving consideration on that.

Mr. JOHNSON. This is "Anti-Missile Decision Soon Under Nike-Zeus."

Dr. YORK. I don't know where it could have come from. Would you like to ask me some specific question on that?

The CHAIRMAN. It came from U.P.I.

Dr. YORK. But where did U.P.I. get it? Do you have some specific question in mind concerning that?

The CHAIRMAN. Yes. That program interests me very much, because, according to this article that I have here by Brig. Gen. S. M. Melnick, in El Paso, he says—I won't read the whole article, it is a full page—he says that the Nike-Zeus is simply a projection of the Nike-Ajax and the Nike-Hercules, simply speeding up the missile and making it a little larger missile. And he says that the Nike-Ajax and the Nike-Hercules are so effective that the Army has run out of targets in El Paso, there is nothing more to shoot at, and they have to create an error in the Nike-Hercules missile they send up to keep the Nike-Hercules missile they send up from destroying all of the targets. Otherwise, the Air Force will run out of targets to furnish them. He is a little bit optimistic, I believe.

Dr. YORK. I won't argue with the general.

The CHAIRMAN. He refers to the Hawk there, and its capabilities, but the main thing I am interested in is the Zeus. He says it has the same qualities as the Hercules, which has been so immensely effective.

I want to know, considering that fact and knowing that the Zeus offers us the only possibility that I see at the present time of bringing down ICBMs after they are launched from Russia and before they are detonated in this country, if you weren't correct when you were quoted as saying you were going to reconsider that program?

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Mr. MCDONOUGH. Well, this ray defense that you spoke about, Mr. Johnson, is that just Buck Rogers or is it real?

Mr. JOHNSON. At the moment it is pretty much Buck Rogers, that is, report. We are sponsoring and financing some work in several areas, some of it theoretically is looking more hopeful as the days go by. But it is this kind of breakthrough that is going to solve this kind of problem.

I think in the time span between now and 1966, we could hopefully expect such a breakthrough. I am not saying a ray, but a breakthrough for a defense against missiles. I don't know what it would be.

Dr. YORK. The best way to produce such a breakthrough or to come across something is to keep working on it in a fairly active way. That, incidentally, is how the hydrogen bomb came about. For the first 2 or 3 years of work on the hydrogen bomb, the situation was that it was possible to prove, as I have sort of attempted to do here, that it couldn't be done, and in fact, the designs that people were spending all of their attention on in those days and the ones all of the calculations were being made about, we now know indeed they would not have worked, but it was through assembling people and having an intensive effort on this kind of system that the workable hydrogen bomb came about, and essentially we hope the same sort of thing somehow is going to happen here; that by keeping a good active pressure on this, that we will find out a way to get around these problems that I spoke of.

Mr. McDONOUGH. We beat the Russians on that, didn't we?

Dr. YORK. Yes, by some.

Mr. McDONOUGH. We were ahead of them by how long on the H-bomb?

Dr. YORK. Even that is an arguable point. I would put it, on one of reasonable efficiency, a couple of years. It is a fact that they exploded one within about 10 months of the time that we did, but there was quite a difference, even so, in just what those were like.

The CHAIRMAN. Now, before we go too far here, Mr. Holaday, do you have a statement?

Dr. YORK. He has stepped out for a minute.

The CHAIRMAN. Does he have a statement?

Mr. HOLADAY. No, sir.

The CHAIRMAN. We caused you to stay over, and we don't like to inconvenience you. We want to conclude this part of the hearings this afternoon, if we can.

Do you have a statement?

Mr. HOLADAY. No, the statement we gave yesterday morning is all I have. I was here to answer questions.

The CHAIRMAN. Mr. Fulton.

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Mr. CHENOWETH. Mr. Chairman.

The CHAIRMAN. Mr. Chenoweth.

Mr. CHENOWETH. I would just like to ask another general question of Dr. York and Mr. Johnson. We hear so much discussion and speculation as to who is ahead in this race and just how far Russia is ahead of us or whether we are on a par, how fast we are catching up, whether they are slipping. What is the best information that you have?

Dr. YORK. If you are talking about military posture as a whole——

Mr. CHENOWETH. Take the military first.

Dr. YORK. But military now, and not missiles, but the total posture——

Mr. CHENOWETH. As it relates to missiles.

Dr. YORK. The total posture, it is our conviction that we are ahead, in total military posture. I am not just talking about missiles or space, either. I am talking about everything. As far as missiles are concerned in terms of research and development, we probably are somewhat behind.

Mr. CHENOWETH. What do you mean now we are behind, how far behind?

Dr. YORK. A missile is so complex, it consists not only of propulsion, but guidance, control, warhead, reentry body, and also what is more difficult to measure, experience, which has to do with reliability; that you cannot just put a date on it, but in propulsion the evidence as far as I am concerned is that the Russians are positively ahead.

On these other things I think they are probably not. How to balance all of this I do not quite know except to say that I think we are behind.

Mr. CHENOWETH. Are we getting any information out of Russia that is of any value to you in appraising the situation?

Dr. YORK. Yes, we get information of value in appraising the situation.

Mr. CHENOWETH. Is it all classified or could it be revealed to the committee?

Dr. YORK. The CIA does have a briefing, I believe.

The CHAIRMAN. We are going to have the CIA later on.

Mr. CHENOWETH. Well, you do feel satisfied, Doctor, with the progress we are making now in this race?

Dr. YORK. In the field that I am involved in, which is research and development, by and large, yes.

Mr. CHENOWETH. Well, I am glad to get that.

The CHAIRMAN. Doctor, would you say that Dr. von Braun was incorrect when he said that the Russians were a year ahead of us?

Dr. YORK. No, except I find it hard to use that kind of measure of saying a year or not. I do not feel that is in error, I just feel it is an oversimplified way of answering the question. I do not think it is wrong.

The CHAIRMAN. Well, if there are no further questions——

Mr. MITCHELL. May I ask just one more?

The CHAIRMAN. Mr. Mitchell.

Mr. MITCHELL. Since Mr. Holaday has been in, I do not think a question has been directed to him. I think he should have at least one today, so, Mr. Holaday, I will ask you if you had a recommendation last fall, I believe that was in your agency and you were concerned with it, concerning Nike Zeus and production—did you make a recommendation to go into production or not?

Mr. HOLADAY. The Nike Zeus study was made by the committee on which Dr. York was a member. They reported to our committee and it was our recommendation which went up and became part of the action of last fall. It was explained by Dr. York to you that other people put their considerations into the recommendation and that the JCS also recommended, except for the Army member, that Nike-Zeus not go into production.

Mr. MITCHELL. Then you followed the approval of the two who recommended production last fall?

Mr. HOLADAY. Yes. I am wondering, though, if you are asking the same question.

Dr. YORK. He did not recommend production.

Mr. MITCHELL. I realize he was not on that study group. But were you called upon to make a recommendation?

Mr. HOLADAY. No, I was not called upon to make a recommendation at that time.

Mr. MITCHELL. Did you make one?

Mr. HOLADAY. Yes, sir.

Mr. MITCHELL. What was it?

Mr. HOLADAY. Then I assume you are going back to the letter which got into the hearings in the Senate. There is a letter which I will be glad to make available. I will read to you what it says about Nike Zeus at this time because this is a classified meeting—this is a classified piece of paper. Would you like to have that recommendation?

The CHAIRMAN. Go ahead and read it.

Mr. HOLADAY. On Nike Zeus, while I concur in maintaining the Nike Zeus program at an R. & D. level, I believe that $40 million should be added to this program, $300 million plus $40 million, a total of $340 million, to permit engineering development work on certain pieces of mechanical equipment, such as machines to automatically produce transistors and resistors as part of our development program. This will give us assurance that equipment of this type can be developed and establish a better understanding of the total effort required to reach a production level.

The CHAIRMAN. In other words, you recommended that they go ahead with it?

Mr. HOLADAY. No, sir; I recommended that a certain amount of money be put in here to go ahead with the development of these automatic machines. It was a lead-time proposition to see if the machines can make them. This is quite an important phase here, because if we are unable to develop these automatic machines to make transistors and resistors the country just does not have enough billions * * * to make these by hand. This is a phase that we will have to find out. This is one of the very important engineering phases of this program.

The CHAIRMAN. Well, that is where the Army got the figure of $40 million?

Mr. HOLADAY. I do not know where the Army got that.

Mr. RIEHLMAN. Mr. Chairman.

Mr. MITCHELL. He has offered that letter for the record. I would like to have it inserted.

The CHAIRMAN. Do you have any objection to putting the letter into the record?

Mr. HOLADAY. No, sir; not if you ask for it.

The CHAIRMAN. It is a classified record. No objection, it is so ordered.

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Mr. CHAIRMAN. Mr. Riehlman.

Mr. RIEHLMAN. I had a group of questions I anticipated asking Dr. York in the open session. I did not get the opportunity. I left before the meeting closed. I would like the permission to present him with those questions dealing with his new authority and direction over his whole program, which I would like to have made a part of the record. I think they are important.

The CHAIRMAN. No objection, so ordered.

Mr. MILLER. A part of the open record?

The CHAIRMAN. No; the classified record.

Mr. RIEHLMAN. It will not deal with classified subjects, so it could be in the open record.

The CHAIRMAN. If there is no objection, it will be placed in the open record. Of course, Dr. York's answers he can so frame that they will not be classified.

Mr. RIEHLMAN. There will not be anything that will hinge on secrecy.

The CHAIRMAN. Any further business? It is 4:30.

Mr. McDONOUGH. Mr. Chairman, a question off the record but rather pertinent.

(Discussion off the record.)

Mr. FULTON. I would like this on the record.

Mr. McDONOUGH. I do not want it on the record.

Mr. FULTON. Then I do not think it should be asked.

Dr. YORK. Decisions of this sort would normally be made by the agencies actually planning the program, which means by one of the services or ARPA rather than someone like myself on the Secretary of Defense's staff. I suppose a situation would develop where I would have to get into it, but normally this is a matter that would have to be taken up by the services or ARPA.

Mr. FULTON. How is this political rivalry developing between New York and California, may I ask the members from the respective States?

Mr. McDONOUGH. It developed evidently as a result of some influences in the State of New York asking for a greater share of military contracts over the ones in California.

The CHAIRMAN. I think we have gone far enough into this.

If there is nothing further, the committee will stand adjourned.

(Whereupon, at 4:32 p.m., the committee recessed.)