REVIEW OF THE SPACE PROGRAM

THURSDAY, JANUARY 28, 1960

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

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

The Chairman. The committee will come to order.

We are meeting this morning in the Old House caucus room because the charts used by NASA are too extensive for our own hearing room. The committee will want to see and inspect them carefully.

Dr. Glennan called me from Detroit. He went there to make a speech last night and no planes have taken off from Detroit. He probably won't be in until tomorrow morning. He will be the first witness in the morning.

In the meantime with his consent, we are going to call Dr. Hugh L. Dryden, Deputy Administrator, National Aeronautics and Space Administration.

(Dr. Dryden was sworn previously.)

STATEMENT OF DR. HUGH L. DRYDEN, DEPUTY ADMINISTRATOR, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Dr. Dryden. Mr. Chairman, I wish to talk to you today about the national space exploration program. I appreciate the opportunity of describing to you the philosophy and structure of the national space exploration program for accomplishing the general objectives of the National Aeronautics and Space Act of 1958. Dr. Glennan in his opening statement gave you an evaluation of our position with respect to that of our competitor and outlined the course which must be followed.

We must establish the long-term goals, we must determine the technical tasks necessary to press forward toward those goals, and we must develop the organization and management to accomplish these tasks.

As he indicated, some of these things have been done and most of them are well along.

Specifically, in the 16 months since NASA was formally established on October 1, 1958, great progress has been made in the formulation and initiation of a comprehensive integrated program of action.

The most visible and spectacular aspect of the space activities under way is the succession of launching of space vehicles at Cape Canaveral, some successful and some unsuccessful.

These launch vehicles are intended to boost a spacecraft across the frontier into outer space to perform those missions needed to reach our national objectives. As the launch hour approaches, as you know, the labors and hopes of hundreds of scientists, engineers, technicians, the work of months and years, come into general public view for the first time. We begin to understand that much of the space program in progress at a given time, for example, today, is aimed toward missions to be flown later. Our integrated space program is like an iceberg. The parts in view, above the water, so to speak, are the smaller part of the total effort required to perform successful missions in space. Most of the iceberg is under water, hidden from view.

The general pattern of activities necessary to a specific flight mission is represented schematically on the accompanying chart, Missions. Each mission requires a suitable launch vehicle system to launch the spacecraft into orbit or to great distances from the Earth to the Moon or planets.

If I might divert to the large exhibit on the left, this is intended to exhibit to you in general terms the nature of some of the missions about which I am talking (fig. 9).

Some refer to the flying of rockets and probes essentially vertically which return to the Earth. Some of the missions, as at the bottom, are Earth orbital missions. Some, as just above, are missions to the Moon, and finally, missions to the neighborhood of the planets.

When I use the words "flight mission," I am talking about one of these types of activities and the remarks which I make apply in general to all of them.

Each mission requires a spacecraft equipped for the specific purpose and provided with the instrumentation, telemetry, and other apparatus to accomplish the desired mission. We often call this apparatus the payload.

We are trying to get this word "spacecraft" in general use to mean the vehicle which goes into orbit with everything it contains. The launch vehicle is the rest of the space vehicle which puts the spacecraft into orbit. The payload is that part of the spacecraft such as instrumentation, telemetry, and so forth.

Each mission requires the operation of suitable ground facilities to receive and record telemetry, to track the spacecraft for determining its position continuously, to photograph its track, send command signals, or whatever else may be required by the mission.

Developments in these three areas and the missions to be carried out must be planned together in proper time phase; the possible missions are in fact determined by developments in launch vehicle systems, spacecraft components, and available tracking and telemetry systems.

This leadtime aspect is a most characteristic feature of space activities. It is found in many other areas of our life today, even in legislative activities. The history of a given space flight is analogous to the history of a bill in the Congress. Some bills are passed and signed, and hence are successful. A bill under active debate on the floor has its roots extending well into the past, perhaps to previous sessions of the Congress.

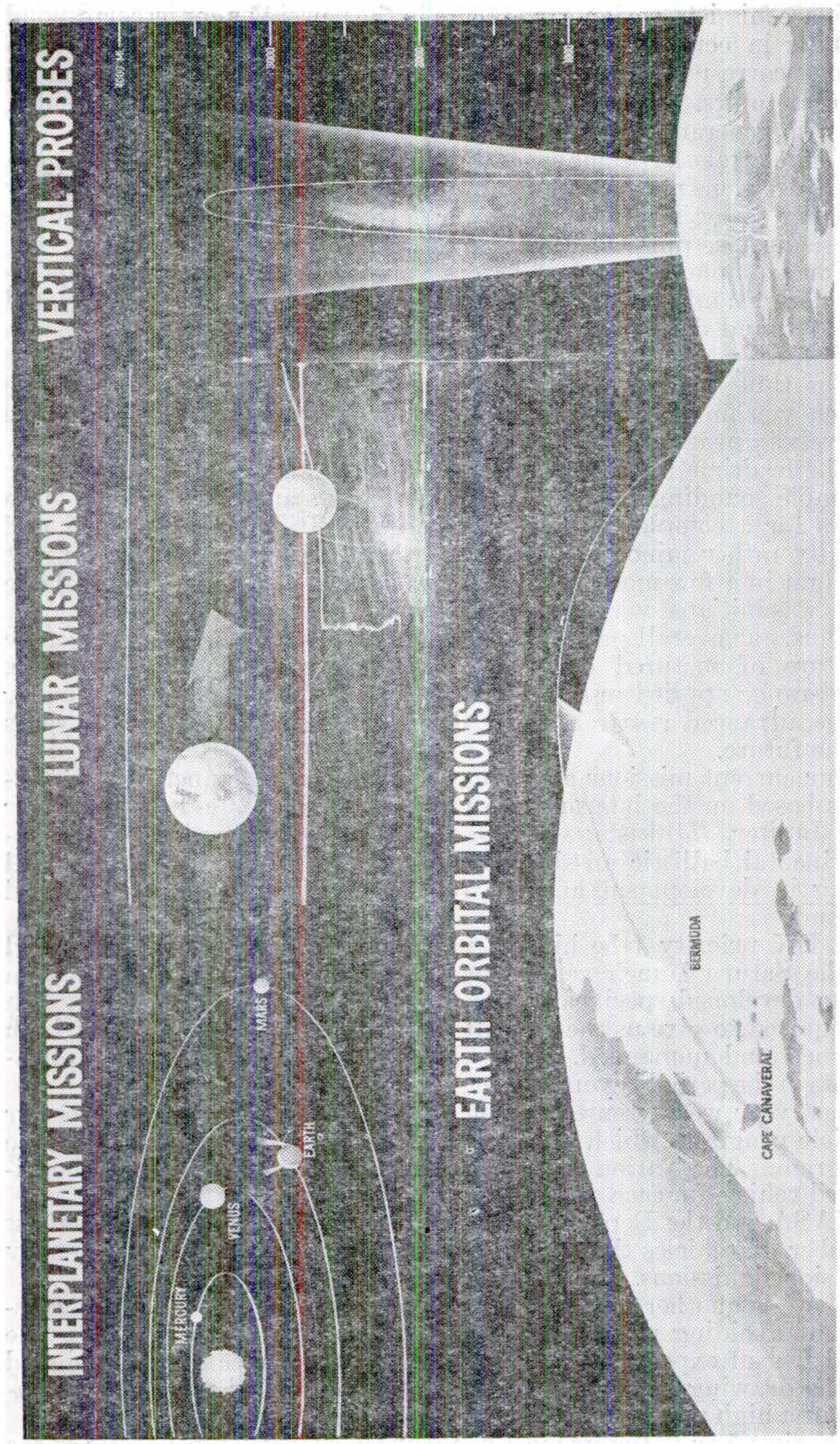
INTERPLANETARY MISSIONS
LUNAR MISSIONS
VERTICAL PROBES
EARTH ORBITAL MISSIONS
MERCURY
VENUS
EARTH
MARS
BERMUDA
CAPE CANAVERAL

FIGURE 9

Space missions we hope to execute in the new few months correspond to bills in committee hearings. Our advanced research and technology corresponds to committee hearings and staff investigations on general topics. Research not only supports specific space missions, but also generates new missions.

To undertake a specific space flight mission a year or more from now, many decisions must be made now and many tasks must be begun now relating to activities at the lower levels of our iceberg-like chart. These must be pursued vigorously in the intervening months.

For example, the budget before you for fiscal year 1961 supports the design and procurement of vehicles and payloads and related research and development which does not appear as a flight mission until fiscal year 1962 or later.

The things which you will see in the next few months are those which you financed last year and for which preparations have been actively in progress.

The leadtime required may vary from a few weeks or months for a simple sounding rocket with more or less standard instruments, to years for a completely new superbooster. It is an exceptional and usually rather minor space project which can proceed from concept to flight in a few months. The Atlas booster just becoming available to us was initiated with highest priority 5 years ago.

Thus, our overall program presents to the spectator a kaleidoscopic mixture of matured developments, actively developing hardware, short-range applied research and component development, and longer range advanced research which determines our position a few years in the future.

Our current missions are being performed with launch vehicle systems based on the intermediate range ballistic missile boosters, Thor and Jupiter. Multistage launch vehicle systems based on the intercontinental ballistic missile booster Atlas as the first stage are well along in development and are scheduled for missions in 1961 and beyond.

A DX priority (the highest national priority) has been assigned to the Saturn launch vehicle system based on a new rocket system being developed specifically for space vehicles. The Saturn system is required to give us the capability of advanced space missions, both manned and unmanned. It is the key to our possible accomplishments in the period beyond the next few years.

Last year we presented to you the concept of the national booster vehicle program, which we now prefer to call national launch vehicle program. The Nation cannot afford to design a specialized and optimized vehicle for each of the dozens of missions.

NASA and the Department of Defense seek to develop the smallest number of vehicles that will encompass the entire range of presently envisioned missions.

There is another reason for such a course in addition to the necessity of avoiding unnecessary duplication and expense. This is the hard fact of experience that a new launch vehicle cannot be designed on the drawing board, manufactured, and launched with an expectation of a high probability of success on the first mission.

The first 5 or 10 flights must be regarded as development tests of the launch vehicle to gain reliability. By using the same vehicle for many missions, a high degree of reliability will be reached earlier, our dollars will go further, and our relative competitive position will be enhanced. In initiating our space program 16 months ago, we had to order interim vehicles which could be obtained within 1 year in order to gain flight experience now. We are, however, moving as quickly as possible to five vehicles as will be described by a later speaker.

The ground tracking and telemetry networks are the means by which the results of space exploration are received on the ground. The optical and Minitrack network established during the International Geophysical Year has, with some extension to cover polar orbits and with the normal improvements, proved adequate for unmanned earth satellites.

Project Mercury requires special provisions because of the presence of the astronaut; it uses existing military stations and some new portable stations along the intended trajectory. The needs of the deep space probes are met by three stations using large antennas, one of which exists at Goldstone, Calif.; one is under construction at Woomera, Australia; and the third is scheduled for construction in Africa.

Our philosophy in this area is to integrate our stations with those of the Department of Defense, utilizing existing stations wherever possible and installing temporary movable stations to accommodate temporary needs. A later speaker will give you a complete picture of these ground support facilities without which the whole activity would be useless.

Many spacecraft are peculiar to the intended mission. Some require attitude stabilization, retrorockets, or other special components. Auxiliary power, telemetry, and sometimes other communication or command transmitters are needed. The instrumentation is that required by the mission.

In addition to these three underlying areas of development which directly support and are closely integrated with specific missions, a broad foundation of advanced research and technology carried out in laboratory facilities on the ground is prerequisite to leadership in space exploration. The technological problems are most rapidly and economically solved in ground facilities which simulate the launch and space environment, as fully as possible; i.e., as regards vacuum, temperature, noise, vibration, acceleration, loads, and so forth—the one feature we cannot reproduce on the ground is weightlessness.

Research explores the new areas, new knowledge of the fundamentals of propulsion, of effects of meteorites on structures, of new phenomena in solid state physics, or in plasma physics, and provides new ideas for study and exploitation.

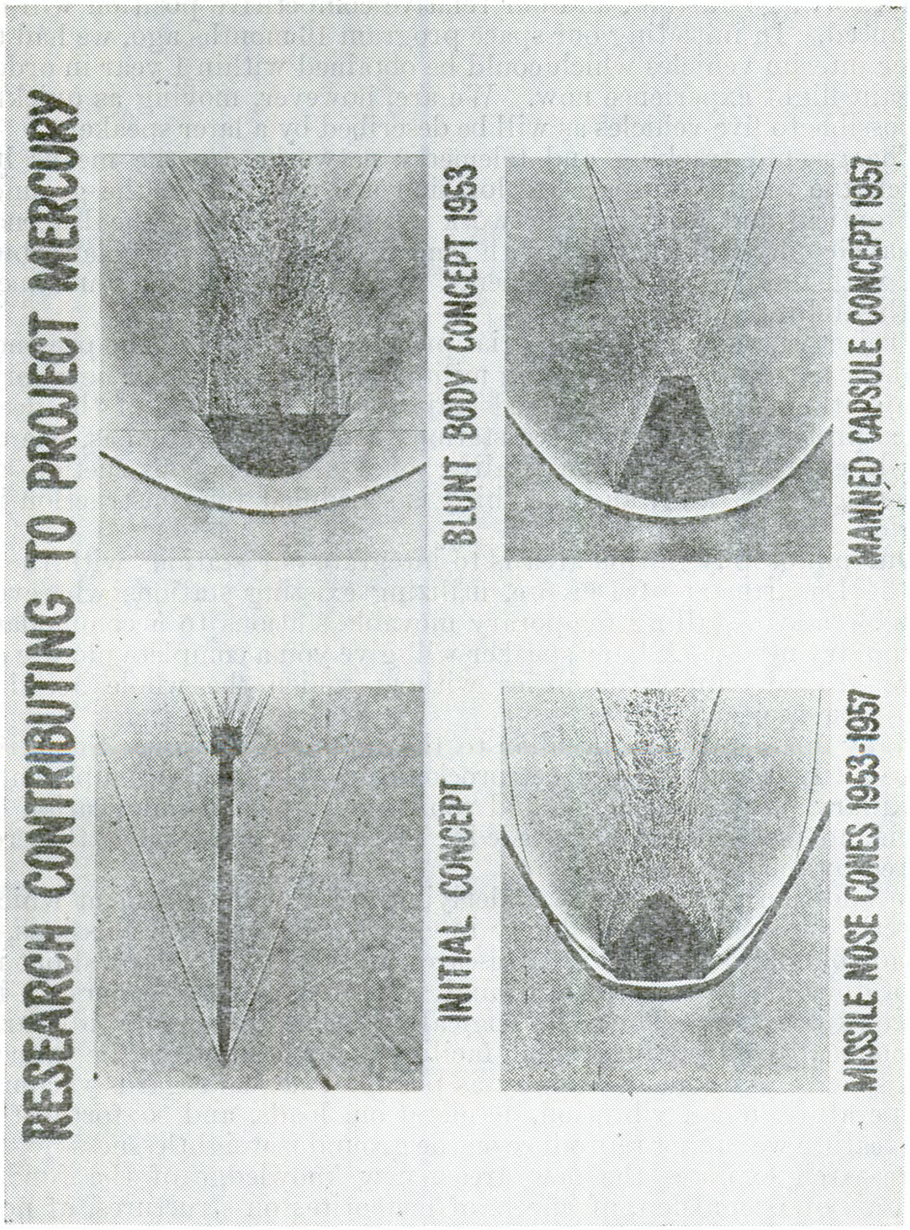

FIGURE 10

The leadtime aspect of research activity may be illustrated by an historical example, research on the reentry heating problem which gave the foundation for the concept used in Project Mercury. About 10 years ago the scientific community and industry were all following the idea of using slender sharp-nosed bodies for ballistic missile warheads (fig. 10).

The very first concept of the ICBM then under development at a very slow rate was with a sharp-nosed body.

NASA research showed that such sharp-nosed bodies—illustrated at the left of the chart—absorb about 30 percent of the aerodynamic heat which is generated during atmospheric reentry. During atmospheric entry, the heating of the body would be so great that no known high-temperature materials and structures could stand the temperatures which would be experienced.

In 1953, Mr. H. J. Allen of the Ames Research Center, showed that a blunt reentry shape generating a large bow shock wave, would generate most of the heat within the atmosphere itself, and that less than one-half of 1 percent of the heat would be absorbed by the body.

As you see at this figure at the top on my right, he went to the extreme in his early research of a flat-pieced body and his first experiments were of that type.

A little bit later the basic research went to the blunt body concept at the lower figure used by all present ballistic missile nose cones, with some variations, of course, as developments have proceeded.

In subsequent years, concentrated research effort on these problems has led us to a better understanding of basic flow and heat transfer phenomena at speeds approaching orbital velocities.

I might remark that the developments in the ICBM have led to the possibility of somewhat less blunt shapes than the one which you see there. However, the reentry satellite velocity is a tougher job and we must use blunter shapes than on the ICBM; and, as you know, the IRBM can use a less blunt shape still, because the demands are not so great.

By the time the Soviet Union had launched Sputnik I into an earth orbit on October 3, 1957, researchers at our Langley and Ames Research Centers were studying problems of manned satellite capsules. However, the key to the problem of allowing a manned capsule to withstand high reentry temperatures had been developed from our basic research in 1953 on general problems of high-speed flight and later studies relating to the reentry into the atmosphere of ballistic missile nose cones. It is apparent the nature of research is such that the application of the results is often not foreseen at the time the studies are initiated.

There is a constant interaction between the various elements of this integrated space exploration program. Not only does the foundation of advanced research and technology give results leading to new vehicles, new telemetry and tracking devices, and new instrumentation and thus, to new missions made possible, but the desired goals and missions suggest vehicle, telemetry, and intrumentation developments which should be carried out and these, in turn, lead to the need for research in certain areas.

Thus, a great deal of our current research is suggested by the problems of landing a man on the moon, of operating a manned station in space, or of operating an unmanned astronomical observatory. The results obtained are, however, basic in character and applicable to many other specific missions as well.

Having examined the structure of the program underlying a specific mission, let us look at the space flight missions of the national space exploration program. They fall into three categories: Those directly concerned with the travel of man, himself, into space, in the foreseeable future throughout the solar system; the application of earth satellites to human benefit; and the scientific study of the space environment.

Together, these categories form a single integrated program of space exploration and no category can be neglected without detriment to the others. Thus, it is obvious that the results of the scientific study of the space environment, for example, quantitative detailed information on the Van Allen radiation belt and on the impact of meteorites, are essential to the design of reliable space vehicles to be used either for applications to civil and military purposes, or for habitation by man.

Similarly, the accomplishment of various steps in manned flight contributes to the scientific knowledge of space and provides a technology for making more difficult scientific measurements by human observers or by every heavy apparatus such as a large telescope. In either category, unforeseen new knowledge may well revolutionize accomplishments in the other category.

A DX priority—the highest national priority—is assigned to Project Mercury, the first step in the travel of man in space at satellite speeds and beyond. This program includes as a preparatory mission the travel of man in a ballistic trajectory, during this calendar year, if everything goes well. Soon thereafter, we will begin to gain direct experience in the orbital flight of man. A progress report on Project Mercury will be given by a later speaker.

Our program looks forward to a continually increasing capability and accumulation of experience. Much of our advanced research and technology is planned to attack the problems to be encountered in the travel of man to the Moon and his safe return to Earth. As we advance toward this goal, we must achieve such intermediate goals as a manned space station in orbit about the Earth and the flight of man to orbit the Moon and return safely to Earth. We must develop spacecraft capable of reentering the Earth's atmosphere not only from Earth satellite speeds without excessive heating or deceleration, but also from the much higher speeds involved in return from the Moon. We know already that there is a difficult guidance problem connected with the safe return through the atmosphere.

The program includes missions leading to the applications of Earth satellites for peaceful purposes to promote human welfare. These applications have been of great interest to men of all nations. The development of meteorological satellites is one of the important goals of the national program. Still in the earliest research and development stage as regards the instrumentation, the results already obtained open new vistas to the forecaster and research scientist alike. A second application of special benefit to the Western World is that to the task of long-distance communication.

The third category of missions includes those used for the unmanned exploration of space. Satellites and space probes can carry out measuring instruments far into space, in time to the far reaches of the solar system. They do precede man and explore the way for him, but more important they extend the body of scientific knowledge about the Earth, its atmosphere, ionsphere, and other aspects of nearby space, about the Moon and planets, and about our entire universe.

Although we speak of this program as a space science program, it, in fact, includes a multiplicity of programs in gavitational, electrical, and magnetic fields, cosmic rays, electrified particles, radiations of all wave lengths, in fact, all branches of physics and chemistry extended into outer space.

The results promise to benefit our activities on earth as much as our activities in space, and in a sense, this category of missions also represents the application of satellites and space probes for peaceful purposes to promote human welfare.

The accomplishments of the national space exploration program to date have been substantial. Experience in its conduct has made us more acutely aware of the unknown factors in the conduct of research and development on the previously unexplored frontiers of space. The course ahead for several years is well established and we have made plans for a decade ahead in the light of our present knowledge. We expect to revise these plans from time to time in the light of the experience gained.

Mr. Horner will describe the long-range plan and discuss the organization and facilities which have been assembled to carry out the national program of space exploration.

If you wish, Mr. Chairman, we may proceed with that presentation and have some questions then or have questions now, as you prefer.

The CHAIRMAN. It might be best to let him proceed, now.

Mr. DRYDEN. I think it would be a little more coherent to get before you the general plan for the future.

The CHAIRMAN. If there is no objection, we will proceed with Mr. Horner. Following that, we will question both witnesses.

Our next witness is Richard E. Horner, Associate Administrator, National Aeronautics and Space Administration.

Will you please give the official reporter something on your background?

(Mr. Horner was sworn previously.)

STATEMENT OF RICHARD E. HORNER, ASSOCIATE ADMINISTRATOR, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Mr. HORNER. I am Richard E. Horner, Associate Administrator, National Aeronautics and Space Administration. I obtained a bachelor of science degree in aeronautical engineering from the University of Minnesota, master of science in aerodynamics at Princeton University, 9 years' commissioned service with the Air Force, 10 years' service in the Research and Development Management of the Air Force, the last three of which I served as Assistant Secretary of the Air Force for Research and Development.

I have been with the National Aeronautics and Space Administration since June 1, 1959.

The CHAIRMAN. Thank you, sir.

Mr. Fulton wants to ask you a question on your background.

Mr. FULTON. Where do you get the title Associate Director?

Mr. HORNER. Mr. Fulton, I think you probably need to ask my boss about that. The position of Associate Administrator was established when I arrived in the Administration.

Dr. DRYDEN. May I say Mr. Horner has somewhat the responsibilities of the Chief of Staff for Operations. The operating divisions of the agency report to him.

Mr. FULTON. My inquiry is whether you need statutory authority to establish the position with an administrative power to act within your agency. That is really the point I am making because I understand it has just been set up.

Dr. DRYDEN. You will recall, sir, the act provided for 10 excepted positions, which the Administrator could establish for the administration of this act, carrying salaries between $19,000 and $21,000. Mr. Horner holds one of those positions. He has no independent legal authority apart from that delegated in the usual course under the law.

Mr. FULTON. Not to bring it up now, but I would like some sort of a short memorandum on that, on possibly establishing this position as pretty much a superintendent of operations.

Dr. DRYDEN. We will be glad to prepare something for the record.

(The information requested is as follows:)

The functions and authority of the Associate Administrator of NASA are stated in general management instruction No. 2-1-1, a copy of which is attached.

The authority for establishment of the position of Associate Administrator and appointment of the incumbent is found in subsection 202(a) and 203(b) (1) and (2) of the National Aeronautics and Space Act, which provide, in relevant part, as follows:

"* * * Under the supervision and direction of the President, the Administrator shall be responsible for the exercise of all powers and the discharge of all duties of the Administration, and shall have authority and control over all personnel and activities thereof."

* * * * * * *

"In the performance of its functions the Administration is authorized—

"to make, promulgate, issue, rescind, and amend rules and regulations governing the manner of its operations and the exercise of the powers vested in it by law;

"to appoint and fix the compensation of such officers and employees as may be necessary to carry out such functions. Such officers and employees shall be appointed in accordance with the civil service laws and their compensation fixed in accordance with the Classification Act of 1949, except that (A) to the extent the Administrator deems such action necessary to the discharge of his responsibilities, he may appoint and fix the compensation (up to a limit of $19,000 a year, or up to a limit of $21,000 a year for a maximum of 10 positions) of not more than 260 of the scientific, engineering, and administrative personnel of the Administration without regard to such laws, * * *."

We need no need to provide specifically by statute for the position of Associate Administrator. The only additional authority which could be vested in the Associate Administrator by statute would be the authority to exercise certain nondelegable statutory functions which presently can be performed by the Administrator and the Deputy Administrator. These functions are relatively few in number and are not so burdensome as to make it necessary for them to be performed by the Associate Administrator.

PART I. NASA MANAGEMENT MANUAL—GENERAL MANAGEMENT INSTRUCTIONS

No. 2-1-1

Effective date: December 23, 1959.

Subject: Functions and authority, Associate Administrator.

1. Purpose

The instruction establishes the functions and authority assigned to the Associate Administrator.

2. Functions

The Associate Administrator is responsible for assisting the Administrator and the Deputy Administrator in the overall management of NASA operations. Specifically, he is assigned the following functions:

(*a*) Insuring that actions, policies, or programs necessary to carry out NASA's mission are developed in a timely manner by the appropriate staff. Reviewing, evaluating, and approving proposed actions and staff papers prepared for approval by the Administrator to assure that (1) such papers or actions are soundly and fully developed, and (2) such papers or actions are properly coordinated and problems resolved to the greatest extent feasible prior to submission to the Administrator and Deputy Administrator.

(*b*) Reviewing advance planning done by the various elements of NASA (including those developed in the Office of Program Planning and Evaluation, a staff office reporting directly to the Administrator) to assure proper coordination among plans developed and to assure that the planning undertaken by various organizational elements is based on the same or consistent program assumptions; securing such modifications in plans as are required to achieve necessary consistency.

(*c*) Reviewing basic budget assumptions and preliminary budgets to assure adherence to budgetary policies and guidance established by the Administrator and Deputy Administrator, and direct action to modify and adjust assumptions and preliminary budgets to bring them into consistent alinement for review by the Administrator.

(*d*) Coordinating and directing the activities of the Office of Launch Vehicle Programs, Office of Space Flight Programs, Office of Advanced Research Programs, and Office of Business Administration.

(*e*) Directing and supervising the operations of the Western Operations Office.

(*f*) Conducting a continuous review of program progress and actions taken by the NASA staff to assure that (1) decisions made by the Administrator and/or Deputy are promptly carried out, and (2) the Administrator and Deputy are kept informed of delays and necessary adjustments.

(*g*) Reviewing problems and conflicts of staff judgment arising among different areas of agency operations for the purpose of resolving such problems or recommending resolutions to the Administrator and/or Deputy.

(*h*) Assuring the proposed actions, policies, and programs are coordinated with activities of other interested agencies, particularly the Department of Defense.

(*i*) Representing NASA in meetings, conferences, and other appearances before or with other agencies of the Federal Government including the Bureau of the Budget and congressional committees.

(*j*) Keeping continually informed of the plans and activities of those offices reporting directly to the Administrator (i.e., General Counsel, Office of Program Planning and Evaluation, Office of International Programs, Office of Public Information, and the Assistants to the Administrator and Deputy Administrator) that he may continually insure effective coordination throughout NASA.

(*k*) Exercising as Acting Administrator, in the absence of the Administrator and the Deputy Administrator from NASA headquarters, all of the functions, powers, and duties of the Administrator, except those nondelegable functions, powers, and duties vested in the Administrator specifically by law.

3. Responsibility and authority

The Associate Administrator is responsible to the Administrator and Deputy Administrator for the effective performance of the total NASA operation, and is authorized and directed to take such action as is necessary to carry out the responsibilities assigned to him within the limitations of this and other official NASA assuances and communications.

4. Relationships with other officials

In performing the functions assigned to him, the Associate Administrator is responsible for keeping the Administrator and Deputy Administrator informed of major problems or developments which may be of interest to them; he is responsible for assuring that actions he takes are consistent with overall NASA policy as expressed by the Administrator.

5. Effective date

The provisions of this Instruction are effective December 23, 1959.

HUGH L. DRYDEN,
Deputy Administrator.

The CHAIRMAN. Would you wish to call him chief of staff, instead?

Dr. DRYDEN. Well titles are always a very difficult problem, as you know.

Mr. FULTON. He is just 1 of 10, now. If he is doing this outstanding work, I think possibly it should be recognized with statutory authority.

The CHAIRMAN. We should call you Dr. Horner, shouldn't we?

Mr. HORNER. No, sir.

The CHAIRMAN. Just Mr.?

Mr. HORNER. That is right.

The CHAIRMAN. Will you proceed with your statement?

Mr. HORNER. Yes, sir, Mr. Chairman.

Mr. Chairman, and members of the committee, it is my purpose to extend the remarks of the Administrator and Dr. Dryden by discussing with you the 10-year plan of program activity in space experiments that we have developed, and relate to it the financial resources that we are currently using and those we are requesting authorization for at this time. I will also set forth our other resources in terms of the organization, personnel, and facilities that are essential to the implementation of the space effort.

You realize, of course, that during the last 16 months all of our planning has proceeded simultaneously with our efforts to create a functioning organization and the initiation of major scientific and developmental programs.

It will appear obvious to you, I am sure, that whereas our plans reflect the lessons of our intensive recent experience, their extrapolation into the future becomes more tenuous as the years become more distant. And, of course, any planning which must be supported by fiscal budgets beyond the one currently under request for authorization must, of necessity, be recognized as dependent upon the many and various influences of Government operations in the future.

In addition, and completely aside from the relative brevity of our experience and the uncertainty of financial resources that might be available in the future, there must also be taken into consideration the well-recognized fact that the nature and depth of future research and development efforts in any complex technical field are heavily dependent upon the character of prior accomplishments. Stated simply, our successes or miscues of this year will have a commanding influence on the integrity of our plan for next year.

Having explained the uncertainties of a long-term plan, I will now turn to the reasons for having one. Virtually all of our key programs presume a scheduled progress in launch vehicle and spacecraft development. These major developmental tasks frequently require time periods of 5 to 6 years for completion and can be substantially longer under given circumstances of technological progress and resource availability.

Thus, although the usefulness of highly tentative plans might be questioned, long-term objectives, on the order of 10 years in advance of today's program, are essential to keep our development activities properly focused.

The actions we initiate this year and next in the vehicle development program will have a determining influence on our capabilities for meeting national objectives in the last half of this decade and even beyond. Accordingly, we have developed a 10-year plan, one which we expect to modify from year to year on the basis of realized experience, development progress, and resource availability. It is formulated around the requirement that its implementation must so utilize the resources of the United States that our national role as a leader in the aeronautical and space sciences and their technologies is preserved and steadily enhanced. We have also assumed that a steady growth in the scale and intensity of our efforts, especially for the next 5 years, is an essential basis for consistent and fruitful efforts in meeting this requirement.

The initial step in constructing the plan was a projection of attainable growth in our capability to launch into the space environment spacecraft of increasing size, versatility, and technical sophistication.

The first chart shows the anticipated growth in spacecraft weight from year to year during this 10-year period. Here I need to define spacecraft as that portion of the vehicle, including the propulsion, attitude controls and guidance units for maneuvering, which is designed to be placed into orbit about the Earth or onto a departure trajectory from the Earth (fig. 11).

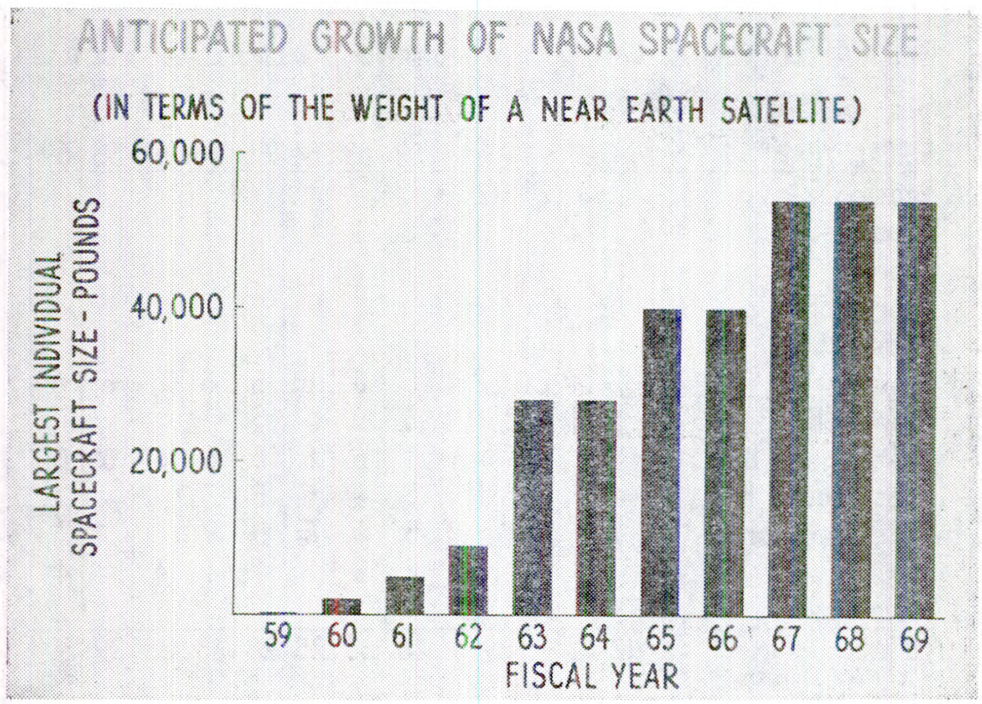

FIGURE 11

For the purposes of comparison, on this chart the capabilities of launch vehicles are measured in terms of the weight that can be projected into a low altitude earth orbit of about 300 miles. You will note that the increasing capabilities in the early years come through the successive utilization of the Thor-Agena B, the Atlas-Agena B, and the Atlas-Centaur.

In the 1963–67 time period, our increasing capability will be primarily attributable to the use of the Saturn first stage and successively improved upper stages based on employment of liquid hydrogen and liquid oxygen. You will note that by 1967 we will have gained the capability of placing payload weights in low earth orbits of about 25 times the magnitude of those available today.

I hasten to emphasize that the requirement for payloads of these weights in such orbits is limited, but remind you that I am using this figure as a convenient method of comparison and the increasing performance represented will be necessary to project needed payloads on more difficult missions to the planets and to high earth orbits.

The rate of growth indicated here is consistent with our foreseen potential for technological progress and is attainable provided adequate resources are applied. It is clearly necessary if the vigorous program which will attain national objectives is to be implemented.

To further define the framework of this plan, I would like to consider now our projected launching schedule which is illustrated here in the general terms of the numbers of each vehicle launching which occurs in the next six quarters, and for each fiscal year thereafter during the decade (fig. 12).

TABLE II

ANTICIPATED MAJOR VEHICLE LAUNCHING SCHEDULE BY VEHICLE

FISCAL YEAR	1960*				1961				'62	'63	'64	'65	'66	'67	68	69
Redstone				1	2	3	2									
Atlas				1	2	1	2	1	6	1						
Juno II			1		1	3										
Thor - Able			2													
Atlas - Able				1	1											
Scout				4	2		2		6	6	6	6	6	6	6	6
Thor - Delta			1	1	1	2	1	1	5							
Thor - Agena B									1	6	6	6	6	6	6	6
Atlas - Agena B							1		3	4	5	6	3	12	12	12
Atlas - Centaur								1	5	4	5	6	9			
Saturn									2	2	3	4	4	4	4	4
Nova Type															1	2
TOTAL	12				29				28	23	25	28	28	28	29	30

* LAST TWO QUARTERS ONLY

FIGURE 12

You will note that in fiscal year 1962 and beyond, the present variety of first stage launch vehicle types will be reduced to one solid propellent rocket, the Scout, and three liquid propellent rockets, the Thor, the Atlas, and the Saturn.

This number might very well be reduced further by eliminating Thor vehicles earlier than is indicated in this chart. The Agena B and the Centaur will become our utility second stages until larger high-energy upper stages come into use on the Saturn in the time period fiscal year 1965 and beyond.

This restriction of the number of vehicle types is planned in the interest of increasing reliability through more intensive experience with each of a limited number of systems. Beyond the capability of the Saturn series of vehicles, we have provided for the introduction of a vehicle, the Nova, with four to six times the first stage thrust based upon the 1½-million-pound F–1 engine currently under development. We foresee the beginning of development testing on such a vehicle in 1968. Our total launching and space flight capabilities are being developed to the point where it is anticipated that a program of more than two launches per month will be conducted for major application and exploration missions in space.

The spacecraft capacity and the planned launching schedule are both a prerequisite for and a product of the intended missions to be accomplished. The interplay between such schedules is obvious in this next table of mission target dates. In some respects this listing might be considered a key indication of the proposed rate and scale of our space experimentation effort (fig. 13).

NASA MISSION TARGET DATES

Calendar Year	
1960	First launching of a Meteorological Satellite.
	First launching of a Passive Reflector Communications Satellite.
	First launching of a Scout vehicle.
	First launching of a Thor-Delta vehicle.
	First launching of an Atlas-Agena-B vehicle (by the Department of Defense)
	First suborbital flight of an astronaut.
1961	First launching of a lunar impact vehicle.
	First launching of an Atlas-Centaur vehicle.
	Attainment of manned space flight, Project Mercury.
1962	First launching to the vicinity of Venus and/or Mars.
1963	First launching of two stage Saturn vehicle.
1963-1964	First launching of unmanned vehicle for controlled landing on the moon.
	First launching Orbiting Astronomical and Radio Astronomy Observatory.
1964	First launching of unmanned lunar circumnavigation and return to earth vehicle.
	First reconnaissance of Mars and/or Venus by an unmanned vehicle.
1965-1967	First launching in a program leading to manned circumlunar flight and to permanent near-earth space station.
Beyond 1970	Manned flight to the moon.

FIGURE 13

Again, it is apparent that the year which is immediately ahead of us is subject to more definitive planning than the suceeding years, and the activities of the latter part of the decade can only be characterized by the most outstanding of planned objectives. Needless to say, there are many space experiments of real significance which do not appear on this listing and the "first launching" terminology generally indicates in each instance a beginning of a series of space vehicle operations.

In the current year is reflected the beginning of tests of several vehicle development programs as well as the first orbital experiments in both meteorology and communications.

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You will also note the scheduled first suborbital flight of an astronaut, boosted more than 100 miles into space with a Redstone vehicle. In the calendar year 1961 we are working toward the launching of a sophisticated lunar impact vehicle and a further step forward in our vehicle development program with the initiation of flight tests on the Centaur.

Assuming continued success in the complex schedule of tests for Project Mercury, the first orbital flight of a manned space vehicle will also occur in calendar year 1961.

I might point out here, Mr. Chairman, and gentlemen, in this chart I have used calendar years, whereas in all of the other charts I refer to fiscal years because they relate to the fiscal operations.

From 1962 we go through the 10-year period with a comprehensive program of exploration of the Moon and the near planets and developing the Saturn launch vehicle to provide necessary information and capability for the beginning of manned circumlunar flight in the latter part of the decade.

It appears to be clear, from a careful analysis of launch vehicle requirements as we now understand them, and recognizing the need for information yet to be developed, that a manned landing on the moon will fall in the time period beyond 1970. These are the major milestones in our long-range plan for space exploration and the application of space vehicles.

Let us look now at the resources which our studies to date indicate to be essential for meeting these objectives. Before I turn to a specific consideration of our current budget authorization request, I would like to make a few generalized comments about future year financial requirements.

The many uncertainties related to a complex technological program such as the one with which we are dealing—unanticipated scientific advances, developmental difficulties, as well as the even more obscure influences of national financial policies and economic trends as a whole—make specific predictions as to total requirements for fiscal year 1962 and beyond speculative to the point of being worthless.

However, it can be said that in view of the half billion dollar obligation rate during the current year and the proposed $802 million program for fiscal year 1961, and its further augmentation as explained by Dr. Glennan yesterday, it is certainly likely that a natural growth of the developments now underway will lead to a budget request of more than $1 billion in the following year with a growth to more than $1½ billion a few years later.

Now, if I may, I would like to turn to our authorization request for new obligating authority in fiscal year 1961. As I have already mentioned, the total request amounts to $802 million. It is divided into three major functional areas of our activities as shown on this chart. For salaries and expenses their is allocated $167,560,000. These are the total charges for travel, communications, and utilities as well as salaries and other miscellaneous personnel expenses (fig. 14).

For research and development the figure is $545,153,000. From this account all project activity is supported, including purchase of materials and parts, as well as disbursements for development contracting. Of course, our investment for research grants and con-

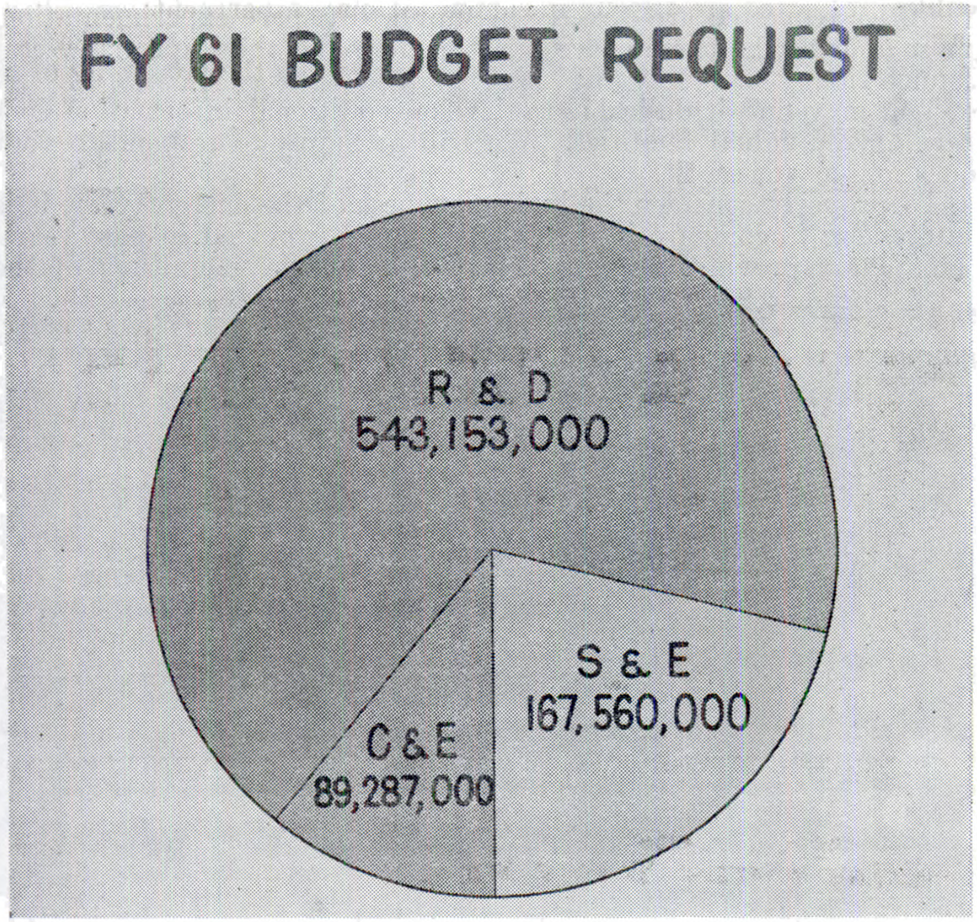

FIGURE 14

tracts is also provided for in this figure. You will note this category of funds constitutes substantially more than two-thirds of our total budget request. The members of the NASA staff who follow me will discuss in detail the individual development programs which are supported with funds from this area.

The third kind of budget authority we seek is that for construction and equipment in the amount of $89,287,000. This money is used to create new facilities for the accommodation of the changing research and development requirements. It is the minimum essential investment to provide the pressing needs for our essential inhouse project activity as well as laboratory and test facilities for the supporting research so essential as the foundation for our entire program.

Although the National Aeronautics and Space Administration inherited a substantial complex of excellent facilities at the existing NACA laboratories, the space exploration program demands a continuing investment to modernize and convert existing facilities as the requirements evolve, and construct entirely new facilities where new technical disciplines in research or testing must be covered.

Of the current request, 25 percent is for provision of facilities at our research centers to make possible the continuing supporting research program described to you by Dr. Dryden. The balance of the facilities requested are directly in support of space experimentation, most of it at the three space flight centers and the Cape Canaveral launch site.

You may find it desirable to develop additional information concerning individual facilities. We will be happy to respond to your questions as you see fit.

To properly consider the budget request of the current year, it is interesting to compare it with the resources provided in past years. This chart provides an easy comparison of the magnitude of the

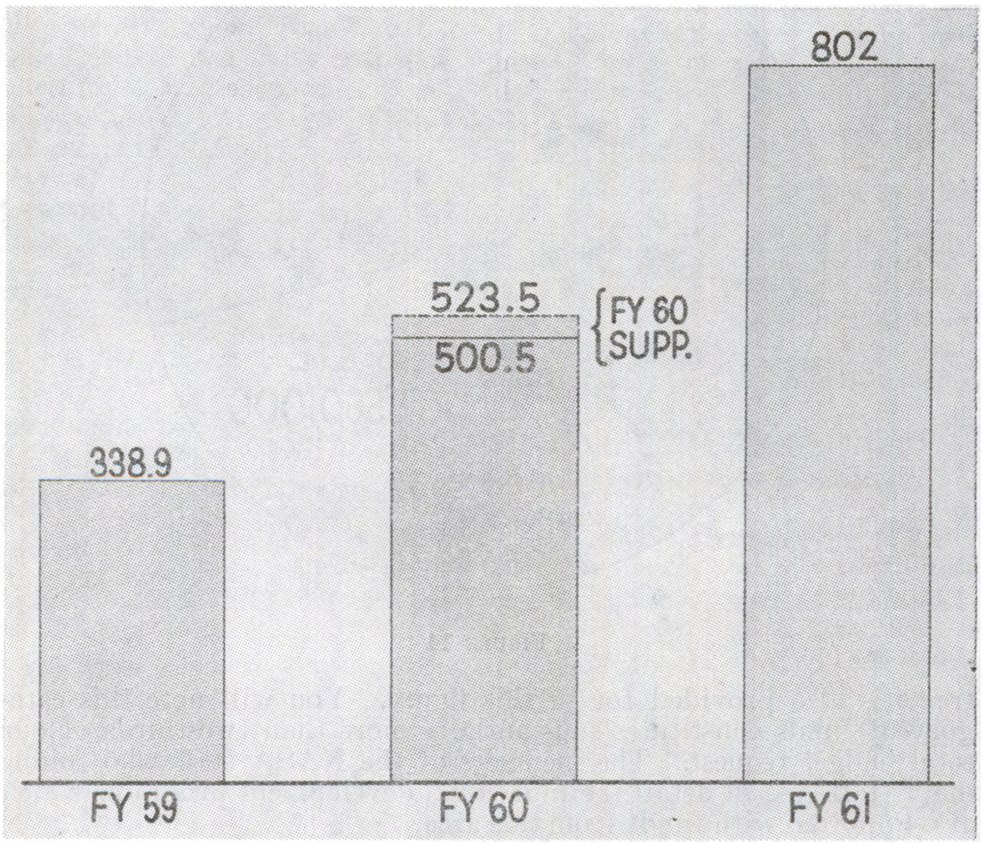

FIGURE 15

NASA programs in fiscal years 1959, 1960, and 1961. As indicated, the fiscal year 1960 number will be increased by $23 million if the Congress sees fit to grant our current request for supplemental appropriations (fig. 15).

I might say, Mr. Chairman, we are at this time scheduled to appear before the Appropriations Subcommittee on Monday in support of this supplemental request.

As I have indicated previously, the budget figures indicate a rapidly expanding program. The rate of expansion, however, is not a natural growth of the needs of the development program, since, in each of the last 2 years, substantial new responsibilities have been assigned to NASA as our national space effort has been identified and organized.

For example, during the past year, the assignment of development responsibility for superboosters has resulted in a major addition to our fund requirements.

This rapid rate of growth has extended our management capability to the limit of its capacity. Extra hours and added assignments have become the rule of conduct for our staffs both at the Washington headquarters and at the field centers. We have, however, been able to substantially maintain the work schedules and, if occasional development failures bring severe disappointment, they also bring added determination on the part of all, to bring success to the highly diversified and broadly cast program we have initiated.

In the area of financial management you will be interested to know that substantially all of the money appropriated for program support in fiscal year 1959 has been obligated to project activity. The program implementation performance has been equally satisfactory during the current fiscal year with funds being committed at the scheduled rate.

I would like to assure you that this is not just a process of committing funds as the schedule dictates, but each contract and procurement action is the result of a carefully considered analysis usually based on extensive scientific study and program correlation.

I would like to turn now to a consideration of other categories of resources which are essential to our program implementation. These include organization, facilities, and manpower. As you know, the overall complex of our organizational structure has been created largely by the integration of existing organizations and parts of organizations into the present National Aeronautics and Space Administration (fig. 16, p. 194).

The nucleus was provided by the 8,040 staff members of the laboratories and the headquarters of the NACA. To this were added 400 members from the Vanguard team, transferred from the Naval Research Laboratory. Seven hundred new positions were provided in the first fiscal year, and an additional 700 in the current fiscal year to round out the staff and provide technical and scientific skills that were not present in the older laboratories but are required for this new business of space exploration.

The proposed budget program reflects an additional increase to a total strength of 16,373 in the Administration, but here again almost 90 percent of the increase results from the assimilation of a single group, that of the Huntsville, Ala., agency, under the leadership of Dr. von Braun.

The remaining fraction of the growth is needed to balance the skills of the organization and to properly effect the integration. In this process of rapidly assembling existing groups into a coherent and effective organization, while concurrently developing a complex program of unusually high scientific and technical content, and at the same time carefully interlacing and coordinating our efforts with other governmental, scientific, and industrial organizations, it has been understandably necessary to increase our Washington staff.

We recognize that at least part of the work burden at the headquarters is interim in nature and we, therefore, strongly resist expanding beyond what we foresee as the longer term needs of a more stable organization and program growth.

The net result, as I mentioned earlier, has been long hours in concerted effort by most of our staff. We scarcely see how we could have accomplished our objectives, without the staff growth that has been realized nor can we anticipate proper performance with less than the stated requirements in the budget authorization under consideration.

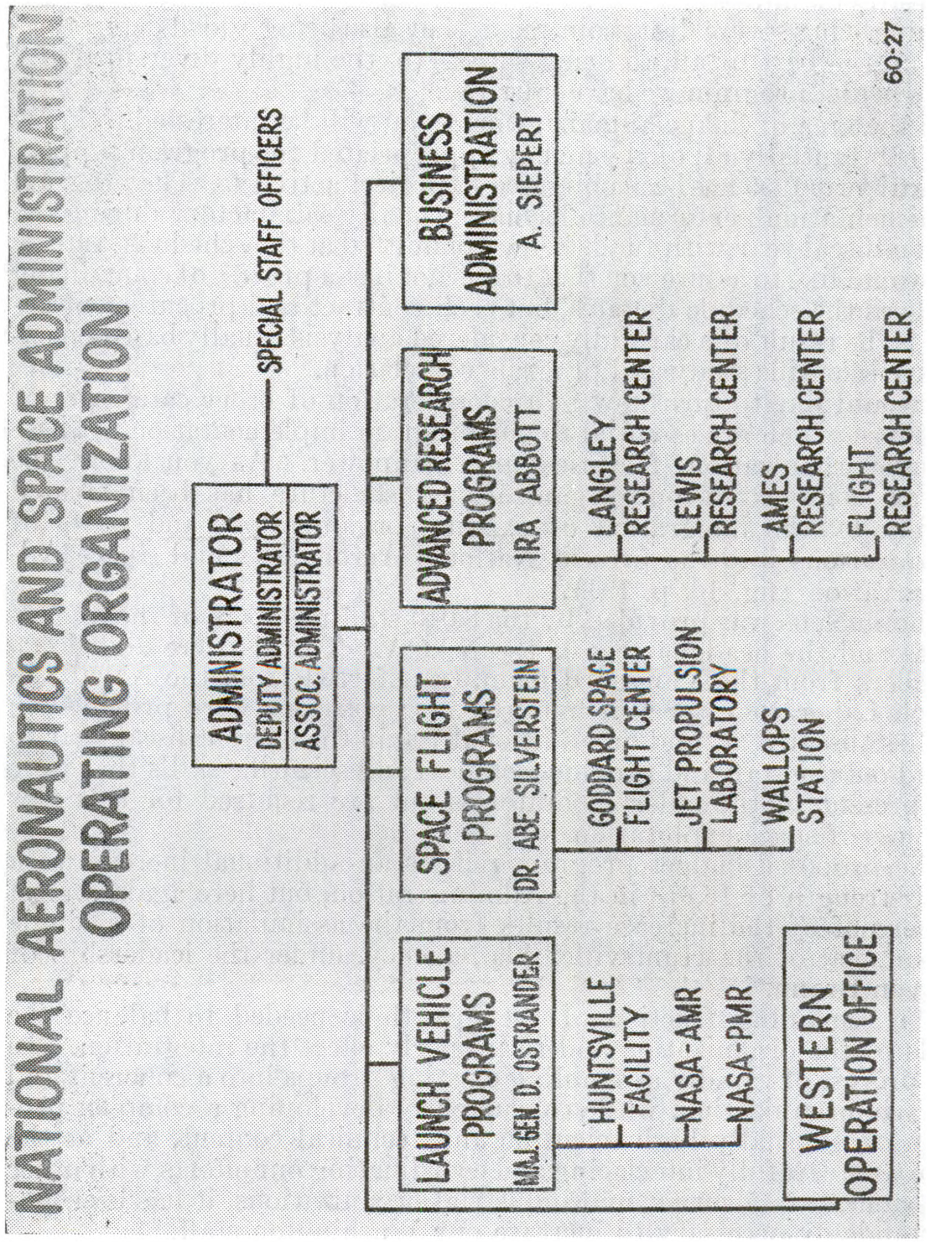
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
OPERATING ORGANIZATION
ADMINISTRATOR
DEPUTY ADMINISTRATOR
ASSOC. ADMINISTRATOR
SPECIAL STAFF OFFICERS
LAUNCH VEHICLE PROGRAMS
MAJ. GEN. D. OSTRANDER
HUNTSVILLE FACILITY
NASA-AMR
NASA-PMR
WESTERN OPERATION OFFICE
SPACE FLIGHT PROGRAMS
DR. ABE SILVERSTEIN
GODDARD SPACE FLIGHT CENTER
JET PROPULSION LABORATORY
WALLOPS STATION
ADVANCED RESEARCH PROGRAMS
IRA ABBOTT
LANGLEY RESEARCH CENTER
LEWIS RESEARCH CENTER
AMES RESEARCH CENTER
FLIGHT RESEARCH CENTER
BUSINESS ADMINISTRATION
A. SIEPERT
60-27

FIGURE 16

With the added workload of the recent assignment of responsibility for development of superboosters, a further addition to the headquarters staff is required. Recognizing the absolute essentiality of attaining the best possible launch vehicle performance in terms of timely availability of load-lifting capacity, and paying respect to the resulting need for reducing the number of types of launch vehicles in order to optimize reliability, the staff function of directing launch vehicle development and operations has been separated from the balance of the space flight programs.

This has resulted in the functional staff organization at headquarters that we see on this chart. Aside from the Office of the Administrator and the special staff officers he requires, the four functional staff elements now include the new Office of Launch Vehicle Programs, the Office of Space Flight Programs, the Office of Advanced Research Programs, and the Office of Business Administration.

The total staff strength intended is 16,373 people. It is the policy of the Administration to delegate all responsibility for program implementation and detailed program initiation to the field centers. Functional areas of responsibility have been assigned to each of the centers, and I believe it is worthwhile to discuss each of them briefly.

You may note their geographic location on the large map at my left and their channel of communication and responsibility to the headquarters staff is indicated on this chart (fig. 17, p. 196).

The Langley, Lewis, Ames, and Flight Research Centers are the laboratory centers which constituted the research capability of the National Advisory Committee for Aeronautics. Organizationally and for program integration purposes they report to the Office of Advanced Research programs in the headquarters. Although their individual staff levels have been stabilized for the past few years and the proposed staff strengths for fiscal year 1961 exactly coincide with the fiscal year 1960 staff numbers, the program of work at each of these centers has undergone a major change in the past 1½ years.

Whereas, by far the bulk of the work of 2 years ago was oriented toward the current and advanced needs of aeronautical developments, the combination of significantly reduced numbers of aircraft development projects in the United States and the needs for research in support of the space flight program have rapidly shifted the emphasis of research efforts at the centers to the astronautics end of the spectrum.

This change has resulted in substantial problems for our research center staffs in reorganizing and retraining for the new tasks, hiring in new technical disciplines as the effort in areas of waning interest is decreased, and the modification of old facilities and the creation of new to accommodate the new research regimes. This reorientation is progressing at a very satisfactory rate.

Having explained some of the problems of reorienting the in-house research program, I would now like to emphasize that although the total effort in aeronautics has markedly decreased, there is still very important work being conducted in this research area. The very low speed regime of flight is being extensively investigated in wind tunnels and by actual flight tests to explore the possibilities of vertical takeoff and landing craft as well as those which have very short takeoff and landing characteristics.

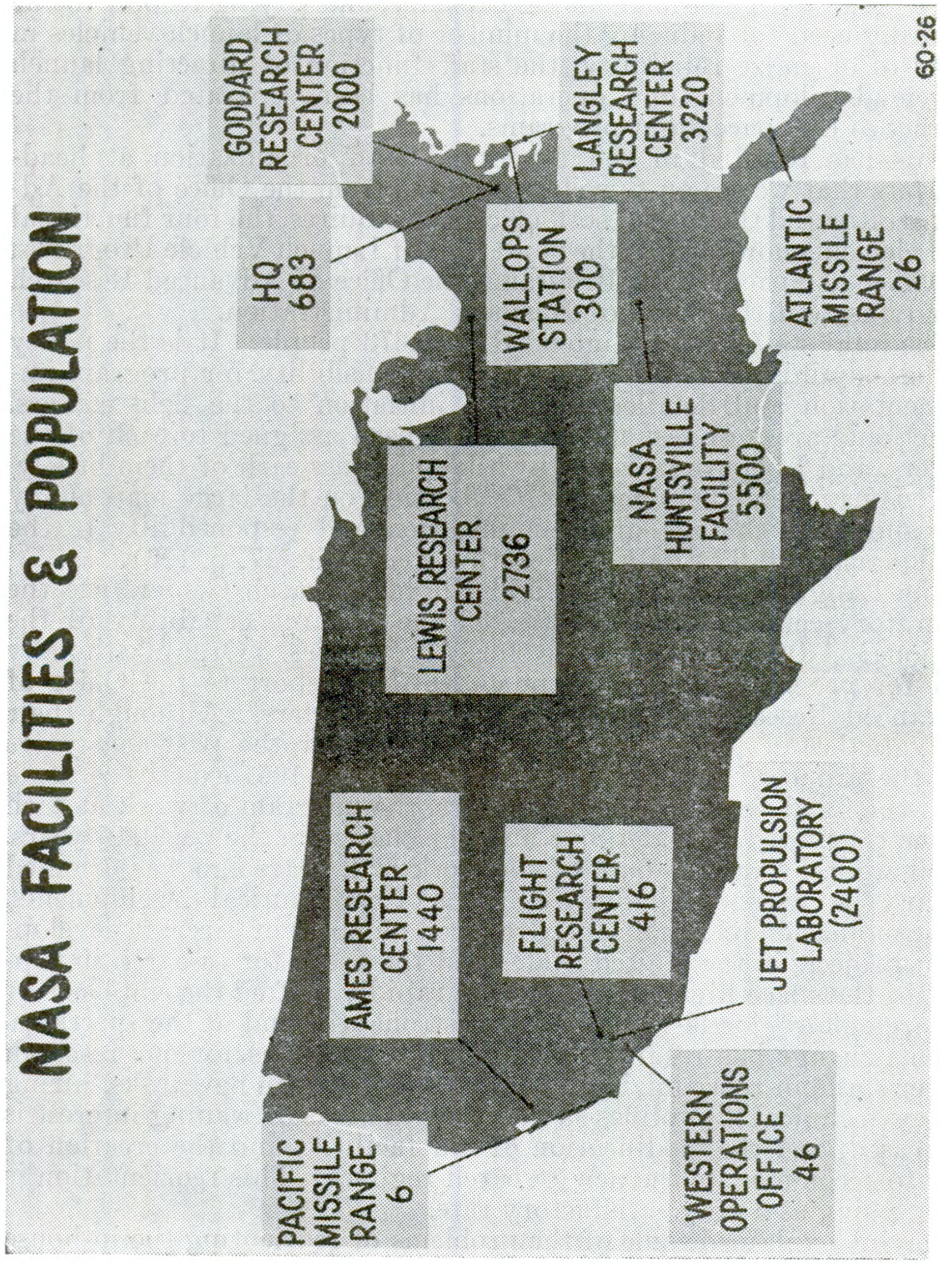
NASA FACILITIES & POPULATION
GODDARD RESEARCH CENTER 2000
HQ 683
LANGLEY RESEARCH CENTER 3220
WALLOPS STATION 300
ATLANTIC MISSILE RANGE 26
NASA HUNTSVILLE FACILITY 5500
LEWIS RESEARCH CENTER 2736
AMES RESEARCH CENTER 1440
FLIGHT RESEARCH CENTER 416
JET PROPULSION LABORATORY (2400)
PACIFIC MISSILE RANGE 6
WESTERN OPERATIONS OFFICE 46
60-26

FIGURE 17

As long as there is a continuing interest in the Department of Defense and the possibility of industrial application, there are likely to be continuing research requirements in this area.

At the other end of the spectrum of flight within the atmosphere, there are still challenging research problems to be solved in connection with supersonic and hypersonic flight. Of course, many of the hypersonic flight problems are equally applicable to space vehicles, for the departure and reentry phases of flight from and to the earth.

The work in high speed aerodynamics, materials and aircraft operating problems are, however, some areas in which there is continuing interest for development of high-speed military aircraft and missiles, and possible application to supersonic commercial transports.

Further, the NASA facilities stand ready to support specific applied research should additional developments of high-speed aircraft indicate the requirement.

Now, let us look briefly at the individual centers. At the Langley Research Center a staff of 3,220 will conduct the research program in fiscal year 1961 at a total program cost of approximately $50 million. This includes the salaries for the total staff, the research and development expenses, and the cost of a major facility addition which will be able to simulate the gas temperatures and velocities which will be encountered by a space vehicle returning to the Earth's atmosphere, a facility which is essential in the solution of key problems in our ongoing program (fig. 18, p. 198).

Major areas of work at the Langley Research Center include research in structures and materials, the aerodynamics of reentry vehicles, continuing work in aircraft aerodynamics and fundamental research in plasma physics. This center, which you will see from the map, is located near Hampton, Va., and is the oldest and the largest of the research establishments. A major portion of the research facilities, which constitute a total real investment of $154 million, are shown in this photograph.

The Lewis Research Center, located at Cleveland, Ohio, represents a facility investment of $148 million, and employs a staff of 2,736 people. An aerial view of the facilities of the center are shown in this photograph. Its primary research mission is investigation related to propulsion. Research programs are now active on chemical rockets with emphasis on high energy propellants, on nuclear rockets, and on electrical propulsion devices (fig. 19, p. 199).

Electrical power generation in support of this latter area of propulsion research also requires major attention from the center.

At the Ames Research Center, in the Santa Clara Valley of California, on the Moffett Naval Air Station, a staff of 1,440 conducts a comprehensive research program in facilities with an original construction value of $107 million. An aerial view of these facilities is shown in this photograph. The principal areas of work are space environmental physics, including simulation techniques, gas dynamics research at extreme speeds, and automatic stabilization, guidance, and control of space vehicles. There are also under experimental evaluation at this center several full-scale models of vertical takeoff and landing craft (fig. 20, p. 200).

The Flight Research Center at Edwards, Calif., is a relatively small but unique and highly specialized facility, shown in this photograph.

FIGURE 18

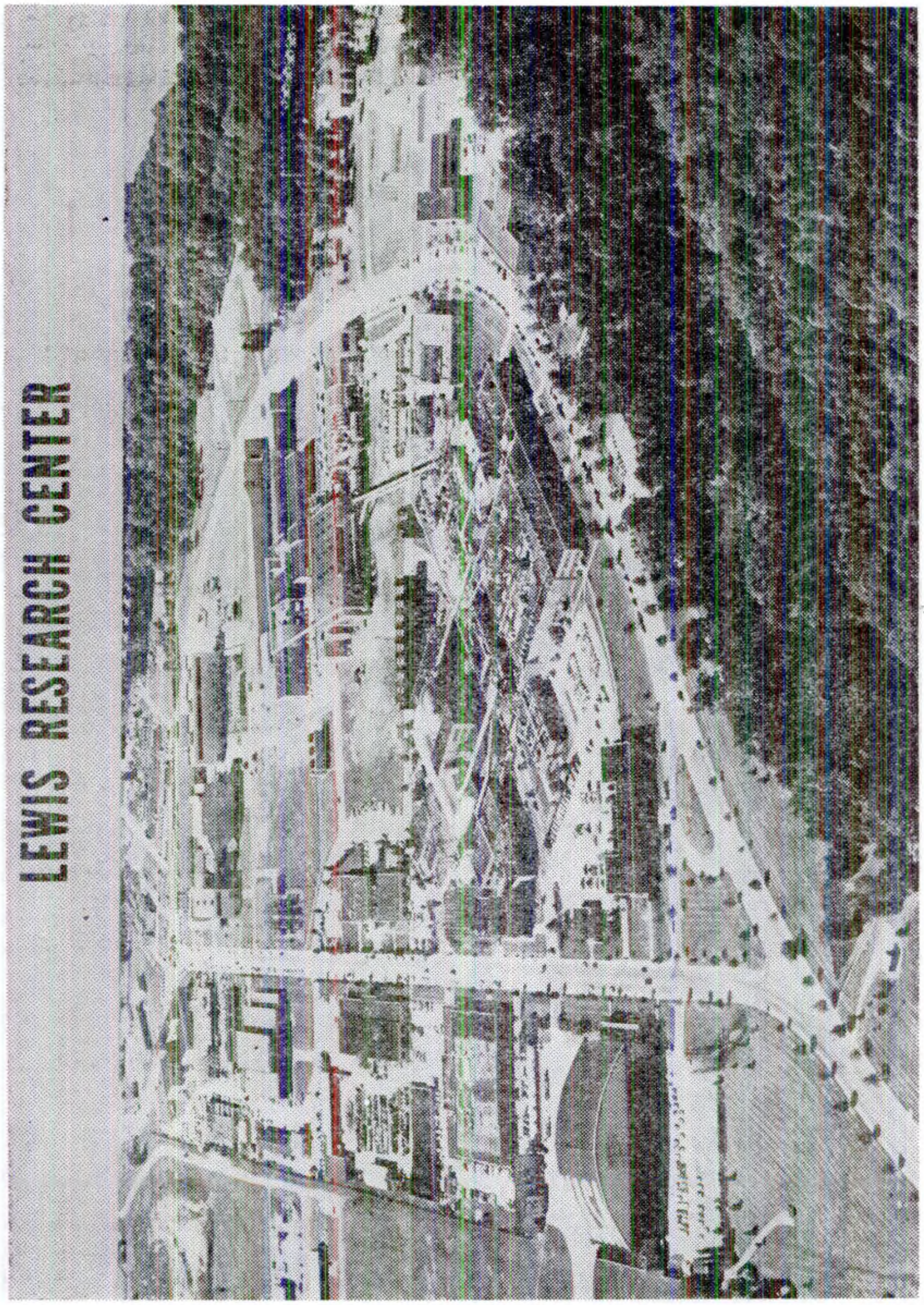

FIGURE 19

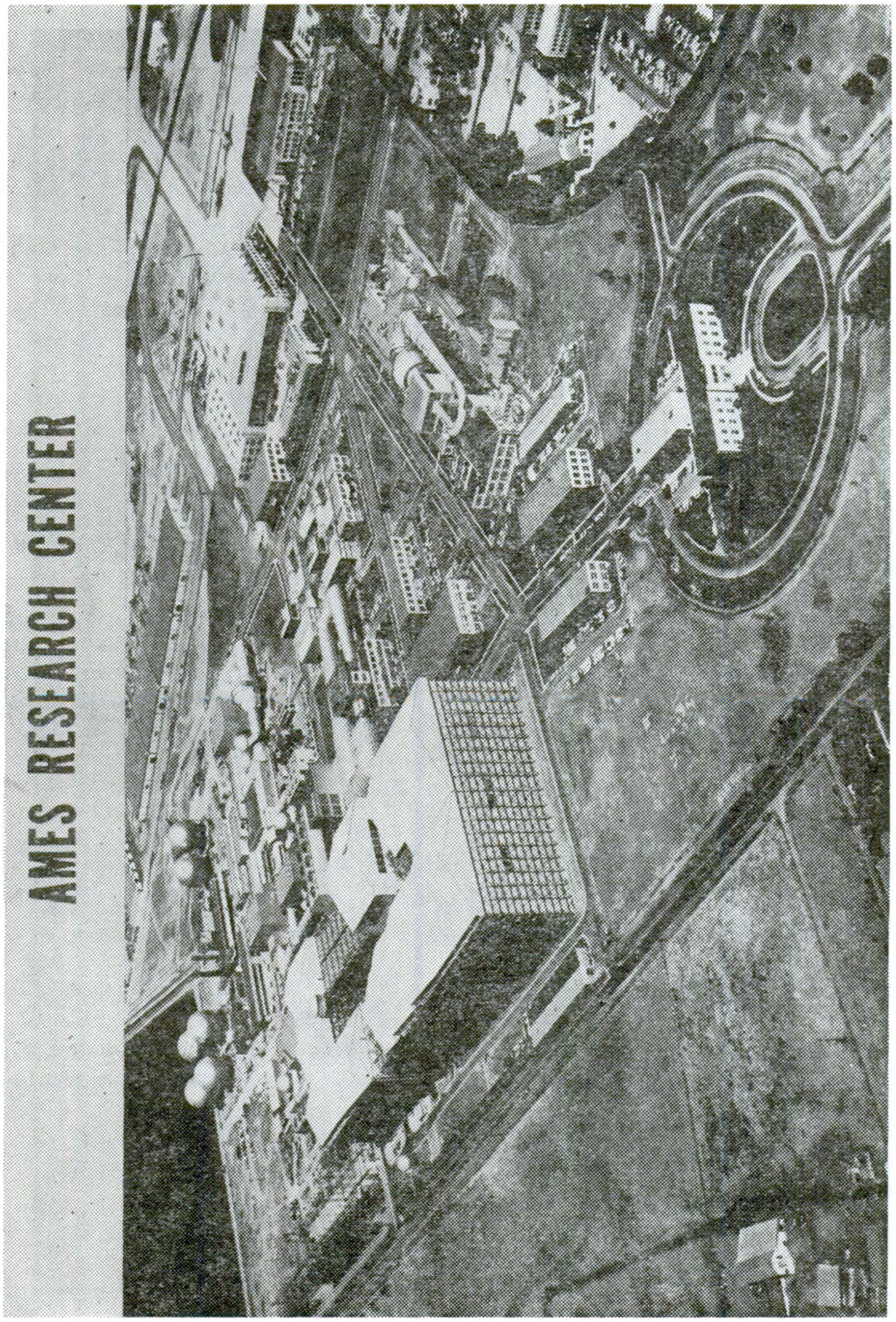

FIGURE 20

On the edge of Rogers Dry Lake, it takes advantage of this 75-square-mile flat surface as an ideal testing ground of research aircraft. Four hundred sixteen staff members are currently concentrating most of their efforts on the flight evaluation of the X–15 (fig. 21, p. 202).

A limited number of flights have already been conducted by the contractor's flight crew. One as recently as this last weekend. It is anticipated that center personnel will shortly begin the flight research program wherein the pilot will be propelled substantially above the earth's atmosphere and experience the characteristics of space flight for durations of a few minutes.

Next week we will accept delivery on the first airplane from the contractor and begin the planned research efforts.

The coming year should be of high interest in this project if the program goes as expected.

In the space flight side of the program there are three major research and development centers at work and three locations in which we have varying levels of investment for purposes of launching space vehicles. In research and development activities, we have divided the work into two categories—launch vehicle development and operations on the one hand, and spacecraft development and operations on the other.

Two centers are primarily engaged in spacecraft development and, again, a functional division in the work has provided to the Goddard Space Flight Center the primary responsibility for those projects concerned with earth orbiting craft both in their development and operation, as well as supporting research and test as necessary for the mission.

It is at this center that the Vanguard team served as a nucleus for a staff which is projected to grow until it numbers 2,000 with the proposed fiscal year 1961 budget authorization. The staff is currently housed in several different locations in the Washington area and at the Langley Research Center.

However, the badly needed space research facilities for this center are under construction at Greenbelt, Md., and the first of these will become available for beneficial occupancy by the middle of this summer. The satellite and sounding rocket program, the manned space flight program, and the application of space vehicles, including passive communications and meteorology, are the major program elements of this center. Following witnesses will discuss these programs in detail, and point out accomplishments to date.

The responsibility for the other major area of spacecraft development is assigned to the Jet Propulsion Laboratory at Pasadena, Calif. It is the exploration of deep space, including the lunar and interplanetary flights. This laboratory is employed in our program through the medium of a contract with the California Institute of Technology. The staff at the present time totals approximately 2,700 people, including several hundred currently engaged in the systems engineering of an Army weapon, the Sergeant ballistic missile (fig. 22, p. 203).

As the activity on this weapon system is phased out, we expect some decrease in the total staff size, but our present plans indicate that a stable requirement will persist for about 2,400 people. An

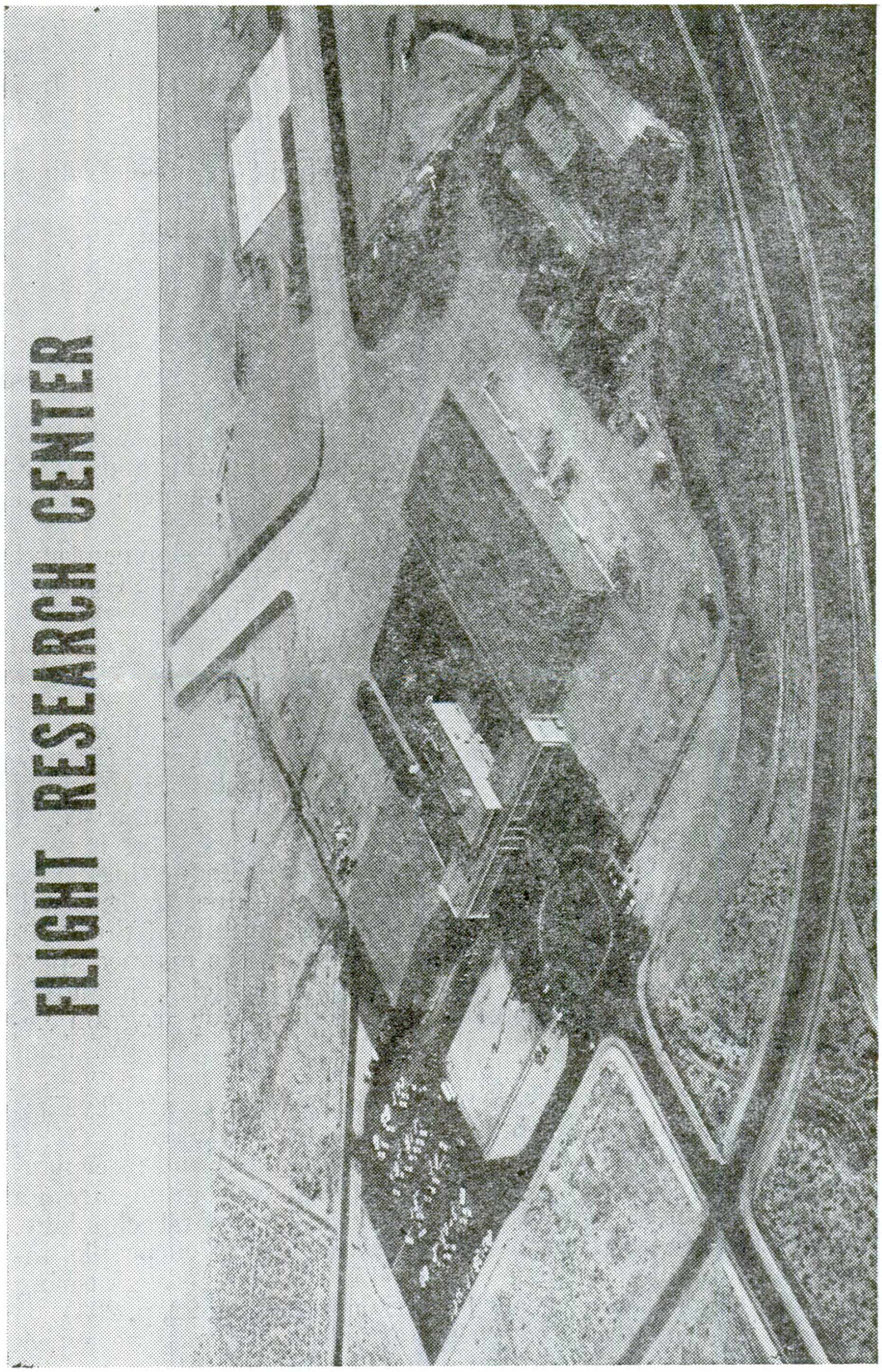

FIGURE 21

FIGURE 22

aerial view of the facilities which the laboratory occupies in the foothills of the Sierra Madre is shown.

It is in the area of work of this organization that one becomes most impressed with the extreme complexity of the spacecraft which must be created to carry out the interesting missions in lunar and interplanetary exploration. As I have indicated earlier, our program anticipates a major flight experience of this kind at approximately 3-month intervals in the time period affected by our proposed budget. A vast amount of creative engineering is a prerequisite to each flight, and the data analysis of the quantities of information recorded also represents a tremendous task. It is clear that this work will require a major fraction of our resources in the years to come.

I might say here, in most of our past experiments, the bulk of the investment for each flight has been to the vehicle, itself—to the propulsion system. We can clearly see this is not going to be the case in the future, that even with the added costs of the larger vehicles, the costs of the payloads to carry out the tasks that can be done and must be done are going to be even higher than those for the launch vehicles.

It is appropriate to divert here a moment and explain a principle of our program formulation in this area. The question of backup vehicles for specific experiments has arisen frequently. This has indeed been a cogent question during the early days of our program when improvisation has been common and individual space flights have been somewhat loosely related in the fabric of our entire effort.

It is our objective, however, to plan our experiments in each of the major program areas as a coherent and integrated effort. Each major experiment will be carefully related to the overall program objectives, based upon the results of previous flights, and generally increasing in sophistication and in difficulty as time progresses.

Many of the spacecraft will, in themselves, be related through the use of common structural frames, power supplies, and instrumentation. There will also be many which, though differing in their performance objectives, use launch vehicles of the same type.

In such a program the best utilization of our resources is not realized by providing backup boosters for each payload. Rather, it should be considered that a launch is scheduled periodically, in this case each 3 months—that is in the case of the deep-space exploration program—and if a catastrophic failure is experienced with any one launch, then a determination can be made at that time as to whether a similar spacecraft should be flown on the next scheduled vehicle.

The need for extensive ground testing of all spacecraft requires that spare devices be produced in each case. It is, therefore, possible to assemble an additional spacecraft to replace a failure on reasonably short notice. This, I would emphasize, is a principle used in the formulation of our program. Like all such principles, it is occasionally desirable to consciously violate it where unique program requirements prevail. Thus, our program is under constant surveillance to identify specific flights where a backup vehicle would be advisable and in these cases one is provided.

The launch vehicle development and operation task is assigned to the NASA Huntsville facility. I know you are all aware that the decision to transfer this facility to NASA was taken recently, and the plan to carry out this decision is currently before the Congress.

It provides for a transfer of 5,500 people under the leadership of Dr. von Braun. The development facilities, which will also be transferred, had an original investment cost of approximately $100 million.

The major project activity of the group at the present time is, and for some time will be, the development of the Saturn booster and the integration of the upper stages. Dr. von Braun will provide the committee with a detailed briefing on this project.

There are also numerous other activities at this center, including work on several Army missile systems, which will be carried on in accordance with the agreements we have made with the Department of Defense.

As I previously indicated, the responsibility for launch vehicle operation as well as development comes under the von Braun group. For this purpose, a missile firing laboratory is maintained at the Atlantic Missile Range at Cape Canaveral, Fla., which will supervise all NASA vehicle launchings from that site and will actually carry out the launching of vehicles developed at Huntsville.

In the time period pertinent to this budget authorization request, we will also have some space flight operations from the Pacific Missile Range. We plan to launch from this location all spacecraft which require polar orbits. Although the launch operations will be carried out largely by contract, a small group of NASA technical and administrative liaison people will be located at the site.

At Wallops Island, off the Virginia coast, we have a small launching service organization which conducts the numerous launchings of our sounding-rocket program and the solid propellant orbital vehicle which we will bring into service during the current calendar year. A staff of 300 people operates a facility valued at $18 million which is shown in this aerial photograph. The work is largely in response to the needs of the sounding-rocket and satellite program (fig. 23, p. 206).

To round out the organizational picture, as shown in the lower left-hand corner of the chart, is the Western Operations Office. This office is established in Santa Monica, Calif., with a staff of about 40 people. Its function is to perform liaison with the many development contractors engaged in our program and to carry out contract administration as required. The existence of this office greatly reduces the requirement for travel to this area by personnel of the headquarters and various other centers.

Mr. Chairman, I would like to turn for just a brief period to another subject which has been of extreme importance to us and has occupied a great deal of our attention. This is the matter of our program coordination with the space efforts of the Department of Defense.

I want to emphasize, first, that we have an excellent relationship with the military departments and the Office of the Secretary of Defense. Program correlation and project coordination are thorough and compatible with our needs, as I believe they are with the needs of the Department of Defense. There has been a great deal of discussion about a single national space program with, I am afraid, all too little understanding of what is precisely involved in this term.

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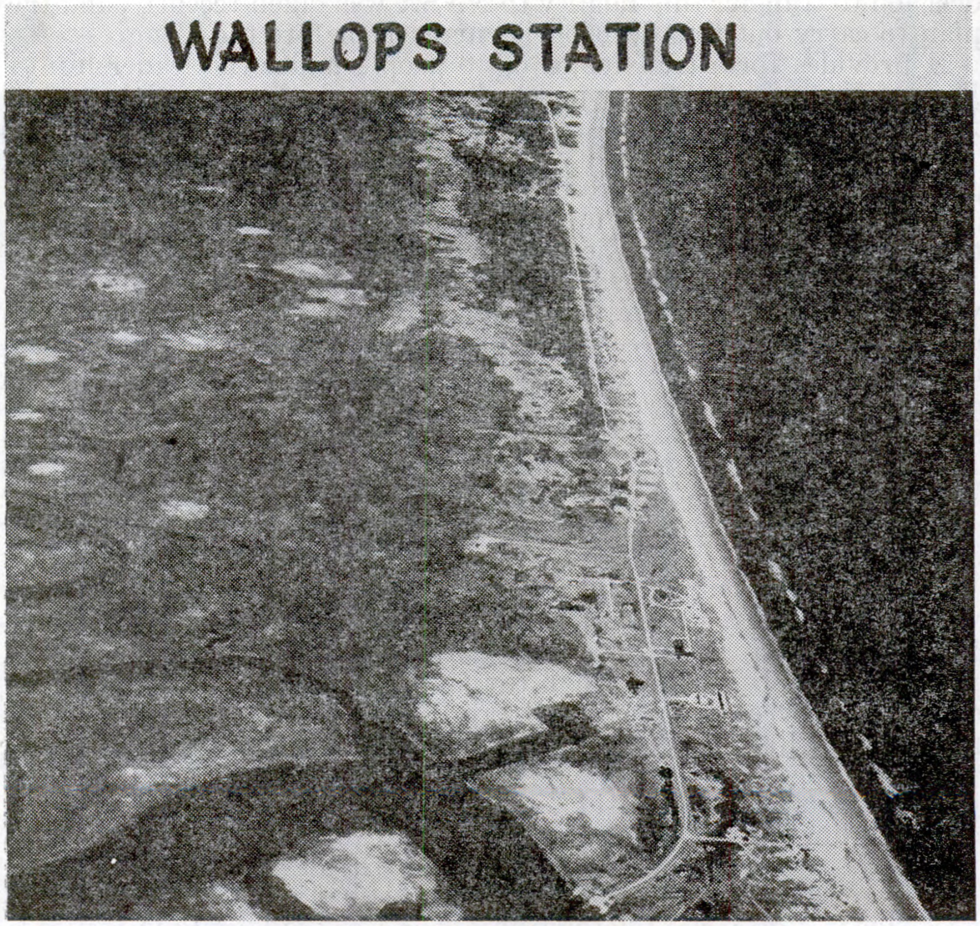

FIGURE 23

The Nation's space efforts can be discreetly considered in two major categories. One is space exploration, the measurement of scientific phenomena in space and on distant bodies, whether it be by the use of instrument or the human senses.

The other is the application of spacecraft. Now, to insist that there should be a single national space program might very well be to insist upon relating such diverse endeavors as meteorology, international communications, navigation, military reconnaissance, and space exploration. They are neither easily relatable nor sensibly compatible. It is, however, clearly possible to formulate a national space exploration program, and it is our belief that it was the intent of the Congress, as shown by the legislative history of the National Aeronautics and Space Act of 1958, that the NASA should indeed formulate such a program and proceed with its implementation. This we have done.

I make this point because its recognition is prerequisite to a workable relationship between the NASA and the Department of Defense. We have this recognition.

I have had a chart prepared which I think illustrates the coordination as it currently exists. A few facts stand out. Space exploration is the responsibility of NASA. Military applications are the

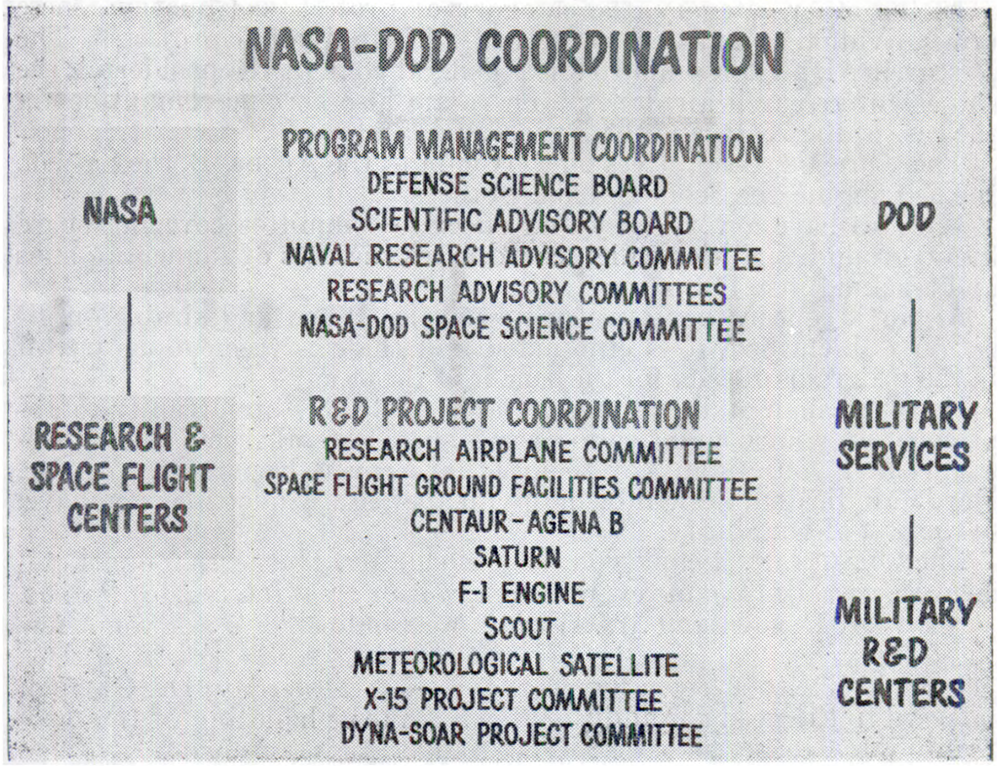

FIGURE 24

responsibility of the Department of Defense. Civil applications are the responsibility of NASA. There are some applications which are of interest to both military and civil needs. The underlying research and technical development is largely useful in both programs and common use can be made of launch vehicles (fig. 24).

Therefore, in the areas of certain applications—launch vehicle development, and background research and development—careful coordination is required to assure that full value accrues in joint utilization of either agency's products. The chart shows examples of these coordinating devices.

You will see at the top a category which we would call program correlation. They are program management coordination instruments. They exist in some cases under the executive jurisdiction of the Defense Department and in other cases, under the executive jurisdiction of NASA.

All of these boards and committees have membership from both the Department of Defense and the NASA.

The Defense Science Board, the Scientific Advisory Board of the Air Force, the Naval Research Advisory Committee, all have NASA membership and all treat with the program elements I have mentioned here as of joint interest.

The Research Advisory Committees of the NASA are 13 in number and they each cover a different technical discipline. They each have membership from the Department of Defense.

There is also a NASA–DOD Space-Science Committee which considers the whole area of space experimentation.

In the other category, the category of project coordination, these are individual committees concerned with individual projects. The Research Airplane Committee is a general committee considering the subject of research airplanes. There are also specific committees in the case of the X-15, and the Dynasoar.

There are also committees on the Centaur, the Agena-B, the Saturn, the F-1 engine, the Scout and many others.

We also have a very busy and effective committee covering space flight ground facilities which coordinates the uses of launching sites and tracking installations.

Again, I repeat, they are working well. When undesirable duplication is identified, it is eliminated and there is tremendous payoff in the programs of each for the benefit of the other.

Mr. Chairman and gentlemen, I appreciate this opportunity to appear before your committee to discuss these several facets of our program with you. Many of them I have covered sparsely. As Dr. Dryden indicated, we will be happy to answer any questions you have, to the best of our ability.

The CHAIRMAN. Thank you very much, Mr. Horner. Your statement was certainly comprehensive and was of great interest to all of us.

Now, Dr. Dryden and Mr. Horner, we would like to ask you a few questions.

I would like to ask you first this question: Yesterday, Dr. Glennan referred to the need for additional funds in the handling of this program. Mr. Horner makes reference to that in his statement.

Can you give us more detailed information on that? How much will you need and for what purpose will you need additional aid?

Dr. DRYDEN. We are talking about the funds required for the acceleration of superboosters.

The CHAIRMAN. It is especially important to the committee, I am sure.

Dr. DRYDEN. As you know, we follow the procedures of submitting this through the executive side of the Government and we hope to get to you, certainly within the next week, a transmittal by the President of an amendment to the 1961 budget to cover this subject.

The CHAIRMAN. Now, Dr. Glennan made reference to the urgency of this legislation and we want to give it top priority. You call it DX priority and we want to give it that top priority, but we can't do it if you are not prepared to come and tell us about it.

Can you tell us in a general way what you propose to do?

Dr. DRYDEN. I think the statement has been made that it is of the order of $100 million additional. I cannot tell you what the specific amount will be because it is not yet through all of the review procedures, but this is the order of magnitude.

The CHAIRMAN. The committee shouldn't be surprised to note a request for $100 million at that time. That will be for the superbooster.

Dr. DRYDEN. The superbooster program, including the Saturn, the F-1 engine, and the upper stages of Saturn.

The CHAIRMAN. That gives these programs, then, the top priority, the DX priority?

Dr. DRYDEN. Yes, sir.

The CHAIRMAN. Do you have any programs of space that don't have the DX priority?

Dr. DRYDEN. Yes, sir; there are only two programs that have this priority, and I might remind you this is the same priority as various elements of the ballistic missiles program. These two are Mercury and Saturn.

The CHAIRMAN. Those are the only two in your agency that have DX priority?

Dr. DRYDEN. That is correct.

The CHAIRMAN. Your communications project, which I consider very important, doesn't have that?

Dr. DRYDEN. May I make one explanation of the priority system. A DX priority is a device which enables you to get material delivered that you need at the time you need it. In other words, if you need a particular piece of electronic equipment, you don't have to go to the bottom of the list of those who have placed orders. The DX priority gives you the opportunity for early delivery. It, in itself, does not carry with it any more money.

The CHAIRMAN. It does not carry additional funds. That is what I was going to ask you.

Dr. DRYDEN. This is correct.

The CHAIRMAN. What priority would you have to have in support of the project to give you the needed funds that you have for that project?

Dr. DRYDEN. The point I am trying to make is that the DX priority system is entirely apart from the allocation and appropriation of funds.

The CHAIRMAN. The DX is your priority, is it not?

Dr. DRYDEN. It is actually a Commerce Department priority on American industry.

The CHAIRMAN. Is it under control of Commerce?

Dr. DRYDEN. Commerce is the agent that carries it out. The determinations are, in certain categories, by the Department of Defense. In this particular category, DX, it must go higher in the executive branch.

The CHAIRMAN. Now, we are in a race. The Defense Department says it is a race, and we all know it is a race, with Russia, and our projects have less than a DX priority.

Dr. DRYDEN. The practical situation in every priority system, Mr. Chairman, is that if you put every project in the top priority you return to where you were before.

In other words, you can give this top priority only to a relatively small number of projects in the country. Otherwise the whole system becomes useless. You are competing then with a hundred other projects.

The CHAIRMAN. How many projects have DX priority in this country?

Dr. DRYDEN. It is of the order of 8 or 10.

The CHAIRMAN. And how many does space have?

Dr. DRYDEN. Two in NASA.

The CHAIRMAN. What are the others?

Dr. DRYDEN. Ballistic missiles. Polaris, Atlas, Titan——

Mr. HORNER. There are two for space projects in the Department of Defense and the others are primarily in the ballistic missiles field.

The CHAIRMAN. Items of education and things of that kind do not have DX priority, do they?

Dr. DRYDEN. No.

The CHAIRMAN. What priority would you need to get the requested funds from the Bureau of the Budget for these projects?

Dr. DRYDEN. Priority assignment in itself has no direct effect on the assignment of funds.

The CHAIRMAN. Well, there is some priority in the distribution of funds by the Bureau of the Budget because when there is more demand than there is money, there is bound to be a priority in handling them.

Dr. DRYDEN. This is handled by an examination of each individual case, as I understand it.

If we want funds for a certain purpose, we have to argue for the funds for that purpose.

The CHAIRMAN. Let me put it this way then: Did you make a request for funds in reference to these projects that you have referred to and which we consider important in space development and fail to receive the amount of money requested?

Dr. DRYDEN. I cannot recall the details on individual projects. We did ask for a substantially greater amount than was allowed.

The CHAIRMAN. For what projects did you ask for more than was allowed?

Dr. DRYDEN. I can't tell you by specific numbers at the moment.

Mr. HORNER. I can give you some examples. I couldn't be sure it is a comprehensive listing.

One of the projects we asked for more funds on than is in the $802 million request is the F-1 engine and it is now a part of the overall study on augmentation of the superbooster program. We are confident that this study will result in augmentation of that program.

The CHAIRMAN. And will you now get the funds you need on that project?

Mr. HORNER. Yes, sir.

As a practical matter, I would anticipate that the difference between the dollars we had originally requested and the total dollars of our budget after this augmentation you have discussed with Dr. Dryden is going to be quite small.

The CHAIRMAN. It would be substantially the same now, under the new setup?

Mr. HORNER. Yes, sir.

The CHAIRMAN. Now, what projects, Mr. Horner—because you are familiar with the details—on what projects did you make requests for funds and didn't receive the amounts requested?

Mr. HORNER. We reduced the amount of construction. This reflects in a reduction in our proposal for new facilities, and substantially in a delay of some of the new facilities that had been requested until later years.

There was some reduction in our advanced technology and supporting research program. This is literally hundreds of individual smaller projects across the board.

We had anticipated some staff expansion which we have now withheld. I don't think of anything else at the moment, Mr. Chairman.

The CHAIRMAN. Did you get all of the funds you requested for your navigational project?

Mr. HORNER. We have no navigational project.

The CHAIRMAN. That is under the Navy?

Mr. HORNER. That is right.

The CHAIRMAN. Do you have communications?

Mr. HORNER. We have a passive communications project and we received substantially the moneys that we asked for.

I point out, Mr. Chairman, that the final balancing of the program between projects is done almost entirely on our own authority. The money that is provided to each individual project is, of course, sometimes questioned in the budget negotiating process and in this questioning and reexamination sometimes the funds on individual projects are reduced, but in the final analysis, NASA exercises its own prerogatives in adjusting the balance between projects.

The CHAIRMAN. Of course, we are behind in the space race and we want to catch up and, as Mr. McCormack says, get ahead.

If NASA says it has all the money it has requested and all it needs, then the responsibility falls on NASA. It is just a practical situation.

If you requested funds and didn't get them, and they are important to you, the committee would like to know it and the country would, too.

Now, you say you have gotten the funds that you need on the other projects?

Mr. HORNER. Mr. Chairman, I pointed out my list would not be a comprehensive one because I couldn't depend on my memory. If the committee would desire, we can provide a listing.

The CHAIRMAN. I think the committee would be very much interested in knowing what you say you need and what you were allowed.

Now, we have only two projects in the DX category, but I would like to know on a nationwide scale what importance is attached to these projects that are assigned to you and have a dual importance—both military and peacetime importance. You can't give us that——

Dr. DRYDEN. We will supply for the record a comparison between the requests we submitted and the amounts allowed.

The CHAIRMAN. Can you do it this afternoon, Doctor?

Dr. DRYDEN. I think so.

(The information appears at p. 228 of the record.)

The CHAIRMAN. What sense of urgency, Doctor, do you assign to this question of getting ahead in space, overtaking and getting ahead of the Russians in space?

Dr. DRYDEN. I think we assign the greatest possible urgency to it.

The CHAIRMAN. How can you do that without adding the greatest possible priority to your request?

Dr. DRYDEN. The amounts, of course, allocated to space are matters of allocations in relation to other projects as well as ours. There are some questions that go to higher levels of authority. We submitted requests for the amounts of funds we felt necessary to move the program as rapidly as we could move it and we will furnish this information to you, sir.

The CHAIRMAN. And you will show us what you failed to get, this afternoon?

Dr. DRYDEN. Yes.

The CHAIRMAN. Mr. McCormack.

Mr. McCORMACK. I have no questions, but you have stated, and so has Dr. Glennan, that we are in competition with another country.

Dr. DRYDEN. Very much so.

Mr. McCORMACK. So the American people might just as well realize that fact. This idea that we are not in competition creates apathy and complacency rather than the healthy progress that should be made in the field of outer space. Is that right?

Dr. DRYDEN. We consider that we are in a broad competition with the Russians, that it is incumbent upon us to produce a program which will move us forward just as rapidly as possible and we think we have formulated such a program.

We do not believe—let me state it positively: I think I testified last year we believe that this is an overall competition like an Olympics tournament. There are numbers of events and there are many areas that are of great benefit to our country which perhaps are not as attractive to the competition.

We believe that in time, just as quickly as we can, we will overcome the present handicap that results from the small size of boosters which are available to us.

So far as we know, this is the only specific way in which we are behind. The Saturn project is the one which will remedy this, we feel. It is true that with the Atlas-Agena we will attain the position that our competition is in now, but by that time they will have moved ahead.

We believe that the completion of the Saturn vehicle at the earliest possible date is the one step that we can take that will relieve that particular handicap.

Mr. McCORMACK. Well, that is really the heart of it, isn't it?

Dr. DRYDEN. This is really the heart of the difficulty, if you like.

Mr. McCORMACK. So we can talk about everything else, but the concentration should be on that—propulsion power.

Dr. DRYDEN. On that and the things necessary to exploit it when we have it. You will recall there are things other than the booster which we must have ready at the time we have the booster.

Mr. McCORMACK. If you solve the source of the difficulty, the others are easy.

Dr. DRYDEN. If we solve the source, the others will follow.

Mr. McCORMACK. How far do you say we are behind the source of this competition?

Dr. DRYDEN. As Dr. Glennan said, something on the order of 5 years will be required to catch up.

Mr. McCORMACK. If we are behind in 5 years, what do you think our competitor will be doing in the meantime?

Dr. DRYDEN. This estimate of 5 years includes some estimate of what he will be doing in the meantime.

Mr. McCORMACK. There is no question but what we have the facilities and capacity in America to do so.

Dr. DRYDEN. The only thing we do not have is time. We didn't start soon enough.

Mr. McCORMACK. That goes to leadership, too; doesn't it?

Dr. DRYDEN. We have to start at the starting line with the other competitors. If someone is halfway down the track, there is no sense entering that particular event.

Mr. McCormack. The question of management and leadership is vitally important also.

Dr. Dryden. These are important to remedy the condition as early as possible. They will not overcome to the fullest extent this matter of time.

Mr. McCormack. With regard to the $23 million supplemental budget for the remainder of this fiscal year, of course, you always knew you could come back with a request for more funds——

Dr. Dryden. That is correct.

Mr. McCormack. And that $23 million is really necessary to carry out the work for the remainder of the fiscal year?

Dr. Dryden. This covers items that are authorized. Therefore, it does not come before your committee for authorization.

Mr. McCormack. For appropriation only?

Dr. Dryden. The need of it is primarily to make sure that our Mercury tracking network matches the availability of the flights. In other words, we cannot fly until our ground stations are completed. We need to expend money this fiscal year in order to make these two elements in the program meet at the right time.

Mr. McCormack. Now, with that $23 million and the $802 million for which you are seeking authorization and appropriation in the next fiscal year, will that amount be all you could wisely, efficiently, and effectively expend during the next fiscal year?

Dr. Dryden. Well, there is no question that if you have more money you can do more. I think the question is, does the additional money contribute to your objective? Can you advance the time scale?

Now, when Dr. von Braun presents his review of Saturn, he will show you what the amount requested buys in the way of time. This detail is being completed and we will give it to you next week.

Mr. McCormack. If you had more money, could you reasonably in the next fiscal year make further progress?

Dr. Dryden. It would not affect the time scale of anything that will happen in the next year or two. It could perhaps give more insurance in the next year or two. It could affect things further down the road.

Let us take these long-range objectives of circumlunar navigation. There is no question that the date at which you reach that is at least in part determined by the amount of money. It, however, is determined mainly by the speed at which you develop the technology and overcome problems whose solutions you don't see right now.

I am trying to make clear that it is not like building a piece of machinery that we know how to build and just having to figure how long it takes to build it.

There are some unknowns in this business.

Mr. McCormack. You asked for more money than the budget message included. You must have had ideas in your agency that you needed that money.

Dr. Dryden. Somewhat more. We asked for what we thought was the optimum rate to get ahead just as quickly as possible.

Mr. McCormack. I notice Mr. Horner used the word "minimum."

Mr. Horner. Yes, sir.

Mr. McCormack. So the figure represents the minimum amount?

Mr. Horner. We feel it is the minimum essential to carry out the program I showed you.

Mr. McCormack. Now, your agency was consulted in connection with the administration bill amending the Space Act?

Dr. Dryden. Yes, sir.

Mr. McCormack. Was the Defense Department consulted?

Dr. Dryden. Yes, sir.

Mr. McCormack. Was the Department of Army consulted before the bill was drafted, and the Department of the Navy?

Mr. Horner. We in NASA carried on all of our communications concerning the proposed legislation with the authorities in the Office of the Secretary of Defense. The Secretary of Defense disseminated the information through the Department of Defense——

Mr. McCormack. What happened over there you don't know?

Mr. Horner. We can't answer specifically.

Mr. McCormack. In other words, NASA sought the opinion of the Defense Department at the Defense Department level rather than the opinions of component branches of the Defense Department?

Mr. Horner. There is one addition I might make to that: There are some elements of the bill that are uniquely of interest to the Department of the Air Force in its role as—I will use the term "space transportation agency," which has been assigned by the Secretary of Defense to the Department of the Air Force and at the request of the Secretary of Defense we did talk with the top officials in the Department of the Air Force.

Mr. McCormack. That didn't happen in the case of the Army or the Navy?

Mr. Horner. We were not asked to do so in the other two cases.

Mr. McCormack. You did it at the request of the Secretary of Defense?

Mr. Horner. I would amend that by one further statement: We did also talk to the Assistant Secretary for Research and Development in the Department of the Navy and the Director of Research and Development in the Department of the Army.

Mr. McCormack. You talked with both of them about the bill?

Mr. Horner. Yes, sir.

Mr. McCormack. Did they express any opinions about the bill as recommended and filed?

Mr. Horner. To the best of my knowledge they are in agreement with the bill.

Mr. McCormack. Now, let's come to section 309 of the bill:

> Nothing in this Act shall preclude the Department of Defense from undertaking such activities involving the utilization of space.

That doesn't mean research, does it?

Will you tell me just what section 309 means now? What is intended and what section 309, as enacted into law, will mean?

Dr. Dryden. As I understand the position, this says that at any time the Department of Defense finds a military job which it can do in space better than they can do it some other way, or that they can't do at all any other way, the Department of Defense is not excluded from proceeding with such developments, including the research—there is a phrase at the end that I cannot quite exactly quote.

Mr. McCormack. I will read it.

> Nothing in this act shall preclude the Department of Defense from undertaking such activities involving the utilization of space as may be necessary for

the defense of the United States, including development of weapons systems utilizing space vehicles and the conduct of supporting research connected therewith.

Dr. DRYDEN. This is the point which Mr. Horner covered in his statement: The responsibility for space application in the military field is that of the military, the Department of Defense. Exploration of space; applications to civil purposes are assigned to NASA.

Mr. McCORMACK. I understand that, but I want to know about the meaning of this provision. Would this mean all research in connection with the military would be vested in NASA or that the Defense Department would have to secure permission to go into basic research in connection with what they consider to be the development of military weapons?

Mr. HORNER. Mr. McCormack, would it clear this up if I pointed out that in our understanding, and in the understanding of the Department of Defense, supporting research covers both basic and applied research?

Mr. McCORMACK. In other words, you are not taking away from the military——

Mr. HORNER. Nothing.

Dr. DRYDEN. We make it perfectly clear this act takes nothing away from the military.

Mr. McCORMACK. We thought we made it clear in the original act, but we found we didn't in the interpretation of the word "except" in the Space Act.

Mr. HORNER. This wording was suggested by the authorities in the Department of Defense.

Dr. DRYDEN. This drafting is their drafting.

Mr. McCORMACK. I don't want to go into it too much now, but if in further consideration of this bill and that provision we want to make that more definite, accurate, and certain, there is no objection to that?

Dr. DRYDEN. No, sir.

Mr. McCORMACK. In other words, you realize that in the world of today the question of preservation rests essentially with our military?

Dr. DRYDEN. That is right.

Mr. McCORMACK. I am very strong for your agency, as you know, but I have never failed to recognize the serious position in which the world is today. It is pretty difficult to have basic research in a civilian agency in connection with a military application. Is that right?

Dr. DRYDEN. That is right.

This language was drafted by the Department of Defense to make perfectly clear that no attempt is being made in this bill to restrict the military use of space.

Mr. McCORMACK. That certainly clarifies my mind because I was somewhat disturbed about the language. Of course, we put the "free information" provision in last year and we have run into difficulties now. There were some questions I was going to ask on that phase, but I would rather wait until Dr. Glennan is here because I would like to ask questions in connection with why certain contracts were made. I am not impugning the motives.

I think as close a relationship between this committee and your agency should exist as is humanly possible.

You will remember that when the space bill was up for consideration in 1958, this committee kept in close contact with you; we told you everything.

Dr. DRYDEN. Yes, sir.

Mr. McCORMACK. That included the White House and Dr. Killian, then the President's science adviser. We even had executive department representatives sitting with us in executive session, which is very rarely done, so there would be that close cooperation. You remember that, don't you?

Dr. DRYDEN. Yes, sir.

In a letter to the committee Dr. Glennan expressed willingness to discuss any and all aspects of his contract decisions.

Mr. McCORMACK. That means in open session.

Dr. DRYDEN. I think so.

Mr. McCORMACK. I have no further questions now.

The CHAIRMAN. Mr. Fulton.

Mr. FULTON. We are glad to have you both here.

In respect to Mr. Horner's status, I would like a recommendation from the Agency to have a position that is an overall operation of responsibility so we can center the responsibility in one person.

I believe as associate administrator he has been given that, but in order to have a statutory responsibility for what is happening currently on programs and operations, I would like to have some sort of a recommendation on that.

Dr. DRYDEN. We can give you a statement, sir. I think this differs only in a degree from the heads of the other organizations. There are other staff positions which do not fall within Mr. Horner's jurisdiction.

Mr. FULTON. I am talking about upgrading the position into one of overall responsibility. I am always interested when we talk about our language. For example, you want to call it our national launch vehicle program. You don't want to call it the national booster vehicle program any more.

Dr. DRYDEN. This came from the confusion as to what a booster was. Is it a rocket engine? Is it a rocket engine plus the fuel tanks? Is it one stage, two stages, three stages?

We wanted a word whose meaning would not be confused. The "launching vehicle" could cover the whole thing, whether it is one, two, three or four stages.

Mr. FULTON. I notice you wanted to do it, but you both referred to "booster" and "super booster" and never went back to the word again.

Dr. DRYDEN. It shows we haven't succeeded in erasing the old word from our mind.

Mr. FULTON. You refer to spacecraft.

I don't think that would be very popular when you are already using casually the word "sputnik" with the same definition.

Where do you get the word "Agena"? Some of us have a knowledge of Greek mythology, but sometimes it gets a little beyond some of us.

Dr. DRYDEN. This is a name developed in the Defense Department for one of the stages which they developed in connection with the Discoverer project.

Mr. FULTON. Was it pulled out of a hat or out of Greek mythology?

Dr. DRYDEN. I just don't know where it came from.

Mr. FULTON. I would suggest a new set of names in the Department. It has no connotation and has no scientific aspect. I wondered about that name.

Next there is the question of the highest DX national priority on various projects. The one project is the Saturn booster. That has a DX priority for the Saturn launch system, doesn't it?

Dr. DRYDEN. Yes.

Mr. FULTON. Secondly, the Atlas booster system has had a highest national priority for almost 5 years?

Dr. DRYDEN. As a missile; yes, sir.

Mr. FULTON. Then, in addition to that, the Project Mercury has been assigned a highest DX national priority.

Dr. DRYDEN. Yes.

You have to state the language very carefully. The "highest priority" could only be one. I said these projects have a DX priority and DX is the highest national priority.

Mr. FULTON. I agree that it is a class rather than one particular program.

The question then recurs on the Mercury project, and I would like to ask both of you this question. The Mercury project is the man-in-space program, and it seems to be a basic essential step of our U.S. space program, is it not?

Dr. DRYDEN. It is, sir.

Mr. FULTON. And both of you say that?

Mr. HORNER. Yes, sir.

Mr. FULTON. Therefore, it is a necessary step in the progress of our U.S. program in space.

Dr. DRYDEN. Very much so.

Mr. FULTON. And that we follow it up promptly or we will be further behind Russia. Is that not the case?

Dr. DRYDEN. That is correct.

Mr. FULTON. Now, there is a 17-member advisory committee on science and technology that met Sunday, January 24, and issued some statements. They likened the Mercury program to the Vanguard project. They said that the Mercury program should be put in its logical place and suggested the target date on the Mercury man-in-space program be delayed 3 to 5 years.

Now, would you please comment on what that would do to our U.S. space program, particularly to our defense program and secondly in our position with Russia?

Dr. DRYDEN. Mr. Fulton, I think this would be extremely unfortunate. To the best of my knowledge, none of the persons on this committee has ever visited the Mercury project or had any contact with it. So far as I know, all they know is what they read in the papers and I believe——

Mr. FULTON. I would like your direct comment, that it would be a tragic blow to the U.S. space program and to our U.S. security to have such a postponement.

Dr. DRYDEN. Very much so.

Mr. FULTON. What do you say, Mr. Horner?

Mr. HORNER. I think it would create a great deal of chaos in our program.

Mr. FULTON. Would it put us further behind Russia in the space race?

Mr. HORNER. I don't think there is any question about that.

Mr. FULTON. How about you, Doctor?

Dr. DRYDEN. I think so. I think, although all of us realize that our competition has had the booster capacity to do this, there still is some hope that we can be there first.

Mr. FULTON. Now, then, the same group said that they favored a number of proposals. They wanted the high priority development of weapons that can knock hostile military satellites out of the skies.

Of course, that brings up the project Defender that is for the purpose of discovering a means to counteract ballistic missiles in the future. That project is allocated for over a half of the budget of ARPA, the Advanced Research Projects Agency of the Department of Defense.

Do you think that is being given adequate attention by the Department of Defense and ARPA in that particular field of defense—the so-called antimissile defense field?

Dr. DRYDEN. I believe from what I know that the antimissile defense is not quite the same thing as the antisatellite problem. The anti-ballistic-missile defense is being given an extremely high priority running down every possible suggestion for means of dealing with ballistic missiles.

Mr. FULTON. So it includes not only Nike-Zeus, but many other aspects and projects of flight phenomena in all the fields. Is that not right?

Dr. DRYDEN. That is right.

Mr. FULTON. What do you say, Mr. Horner?

Mr. HORNER. I don't find any disagreement with what Dr. Dryden has said. I am not very well qualified to comment on the efforts of the Department of Defense in this area at this time.

Mr. FULTON. Now, the comment has been made that your agency does not yet understand the depth of the Russian challenge. You certainly respect that challenge, don't you, and are doing everything you can to counteract it?

Mr. HORNER. That is right.

Dr. DRYDEN. I don't know what the reason for such statement is. I think we fully understand what is involved.

Mr FULTON. What do you say, Mr. Horner?

Mr. HORNER. Well, if the statement was made as an allusion to our desire to have more information about what the Russian program amounts to, it is certainly true, we would like to have more information than is available.

We don't have any question in our minds that there is a very significant Russian challenge, but we don't know just exactly what it is.

Mr. FULTON. But you have your eyes open to the challenge, and you are trying to meet it; are you not?

Mr. HORNER. Yes, sir.

Mr. FULTON. The other comment has been with respect to the adequacy of the National Aeronautics and Space Administration's top management, that it must be reexamined.

Do you find in your agency any evidence, or have there been any complaints of faulty management, or lack of coverage of the various fields by the administrative personnel?

Dr. DRYDEN. I know of none.

Mr. FULTON. Have you had any complaints, Mr. Horner?

Mr. HORNER. I find it a little difficult to respond to that question without being self-serving and subjective.

I think we have made excellent progress in the last 16 months.

Mr. FULTON. Now, Mr. Horner has a chart on the military, civilian, and NASA–DOD coordination efforts. There have been comments that there is a now nonexistent method for resolving military-civilian priority conflicts which must be devised.

Would you please have that chart—with the chairman's permission—put in the record at this point, together with Mr. Horner's testimony to show just what the setup is now so we can advise these 17 bright scientists that it is already in existence, although they don't know about it?

With the chairman's permission, may we put that chart in the record?

The CHAIRMAN. If there is no objection to it, it may be included.

(See fig. 24, p. 207).

Mr. HORNER. These are merely examples. There are more than appear on this chart.

Mr. FULTON. With regard to ARPA, you are on a day-to-day basis.

For instance, with Mr. Godel you are on a day-to-day basis.

Dr. DRYDEN. This shows only the formal contacts and not the telephone conversations, luncheons, and so forth.

Mr. FULTON. If we look at the overall U.S. scientific program, taking into consideration the installations we have, the personnel we now have, as well as the projects we have under study, and in research and development, would you not say that in depth, on science, we are proceeding on a much greater and broader base of scientific approach, both in aeronautics and space, than anybody else in the world is at the present, including Russia? Would you answer that, Doctor?

Dr. DRYDEN. Insofar as aeronautics and space are concerned, I think there is no doubt. Dr. Waterman could answer the broader question better than I.

Mr. FULTON. Mr. Horner, what do you think about it?

Mr. HORNER. That is my impression.

Mr. FULTON. When we are talking about who is ahead or who is behind in space, we must realize that had several of our own lunar shots gone well rather than run into technical difficulties, we would have been even with Russia, even on the lunar shots, would we not, because it had been planned for certain lunar shots?

Mr. HORNER. I think it is generally accepted, and it is certainly true in our estimation, that the last lunar experiment that we attempted was technically more difficult than anything that the Russians have accomplished, if that will partially answer your question.

Mr. FULTON. That is the point I am making, that we are trying for certain high standards of scientific research that we have not been able to attain on lunar shots, but they are much above the standard that Russia has been trying to project on her lunar shots to date. Is that right?

Dr. DRYDEN. Somewhat above. "Much" may be too strong.

Mr. FULTON. What is the reason that Russia has not put into orbit any satellites within almost 2 years? Why has her program suddenly gone zero, blank, and failed on orbital vehicles?

Dr. DRYDEN. I, of course, do not know. I may say that at the meeting in Nice, France, a couple of weeks ago, the Russians said they were going to put up more earth satellites. They didn't say when.

Mr. FULTON. As a matter of fact, they haven't.

Dr. DRYDEN. They have not as yet.

Mr. FULTON. Would you please comment on how many we have had up in the last 2 years compared to Russia's failures? Even attempts?

Dr. DRYDEN. Including NASA and DOD, it is on the order of 18 or 20, I believe.

Mr. FULTON. Thank you. That is all.

The CHAIRMAN. Mr. Sisk.

Mr. SISK. Dr. Dryden, I think both you and Mr. Horner made excellent statements here this morning.

I wanted to ask you a few questions with reference to the Huntsville facility which is technically in the process of transfer. Now, actually, what is the status of that transfer at the present time? Mr. Horner, if you want to comment, or Dr. Dryden?

Mr. HORNER. If my memory serves me correctly the President announced the assignment of the superbooster development responsibility to the NASA in the latter part of October and at the same time announced his intention to have the elements of the development operations division of the Army Ballistic Missiles Agency at Huntsville transferred to NASA.

This is the Von Braun team. We started immediately to make a comprehensive study of all of the administrative, management, and logistic actions that must be taken to effect the transfer without delaying the development operations that are in process, and are accelerating in the case of Saturn, and to properly safeguard the interests of the Army that were being undertaken at that time by the technical people. This was a very complex study, indeed.

We have completed that study and formed a plan for this transfer. The plan, I believe, was delivered to the Congress on the 14th of January—I might want to correct that date in a day or two.

Mr. SISK. That date is correct. The 14th is correct.

Mr. HORNER. The law, as you will recall, provides that the plan be before the Congress for a period of 60 days while the Congress is in session and with the expiration of that time the plan will be carried out.

In the meantime we are going ahead—well, we have, with the Department of Defense, agreed upon controls over program correlation, management controls over project Saturn, and we have begun the formulation of the business and supporting side of what will be a new NASA center at Huntsville with Dr. Wernher von Braun as its director.

Now, there have been concurrently, of course, many activities necessary in support of the ongoing Saturn development program. We have as recently as last month, in cooperation with, and with the assistance of Dr. von Braun's staff and his personal attention, identified the upper stages for Saturn. Only yesterday and the day before there was a briefing of industry at Huntsville, preparatory to submitting proposals which will be due the latter part of next month for industry participation in the Saturn upper stage program.

We have also, as you know, been conducting a thorough study, again with Dr. von Braun and his staff, as to what the real financial needs for the support of that program during the coming fiscal year will be.

This study is just coming to its conclusion and as we have mentioned several times previously, we hope to present to this committee an amendment to our authorization request for 1961 very shortly, as to what the meaningful support requirements for project Saturn are, to indeed place it on a "highest national priority" basis.

Mr. SISK. Now, I understand, Mr. Horner, that this transfer of the Von Braun team is to be handled en masse, so to speak. That is the entire team of approximately 5,500 people is to be included in the transfer. Is that correct?

Mr. HORNER. The technical people, the scientific team under Dr. von Braun, that is true.

Now, you have to recognize that as an element of the Army Ballistic Missile Agency and as an element of the Army, the logistics, administrative, and management support for that team stems from other elements of the Army.

Certainly one of the difficult areas of discussion—difficult in the amount of detail that was necessary—was identifying sufficient support personnel and facilities for this technical team. The staff of 5,500 represents both the scientific and technical team and the supporting side of the new center.

I believe the numbers are about 4,300 scientific and technical—direct technical—workers, and 1,200 on the management, administrative, and logistics support side of the center.

Mr. SISK. The thing that I wanted to be absolutely clear on, because this was the information that we had been given indirectly heretofore, was that there was to be no breakup or splitup of the so-called Von Braun team.

Dr. DRYDEN. There are a few individuals who go back and forth, but this is by joint agreement between Dr. von Braun and the Army.

Mr. SISK. I certainly understand the idea of cooperation as we are carrying it on, of course, in other facilities.

With reference to the actual physical facilities at Huntsville which are being transferred, and which you indicate will amount in value to some $100 million, is just a portion of the physical facilities of Huntsville isn't it?

Mr. HORNER. That is a portion of what was the facility for the Army Ballistics Missile Agency.

Fortunately, almost all of the development facilities that were in use by the Von Braun team were in one area and we have been able to identify a discreet area of real estate about which if we wanted to we could put a fence and this becomes a new NASA center, very much in the same manner as our Langley Center which is on, as you know, Langley Air Force Base, and our Ames Center at Moffet Naval Air Station. It will be a very similar situation.

Mr. SISK. You anticipate no problems which would cause any delay in work due to the problems of transfer of facilities, or to the transfer of the team?

Mr. HORNER. We have been assured by Dr. von Braun and his staff that there will be no such problems.

Mr. SISK. I have introduced a resolution, and I don't know whether you are familiar with it, known as House Joint Resolution 567, to effect the immediate transfer of this facility rather than waiting until March 14, which under law would be required.

I would like to have you comment on that, if you are at all familiar with the resolution. It simply indicates that in view of certain precedents we have had in the past where this has been done, that it is the sense of Congress, in order to expedite the space program, that we permit the immediate transfer rather than waiting 60 days.

Dr. DRYDEN. I think it would be a desirable action to remove any slight uncertainty about the outcome. It would have a tremendous psychological value. I will say, of course, Mr. Sisk, as you know, that the various details of this transfer have to be faced at the proper time so there is no interruption.

Mr. SISK. I understand that and I also understand, of course, that on the Saturn program they have been working with what I understand to be perfect cooperation—at least I hope it is near perfect; I guess nothing is ever quite perfect. It was my hope, of course, that this resolution will have good psychological effect. It would indicate the complete support of the Congress with the proposed transfer and our urgent desire to see that the situation proceeds expeditiously. I felt this would therefore be an advisable resolution.

Dr. DRYDEN. It would be very helpful from that point of view.

Mr. HORNER. I think it would also facilitate the mechanics of transfer of personnel. There are some of the elements of transfer that cannot, as a practical matter, be completed until the end of the fiscal year, but prior to that time we must identify large numbers of support people, exactly where they are going, what facility they are going to sit in, who they are going to work for. The sooner we can have final confirmation that the transfer will take effect, the sooner we can get started on these kinds of activities.

Mr. SISK. I appreciate that statement in support of my resolution very much, I might say to you gentlemen.

With reference to the time schedule which you have outlined here, I want to compliment you. This is the first time, I think, that we have had it drawn quite as specific as you have indicated here this morning. I am 100 percent in support of the position taken by my colleague, Mr. Fulton of Pennsylvania, with reference to this Mercury program.

I would be most unhappy to see any delay at all in pushing forward with it because this seems to me to represent one of the real possibilities of moving ahead with a program which could be extraordinary and impressive, not only for the real good that we could achieve with it, but also in this whole worldwide field of propaganda which we have to recognize today with reference to our prestige.

I would hope that if it were possible, without endangering anyone, certainly, that if you saw the opportunity of moving it forward faster, that you would do so, rather than to delay it.

Dr. DRYDEN. We think that the schedule we have is consistent with the greatest degree of safety that we know how to build into the project. We are not proposing in this to unduly take risks, but we will do this when we are convinced that the flight is reasonably safe. We have given our estimates of the time schedule, if our tests continue to be successful as they have been to date.

Mr. SISK. I appreciate your statement because I think we all agree certainly that we do not want to take the step until every possible bit of safety precaution has been taken.

Let me conclude if I might, Mr. Chairman, with this statement. As I say, these statements were excellent. They were fairly general in nature and I would hope that as other people appear here we may be able to have a little more specific data on actual progress in the next year.

Dr. DRYDEN. There are another 10 speakers or so.

Mr. SISK. We would like to have detailed some of the specific things that have been discovered or things that would be worthwhile in the program.

Dr. DRYDEN. We would like to take up each element, tell you what has happened in the past year, what our plans are for the future, when we have had failures and our best information as to the cause, and so on.

The CHAIRMAN. Doctor Dryden and Mr. Sisk, I think there are some other questions to be asked and then we have other witnesses too from NASA. We are anxious to get ahead with this program.

I think Mr. Fulton has an observation to make and following that we will adjourn until 2:30 unless there is objection.

Mr. BASS. Mr. Chairman, may I say something?

There are two or three members of the committee who have asked questions for 25 minutes. I suggest that we stick to the 5-minute rule to allow some of us junior members to get in a question or two.

The CHAIRMAN. I think the 5-minute rule is the best protection the junior members have.

Mr. BASS. We have not been observing it.

Mr. SISK. May I apologize to my colleague for infringing on his time? I am sorry. I had no intention of doing it.

Dr. DRYDEN. We will come back and be available at any time.

Mr. FULTON. I want to make this observation. I want the record to show that I join with Mr. Sisk in his House Joint Resolution 567 to effect immediately the transfer of the Development Operations Division of the Army Ballistic Missiles Agency to the National Aeronautics and Space Administration.

Could I say something to Dr. Dryden? I have been sitting here thinking and I was wondering about your nomenclature. Isn't it possible that the people of the Vandenberg Air Force Base, on their polar orbits, have named this thing Agena because there is a star near the Southern Cross? If they are going to put things into polar orbit, they are probably going to be aiming it at Agena.

Dr. DRYDEN. That may be.

The CHAIRMAN. I don't know. They didn't get the name from the comic strips this time although the spaceship did come from it.

We will adjourn until 2:30 and we will give the junior members latitude in asking questions this afternoon.

(Whereupon, at 12:20 p.m., the committee adjourned, to reconvene at 2:30 p.m., the same day.)

AFTERNOON SESSION

The CHAIRMAN. The committee will come to order.

At the time we recessed, we had just finished with the questioning by Mr. Sisk.

Mr. Bass, we will recognize you now.

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

Dr. Dryden, I believe you testified this morning that the reason why we were behind the Russians today in this space race was because we have not developed a booster as powerful as they have; is that correct?

Dr. Dryden. We are behind in this one element, yes, which has a profound effect upon our whole competitive position.

Mr. Bass. Am I wrong in assuming this is the principal reason?

Dr. Dryden. This is the principal reason. Not the only one, but the principal one.

Mr. Bass. If we had a booster as powerful as they have today, we would not be behind, would we?

Dr. Dryden. We would have to have the things which go with it, but we could do things which we cannot now do and we certainly could put weights in orbit which are comparable to the ones that the Russians have put into orbit.

Mr. Bass. In what other ways are we behind the Russians?

Dr. Dryden. We do not think that there is any other area in which we are particularly behind the Russians. All I meant to say was that you need more than the booster. You need the payload that goes with it and the means of exploiting the booster. It also takes time to get those things built.

Now, we have ample time to do that while the booster is under development.

Mr. Bass. Well, is it not fair to say that if we had a big booster, one as big as that of the Russians, that we would be at least equal to them in this space race?

Dr. Dryden. We think so.

Mr. Bass. Now, in your request for funds for this Saturn project, which is the big booster project, were you cut down at all in your request on this project?

Dr. Dryden. This is a little complicated situation because Saturn was a Department of Defense project. We did not ask for any money for the Saturn project. It was carried in the Department of Defense budget, an item of $140 million for this year.

Mr. Bass. Do you know how that request was handled in the Department of Defense?

Dr. Dryden. I do not know the details. Now, when the budget was submitted by the President to the Congress, an adjustment was made by which that $140 million was added on to the amount which we had requested; in other words, at the stage just before the big budget book came to Congress, an adjustment was made in the Bureau of the Budget between the budgets of the Defense Department and NASA to transfer this $140 million which had been in the Defense budget to the NASA budget, in anticipation of the transfer.

Mr. Bass. Do you know whether the original request was cut down by the Bureau of the Budget or any other agency?

Dr. Dryden. I do not know of my own knowledge.

Mr. Horner. It is my understanding that the $140 million was the amount the Department asked for the Saturn program, within the context of their overall budget, of course.

Mr. Bass. So both you and Mr. Horner, to your best knowledge, understand that this original request was not cut down?

Dr. DRYDEN. The original request of the Defense Department, so far as I know, was not cut.

Mr. BASS. Now, another very high priority project is the Mercury project; is it not?

Dr. DRYDEN. That is correct.

Mr. BASS. If we should be the first to put a man in space, orbiting around the earth, we would largely gain in this race with the Russians; would we not?

Dr. DRYDEN. We regard this as one of the space missions that has a spectacular aspect and popular appeal; yes.

Mr. BASS. Now, Dr. Dryden, how was your original request for funds for this project handled?

Dr. DRYDEN. We originally asked for $103,966,000 and we wound up by allocating $107,750,000 to Mercury.

Mr. BASS. Then you were given $5 million more than you originally requested?

Dr. DRYDEN. You see, the budget is not handled in that way. An overall amount is fixed and we come back with the proposal as to how this would be divided. The analysis of the Mercury program and needs led to the necessity, as we saw it, of putting a few more million dollars in the allocation for the project Mercury.

Mr. BASS. In other words, is it fair to say nobody cut the project?

Dr. DRYDEN. Nobody cut Project Mercury, that is correct.

Mr. BASS. In your opinion, if the Congress approves your fund estimates, would that enable you to go forward in the fastest way possible under the circumstances?

Dr. DRYDEN. That is correct. I think we testified before, we are depending on this $23 million 1960 supplemental in addition to this amount.

Mr. BASS. One other question, Doctor.

I believe you said earlier that the principal reason why we were behind the Russians in this space race was because they started earlier.

Dr. DRYDEN. That is correct.

Mr. BASS. How early did the Russians start?

Dr. DRYDEN. The Russians started—I am afraid I would have to look up the exact date—quite a while before we did. I think about 4 or 5 years, by setting up a commission on what they called the commission on interplantary communication.

They use the word "communication" in the very broad sense.

Mr. BASS. Roughly when was that?

Dr. DRYDEN. It was roughly 1954—I don't recall without looking up the date, and will correct it in the record.

Mr. BASS. Would it be 1954?

Dr. DRYDEN. My recollection is 1954. Mr. Horner's is 1952. My recollection is 4 years—their first formal step was 4 years before our formal step of passing the National Aeronautics and Space Act.

Now, in both countries there was interest of individuals ahead of these dates.

Mr. BASS. Didn't the Russians work rather intensively on a big booster long before 1954?

Dr. DRYDEN. The big booster situation developed as a result of the choices made in the development of the Soviet ICBM. This story has been told many times before. Their atomic bombs weighed consider-ably more than the ones which we later developed and they went ahead with the design of a very large booster to put this early bomb into their missile.

On the other hand, our first estimates of an ICBM called for the same very large booster and in fact about the same capacity as the present Russian boosters. However, by the time this was crystallized to an urgent program, the nuclear people, the Atomic Energy Commission, had developed bombs of lower weight for the same explosive power so we did not, as we saw it, need the same weight of booster for intercontinental ballistic missiles as was thought when the projects were first started.

Mr. BASS. Thank you, Dr. Dryden.

Mr. Chairman, I see I have used my 5 minutes. I have other questions, but I will withhold them.

The CHAIRMAN. You are not being cut off now because this morning some of the members consumed more than their 5 minutes. Mr. Karth.

Mr. KARTH. Dr. Dryden, the decision to develop the ballistic missile pretty much rested on the so-called breakthrough in the atomic energy field——

Dr. DRYDEN. The decision to give a high priority was certainly based on that. There was a project carried out at a slow rate before that.

Mr. KARTH. Before the breakthrough in the nuclear energy field, didn't most scientists agree that it would be rather difficult to develop a missile of the size and proportions necessary to carry the nuclear bomb as they knew it at that time?

Dr. DRYDEN. I think they felt that this was a very high weight for the result accomplished and the complications of the program were such that they were not enthusiastic about proceeding on a crash basis.

Now, I was not directly associated with these decisions. I don't know whether Mr. Horner cares to add anything or not.

Mr. HORNER. Well, the——

Mr. KARTH. Didn't most of the scientists at that time feel it was unfeasible to develop a missile because of the tremendous weight connected with the atomic bomb?

Mr. HORNER. The ICBM project at the time was a study which indicated that an operational vehicle, using payload weights that seemed to be necessary, and rocket engines that were under development, would probably need as many as 11 separate rocket engines. There were various configurations; 11 in one and 7 in another, as I recall.

This led to an extremely complex system, one in which it was difficult to engender much enthusiasm.

Mr. KARTH. After the 1952–53 breakthrough, there was the first indication at that time that a ballistic missile would be feasible because of the reduction——

Dr. DRYDEN. It was very practical then to get a weapon with three engines that were of the size then existing.

Mr. KARTH. So can we conclude, Doctor, that prior to that time, from a military standpoint, the missile had relatively little significance?

Dr. DRYDEN. At that time, as far as I can recall, there was no real interest in space. Space exploration was not a consideration in determining the size of booster which would be developed by this country.

Mr. KARTH. One other question, Doctor. What, if any, effect is the transfer of the Huntsville group going to have on morale, or did it have, when it was announced it would be transferred from the Army to the NASA? Was there any display of moral differences?

Dr. DRYDEN. To the best of my knowledge there has been some enthusiasm that they will now be free to turn their energies to space, a subject in which they have been interested, and I think some realization that now they will become a major element in the whole national space program.

Mr. KARTH. Does Dr. von Braun share that enthusiasm?

Dr. DRYDEN. I think so. He will be before you in the next 3 days and I suggest that you inquire.

Mr. KARTH. Thank you.

The CHAIRMAN. May I interrupt at this point to tell the members of the committee that we have arranged to have Dr. von Braun here Monday afternoon at 2 o'clock. Since he is coming up from Alabama, we will have everything in shape so we can get promptly to Dr. von Braun and not keep him here any longer than is necessary.

Mr. RIEHLMAN. Doctor, recently the President requested your Administration to make a study of your programs and to advise him as to what was necessary to speed them up.

Dr. DRYDEN. Yes, sir.

Mr. RIEHLMAN. Is that study underway?

Dr. DRYDEN. It is practically completed, but we expect that the results will be before you next week. I mentioned this this morning, sir.

Mr. RIEHLMAN. Has there been anything done in the administration to speed up these projects?

Dr. DRYDEN. One step that has been taken is to authorize overtime on the Saturn project.

Mr. RIEHLMAN. Are there people working overtime on this now?

Dr. DRYDEN. Yes, sir.

Mr. RIEHLMAN. Do you have the funds available to carry that out?

Dr. DRYDEN. The exact financing—that is, what specific appropriation this will come from is not identified at this moment, but we see our way clear on the funds, yes, sir.

Mr. RIEHLMAN. I am happy to know that because we are all vitally interested in that project advancing as fast as it possibly can.

Now, I would like to just make this comment. I followed your presentation this morning and also that of your associate, Mr. Horner, in outlining a very extensive and what I think is a progressive program for the next 10 years.

We all realize that there will have to be some adjustments in these programs as they move forward.

I am hopeful that you, as one of the top directors in the program, will not hesitate to tell this committee your actual position and what the plans are for your administration of these programs.

Now, a great many questions have been asked this morning with respect to the need for additional funds. I for one, want to see that you have every dollar that you need and which you can spend wisely and efficiently to promote this program.

I want to ask you this question. In the administration of your program this past year, up to the present time, in presenting your needs to the top echelon and through the Bureau of the Budget, have you been seriously cut in any respect, or your requests reduced in any major amount?

Dr. DRYDEN. I testified this morning about the amounts which we had requested and we do have the information here, but not in very good form.

I don't know whether the chairman wishes to take time to read this into the record now or let us give you a memorandum later.

The CHAIRMAN. How long is it, Doctor?

Dr. DRYDEN. Well, it is a whole complex of figures.

Mr. RIEHLMAN. Mr. Chairman, for the purpose of saving time, if it is too lengthy, I suggest we put it in the record.

Dr. DRYDEN. The numbers roughly were 957 requested—this is obtained by adding together 783 that NASA requested, plus the $140 million on Saturn, plus $34 million in a supplemental figure.

Mr. RIEHLMAN. What would the overall figure be then?

Dr. DRYDEN. As compared with the 957, we were allocated or allotted $802 million and there is still to come before you the requests resulting from this study for which I gave a "horseback" estimate of the order of $100 million.

Mr. RIEHLMAN. You will be back about to your original request?

Dr. DRYDEN. Certainly somewhere very close to the original request.

The CHAIRMAN. Will the gentleman yield?

Mr. RIEHLMAN. Yes.

The CHAIRMAN. You are $50 million short from the original request, roughly.

Dr. DRYDEN. It depends on the exact number that comes out of this study. I said of the order of $100 million. If it is $125 million or $75 million—I am just giving you a "ballpark" estimate of the order of magnitude.

Mr. RIEHLMAN. Of course, if your study reveals additional expenditures in some of these areas and projects that go beyond what you had in mind in your original estimate, then, of course, you would be short?

Dr. DRYDEN. Yes. I should be accurate about the studies. We have the raw material submitted from Dr. von Braun. We are in process this afternoon of reviewing this in some detail because we have to justify these numbers before your committee and we must get familiar with the background.

Mr. BASS. Will you yield?

Mr. RIEHLMAN. I will yield to Mr. Bass temporarily.

Mr. BASS. Dr. Dryden, the President's budget provides for $140 million for the Saturn's project?

Dr. DRYDEN. That is correct.

Mr. BASS. Just to make sure, I want to ask you and Mr. Horner again, in your opinion is that a sufficient amount for you to go——

Dr. DRYDEN. No; it is not and there is why you are going to get additional requests resulting from this study.

Mr. BASS. Do you know how much?

Dr. DRYDEN. I have said that in the super booster program it will be in the "ballpark" area of another hundred million dollars.

Mr. BASS. In the Saturn project alone?

Dr. DRYDEN. The Saturn, the F-1 engine, and the upper stages needed for use in the Saturn booster. They are programs that will be under the jurisdiction of the Huntsville facility and Dr. von Braun's program.

Mr. BASS. But that amount was not included in the original request?

Dr. DRYDEN. It was not.

Mr. RIEHLMAN. Is there any reason for that?

Dr. DRYDEN. I think the decision and the statement of the President that Saturn was to be accelerated was made in October after the budget material was entered.

Mr. RIEHLMAN. This is because of his request that these additional funds are being asked for?

Dr. DRYDEN. He stated publicly that he was going to accelerate the program and then he addressed a request, directing us to make a study of the additional funds that might be needed.

Mr. RIEHLMAN. Just one other question. As I followed the testimony, Doctor, if we once are able to have the thrust that is necessary to put a large satellite in orbit, we can then expect to use less sophisticated equipment; it will be less expensive for us to build and it will cut down our cost of operating this type of activity.

Dr. DRYDEN. At the present time we have to miniaturize to the extreme and reduce the weight in every possible degree to stay within the capacity of the vehicles we now have.

Mr. REIEHLMAN. That is very expensive, isn't it?

Dr. DRYDEN. It is expensive. I don't want to leave the impression that the payload for the Saturn is going to be inexpensive, because it is not.

Mr. RIEHLMAN. I recognize that, but I have read considerable about it and heard statements that it will be less expensive once we are able to put into orbit the satellite to carry heavy pieces of equipment.

Dr. DRYDEN. Less expensive per pound of payload. If you put it that way, I agree with the statement.

The CHAIRMAN. And more efficient?

Dr. DRYDEN. More reliable. You have to define efficiency.

The CHAIRMAN. Mr. Hechler.

Mr. HECHLER. Dr. Dryden, to summarize what we were saying this morning, you definitely believe we are in a space race with Russia. Is that correct?

Dr. DRYDEN. I have used the word "competition," distinguishing this from a specific event in which the other fellow is halfway down the track already.

Mr. HECHLER. You use two words, "our competitor" in defining Russia, which would indicate that we are certainly in competition?

Dr. DRYDEN. We are in competition over a very broad front. Space is one of those which is very important. We are competing in many other ways.

Mr. HECHLER. In that competition over a broad front, would you say that our international prestige is at stake in relation to what progress we make here in this country in that competition?

Dr. DRYDEN. I think you get a better assessment of this from witnesses you have already heard, those who are feeling the pulse of international public opinion. I have read the testimony of Mr. Allen. This is the judgment of an informed person in this area.

Mr. HECHLER. Well, we on this committee would like to help you as a dedicated official. We want to help your agency. We want to help Dr. York and all others in both the missile and space programs. I think when other officials occasionally say that our international prestige is not at stake, it is not helping you and I would like to see if we can do everything possible to help you.

Dr. DRYDEN. I can answer one within my competence. Our prestige among the scientists of other nations is very high, including the Russians. Among the scientists, for the scientific results of the space program, that is. This is not, of course, very familiar to the average citizen of another country. He isn't much interested in it; he doesn't understand the meaning of measuring more electrons, or Van Allen radiation belts. But you have heard from Mr. Allen of the U.S. Information Agency about the opinions expressed in newspapers and other mediums abroad and he is much more qualified to give an opinion on that than I am.

Mr. HECHLER. Thank you.

Mr. Horner, I would like to ask you one or two questions about your defense of the current administrative arrangements which you so ably set forth at the end of your testimony. I would merely like to raise a question about this sentence at the bottom of page 24 where you say, "When undesirable duplication is identified, it is eliminated."

I would say we certainly deserve to award you some kind of a medal as the all-time administrator in history, if you are able to achieve that.

However, I want to pin this down to a more specific question. It seems to me that the deliberation of committees, coordinating committees, liaison committees and other ad hoc committees, standing committees, sitting committees, reclining committees, has disturbed a number of people in this whole program. This has raised the question of whether an organization such as the Atomic Energy Commission, with a Military Applications Division, would not provide a more clear-cut leadership for the entire space and missile program? I would like to get your direct comment on that.

Mr. HORNER. There was one kind of committee, Mr. Hechler, that you failed to mention and I, perhaps, should have emphasized this morning. Of the committees that you see listed on the chart that I showed, they are almost without exception, working committees. I think this is a very useful method of coordination. It has been very successful in our experience thus far.

In support of my statement here to the effect that undesirable duplication is eliminated, I think we do have some cases that we can set forth, the most notable of which is the cancellation of the Vega program which we felt had become an area of duplication where we could usefully accommodate our requirements within the capabilities of the Agena vehicle which was being developed in the Department of Defense.

With regard to the analogy with the Atomic Energy Commission, I think this is a very difficult analogy to apply to the space business.

The whole area of nuclear development as it applies to the Defense Department has been largely one of weapons where the Atomic

Energy Commission has been given the direct responsibility for development of what you might call the end stages of the weapons systems in the Department of Defense; that is, the final explosive. This is in no way analogous to the situation that we have in space, where there has been a statement in the law, promulgated and passed by the Congress, for the desirability of a peaceful exploration of space for the benefit of all mankind, to be under the management of the civilian agency.

Mr. HECHLER. The progress which is made in the Department of Defense on its military work has a definite relationship and contribution toward our progress in space, does it not?

Mr. HORNER. It has a definite relation. It has in the past shown a tendency to have a positive and a negative relationship. The best example I can think of at the moment is the question we have been discussing here of the Saturn.

In the Department of Defense, as we have pointed out, the Saturn was supported at the rate for this coming fiscal year of $140 million.

Now, it was at that rate, not because this was what the project management stated as a need for the optimum development of the project, but because there was, in fact, no identified military requirement for the Saturn booster; and the management in the Department of Defense felt that was the proper rate at which to support a project that did indeed not meet an immediate military requirement.

Now, we do have a direct requirement for this in space exploration and it is because of this requirement in the space exploration program, that we have gone through this study of the real needs of the program to optimize its developments and as Dr. Dryden has pointed out, we will submit a recommendation to the committee here for augmentation of that program.

Well, that is the kind of an example that illustrates the possibility of a development project in the Department of Defense being influenced in a negative way, as far as the project is concerned.

Mr. HECHLER. What is accomplished in this program depends not alone on what you can do, what Dr. Dryden can do, what the other high officials, in fact, all the employees of your agency can do. It depends also upon an understanding and support by all of the American people.

I think there is a certain frustration among the people. It results in such questions as, "Button, button, who's got the button?" who is in charge here? On top of this comes the statement of the President at his news conference that our international prestige is not particularly at stake.

I think the combination of all these things creates the impression for the American people, the bad impression that we don't have a centralized, clear-cut leadership of this program.

I don't expect you to answer in detail these observations, but I merely wanted to throw them out as perhaps helpful observations which may eventually result, I hope, in more clear-cut leadership in this whole area. This is not meant in a critical way toward the gentlemen who have been testifying here.

Dr. DRYDEN. I think the changes in the legislation submitted were to make it quite clear that we had the "button" as you expressed it, in the area of space exploration, that the military had the button for exploiting the military uses of space, just as early as practicable.

Mr. HECHLER. Then what we really need is leadership at the top.

Mr. Chairman, that is all I have.

The CHAIRMAN. Mr. Chenoweth?

Mr. CHENOWETH. Dr. Dryden, going back to the question Mr. Riehlman asked a moment ago concerning the amount of money the administration is making available for the whole program, I am not quite sure I got your answer correctly.

What has been your position as far as funds are concerned? Have the space efforts been retarded in any way by lack of funds? Is there a failure of Congress to give you the money requested or have you had sufficient funds to carry on your objectives for the immediate future?

Dr. DRYDEN. We asked for funds for the program. We came fairly close. We said if what was given wasn't enough we would be back, and we are back for $23 million in fiscal 1960.

Mr. CHENOWETH. That will take care of you for this fiscal year?

Dr. DRYDEN. That is true.

Mr. CHENOWETH. I understand you are coming in with a request for another $100 million for Saturn.

Dr. DRYDEN. Roughly that order of magnitude.

Mr. CHENOWETH. Then it is reasonable to assume that perhaps during the next fiscal year you may be in at different times with additional requests?

Dr. DRYDEN. All I can say is if we think we need more we will be back.

Mr. CHENOWETH. I hope you do come back. I think it is the sense of Congress that we give you what you need to do this job.

I was anxious to know whether we had succeeded in that in the past. That is why I related myself to the question of Mr. Riehlman.

I wanted to ask you one further question concerning the Russian participation in the space program. I had the year 1948 in mind, in some connection, that that was when the Russians took over some of the German installations.

Dr. DRYDEN. I think that was when they took up the missile program.

Mr. CHENOWETH. What was it in 1948?

Dr. DRYDEN. I think that is when they started V–2's, which they had taken over from the German site at Peenemunde.

Mr. CHENOWETH. From 1948 on, have they been pretty active and diligent in pursuing the program?

Dr. DRYDEN. Very active.

Mr. CHENOWETH. What were the years of 1952 and 1954 that you mentioned a moment ago? What was their significance?

Dr. DRYDEN. This was when they set up at a high level within the government a commission whose duty it was to move ahead in space research and the corresponding action in this country was the passage by Congress of the National Aeronautics and Space Act which set up NASA.

In both countries there was activity among individuals before and activity in the missiles field before this time.

Mr. CHENOWETH. I wanted to make it clear then that the Russians were in before 1952. Would 1948 be the year?

Dr. DRYDEN. Just as we date our interests in space back to the time of Goddard, they date their interests back to the time of Tsiolkovsky.

When R. H. Goddard was working, nobody paid any attention to it. He was the first to use liquid-fuel rockets with the same fuels we are now using. But this was way ahead of the time when this was accepted.

Mr. CHENOWETH. These dates are interesting because there is a great deal of discussion as to just when we started and why we are behind the Russians, if we were.

That is all, Mr. Chairman.

The CHAIRMAN. Mr. Daddario.

Mr. DADDARIO. Mr. Horner, you are very happy, as I understand it, with the cooperation which exists between NASA and the Department of Defense.

Mr. HORNER. I have been quite satisfied with the performance thus far.

Mr. DADDARIO. If that is the case, why has it become necessary to switch the so-called Von Braun team from the Department of Defense to NASA? I can recall when people from your agency came before this committee last year and they were asked this question. They said that everything was going along very well and there was a wonderful spirit of cooperation between them. Yet apparently, because of the fact that that was not so, it has become necessary to make a transfer.

Mr. HORNER. This question, which you are all familiar with, of the transfer of the Von Braun team to NASA did come under very close scrutiny and consideration a year ago this last October or November.

At that time the technical people at the Huntsville agency were working on a program that was approximately 80 percent missiles and 20 percent space work. To transfer the team at that time would have required quite a displacement of project activity and it would certainly have been difficult to assure continuity in all of the very important military programs of the Department of Defense.

As a matter of fact, out of consideration for this very situation, we at that time proposed to take only a limited number of the Von Braun team. However, in the past year this situation has changed markedly. Whereas the work there now is developing to the point where it is more on the order of 80 percent space work, and primarily in the Saturn booster, which has its primary requirement in the space program, and 20 percent and in the very near future, it will still be less, in the missile program.

Now, you see we can take the transfer of the Von Braun team without this serious dislocation problem in the military missile program, and that is fundamentally the reason for the transfer.

It is just a streamlining of administrative procedures. We certainly could use the Von Braun team by contract arrangements through the Army. It is just a reduction of the overhead by having a direct relationship with it, rather than having to go through another agency.

Mr. DADDARIO. If that is the case, why did you ask for the whole Von Braun team in the very first instance? You didn't ask for just part of them in the first instance. It was only after you had had some kind of argument and dispute about it that you were willing to come to this agreement to have them coordinate with you.

Mr. HORNER. No, sir; you are mistaken. We only asked for about 2,200 people in the first instance, plus the contract with the California Institute of Technology, which employs the Jet Propulsion Laboratory.

After careful consideration of this with the Department of Defense, it was decided to only transfer the jet propulsion laboratory contract.

Now, the total number of people who are being transferred this year are more than twice the 2,200 people who were originally asked for.

Mr. DADDARIO. Then is it your statement here that in the very first instance, when you asked for certain of the Von Braun team, that you got all of the team you wanted?

Mr. HORNER. A year ago we didn't get any. There was none of the transfer effected last year.

Mr. DADDARIO. Didn't you ask for a transfer of some of that team?

Mr. HORNER. We asked for consideration of transfer of about 2,200, as I remember. Something less than half.

Mr. DADDARIO. What did you get?

Mr. HORNER. Nothing.

Mr. DADDARIO. Therefore, you did ask for at least some of the Von Braun team and got nothing?

Mr. HORNER. Indeed, we did, and, as I said, after very careful consideration of this problem with the Department of Defense, consideration of the dislocation problems in the military missile programs, we agreed with the Department of Defense that it would be inadvisable to transfer the Von Braun team at that time.

Mr. DADDARIO. It was that simple? There was no particular argument about it?

Mr. HORNER. These things are never simple, but as I said, NASA did agree that it was inappropriate to transfer the team at that time.

Mr. DADDARIO. And when the team was transferred from the Department of Defense to NASA, was that also done with full cooperation and no discussion about it?

Mr. HORNER. We have had very considerable discussion about it, and we have had excellent cooperation from all elements of the Army, from all elements of the Office of the Secretary of Defense, and we have had excellent cooperation from the Von Braun staff in itself.

Mr. DADDARIO. Was it General Medaris' position that the team ought to be transferred to NASA and that it was the time to do it?

Mr. HORNER. Yes, sir; and I think he has so stated.

Mr. DADDARIO. And you had his cooperation?

Mr. HORNER. Yes, sir.

Mr. DADDARIO. We are having General Medaris before this committee sometime, are we not?

The CHAIRMAN. I think so; later on.

Mr. DADDARIO. I direct you to section 309(a), the coordination-cooperation section. Who wrote that?

Mr. HORNER. That section actually was drafted in collaboration with the Department of Defense. It was largely drafted in a working meeting with the officials of the Department of Defense and the current language represents their modification of the joint drafting.

Mr. DADDARIO. You say "their modifications." To whom?

Mr. HORNER. There were certain word changes that were introduced by Department of Defense officials. Since our objective in that particular section was to insure not only the fact of no inhibition to the Department of Defense and their necessary activities in space, but also the appearance of it, we were most happy to take their suggestion as to what they felt was the best language to accomplish that.

Mr. DADDARIO. And then you say the Department of Defense, the Navy, Army, and Air Corps had representatives at the meeting that you have referred to, who participated in the language and presented suggestions for the changes?

Mr. HORNER. At that particular meeting, the representatives from the Department of Defense, I believe, were all from the Office of the Secretary of Defense. As I have mentioned this morning, I believe, at a later time and at the suggestion of the Office of the Secretary of Defense, we talked in some detail with officials of the Air Force because of their interest in the launch vehicle operation, and at still another time we had discussions with the Director of Research and Development for the Army, Mr. Morris, and Assistant Secretary for Research and Development of the Navy, Mr. Wakelin.

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

The CHAIRMAN. Mr. Van Pelt.

Mr. VAN PELT. No questions.

The CHAIRMAN. Mr. King.

Mr. KING. Mr. Horner, this morning you devoted some time in your prepared testimony to the delineation of the authority and activities of NASA, vis-a-vis the Department of Defense. You had a chart and went into some detail on that.

I wonder if we might pursue that just a little further. What I want to get into my mind as a layman is a rather clear picture as to where the authority of NASA ends and that of DOD begins, or vice versa, insofar as you find yourself jointly dividing up the general field of space activities.

Specifically, there are many activities in which you have joint interests. I realize DOD is concerned with that aspect of space activity which deals largely with our defense effort, broadly speaking, and that NASA generally is concerned with space, insofar as the field of peaceful exploration of space is concerned, and so on and so on.

Yet there are many areas which obviously overlap. Both NASA and DOD will have joint interest in one missile, perhaps, or they will benefit equally from one particular mission or project, such as navigation projects and space exploration and communications, and so forth.

And there will be many areas of research and investigation which would mutually benefit both NASA and DOD, such as tracking and data reduction operations in which you have joint interests.

So, could you again just briefly clarify in my mind where your line of division is with regard to these areas in which you have joint interests?

Mr. HORNER. Well, I think the things that fall clearly on one side or the other—you have identified very well, Mr. King, the military applications on the military side, the space exploration on the NASA side, together with civil applications. And then this morning I identified three areas of mutual interest. They were the space launch vehicle development and operations, because launch vehicles can be used quite frequently for both military applications and space exploration——

Mr. KING. Are you talking about boosters, your big rockets?

Mr. HORNER. Yes, sir.

Mr. KING. Titan, Atlas, Thor, and Jupiter.

Mr. HORNER. That is correct.

Another area, of course, is all of the background research and development which is of interest to both agencies and useful to both agencies. And then the third area is this area of applications; because, whereas there are a few applications that seem to be uniquely of interest to the military, and of no civil application, there are hardly any applications that one can think of today for civil uses that are not also of use and of interest to the military.

Now, in actually deciding responsibility for who is going to, you might say, be the executive agent for carrying out developments in the applications field, we have sat down with the officials of the Department of Defense—the cases are not very numerous, they are relatively few—and decided on the basis of talents that happened to be in the various laboratories on either side, the inclinations, the relative utility in the military or the civil side and on the basis of this, we decided that, for example, the passive communications satellite, that is currently under development, would be the responsibility of NASA whereas, the active communications satellite is the responsibility of the Department of Defense.

Now, this was influenced by such factors as a very healthy, imaginative group within the NASA that had done quite a bit of work upon erectable structures which is very important to the passive communications.

On the other hand, there had been a very low level of work in the NACA, which represents a large part of the NASA staff, on electronics, and the electronics work had been very largely carried out under the responsibilities of the Department of Defense. So this made the active satellite fit very nicely into the Department of Defense.

Well, you see, it is on the basis of these kinds of determinations that decisions were made as to which responsibility would rest on which side.

Mr. KING. All these historical patterns entered into your decisions and in some cases you have to just arbitrarily allocate to one or the other. Is that right?

Mr. HORNER. It certainly has some appearance of being arbitrary, but in almost every case, there has been good background reason for making the determination one way or the other. And then after the determination is made, we do have working people in both the Department of Defense and in NASA with joint interest in the programs so we are kept immediately up to date on the progress that is made and on possible applications in each area.

Mr. KING. What about, for example, your navigation missions, on which we have had a briefing, I believe, already this week, having primarily military but ultimately tremendous civilian application also?

Mr. HORNER. The Department of Defense has an active navigation satellite development program. We have an interest in it. We have people who work with the Department of Defense, who keep up to date on the activity over there. The determination to put it in the Department of Defense was simply because it was much more important to the Department of Defense or had the appearance of being much more immediately important to the Department of Defense than it did to civilian application.

Mr. KING. When it gets into a larger civilian application, will the military still administer that program?

Mr. HORNER. Well, of course, the navigation satellite is something that is a little bit unique in its own respect, in that the airborne elements that are useful to the Department of Defense will very likely be useful to anybody else who wants to use it also. And so it is entirely possible that in this particular case, the net result will be a navigation satellite that is useful not only to the military, but for civilian applications, too.

There have been some questions as regards security, requirements for tolerances, how closely one must be able to navigate to a given spot on earth, for military versus civil applications, but these kinds of questions can be fairly easily accommodated with rather modest changes in the hardware and we have not yet determined that we will at some point need to have a development of a civil navigation satellite. But under any circumstances we will be able to make great use of the hardware that has been developed in the military program.

Mr. KING. Well, that gets to the heart of my problem. Where a project starts out clearly military, because of certain military exigencies of the moment, but where ultimately its greatest application will be in peaceful fields, rather than those of the military, do you contemplate that there will be a shifting from DOD to NASA?

Mr. HORNER. Assuming the military requirement was real in the first place and was proven to be so by the development, it would be more a case of our peeling off a civil adaptation of the development, rather than shifting responsibility from one agency to the other, because I presume there would continue to be a military requirement.

Mr. KING. I see. We have mentioned navigation. Communications, I imagine, would be really your big field. We have been told in glowing terms just how communications will fit into the future of transmitting radio waves and TV, of course, all over the world.

Now, eventually, will that broad dynamic program be administered by NASA?

Mr. HORNER. If there is a successful communications satellite system resulting from the development programs, I am sure that the military will have a continuing interest in it and we will undoubtedly also have an interest in it. To the extent that any communications system established by the military is not satisfactory for civilian uses, we will take from their developments those hardwares that are needed for a civil system and engineer such a system.

Today there are protagonists for the active satellite system and for the passive satellite system. Frankly, we don't know which is the best system for commercial or industrial applications. It may be a combination of both. And if that appears to be the case, then we will use both.

Dr. DRYDEN. May I make a remark in this connection? In the use of a navigation satellite for civil purposes, there is a very high premium on low cost of the equipment in every ship or other group that wants to use the satellite data. This is not a consideration in the military application of navigation satellites. In military application, if you can get a very high degree of accuracy, you are willing to put a lot more money in the equipment on, say, naval vessels, than would be practical on a system of value to every owner of a small boat, for example.

Mr. BASS. Then you are saying as of now it would have more use to the military than to the civilian?

Dr. DRYDEN. We have no active program. We have some feeling that in the long run that the equipment needed for this will be so small in weight that it can be tacked on, just as an extra load, on some of the other satellites that we fire.

Mr. KING. May I pursue this just a moment further?

You mentioned a minute ago, Mr. Horner, background material, or background research. Do I understand from that that NASA and DOD have worked out between themselves the arrangement that NASA shall take over as its prime responsibility the very, very basic background research for both of them?

Mr. HORNER. Certainly not. No, sir; I am sorry if I left that impression. We are both interested in each others programs. We both have what I might call areas of excellence wherein historically a laboratory has specialized in a particular narrow technical area. The products of laboratories on both sides are useful to both programs. I am sure they will continue to be so.

Mr. KING. Do you collaborate as you go along so each one knows what the other is researching so that you will not find yourself in a position of having two teams working on the same bit of basic research?

Mr. HORNER. We collaborate, but sometimes it is desirable to have two teams or even more than two teams working on a research area. Two teams usually means two different approaches and it is fundamental to research that you don't know what answer you are going to get when you start it, or you shouldn't be doing it.

Mr. KING. That is true, but suppose one team comes up with the answer and the other team doesn't know about it and goes on and wastes a lot of valuable time. Then the collaboration becomes important.

Mr. HORNER. We spend most of our time correcting the communications problem which is always a problem, but the dissemination of information is very important to us and we think we are doing pretty well at it.

Mr. KING. Then there is a certain degree of validity in your arrangement here. It depends upon constant collaboration and working it out as you go along. Is that right?

Dr. DRYDEN. At all levels of the organization.

Mr. KING. Fine. I appreciate that.

May I ask one question of Dr. Dryden about the authorization bill? I notice on the first page, under "A," you have "Salaries and expenses," but no specific figure is mentioned.

Under "B," "Construction and equipment," you do have the specific figure of $89-plus million and that is broken down into 1 through 9. Then you get to "C" on page 3. You have "Research and development" and again no specific figure is mentioned, although Mr. Horner gave us the three figures this morning on the pie chart, showing us the division.

I am curious why the three figures are not specifically mentioned under the A, B, and C categories, respectively.

Mr. HORNER. This is proposed authorization legislation and it was left in that condition specifically because at the time it was submitted we had this study active, which we have discussed earlier, and although we had the numbers that pertained to the $802 million total, we recognized we would want to amend those numbers and thus we left them open at that time.

As Dr. Dryden mentioned this morning, we hope to correct that within the next week.

Mr. KING. Well, then, when this bill is submitted to Congress, those three figures will be inserted. Is that correct?

Mr. HORNER. Yes, sir.

The CHAIRMAN. I think the committee will probably insert them; all right.

Dr. DRYDEN. I think the committee will probably insert them. I might point out that the effect of leaving this open would permit prompt action on supplemental appropriations without the necessity of new authorizations during that year.

Mr. HORNER. Mr. Chairman, if I may I might point out one thing Mr. King has called to our attention and that is the fact that a number was included there on the construction and equipment and that number undoubtedly will be changed.

The CHAIRMAN. When this bill came to me it did not have those figures inserted. The question was whether we would hold them up until we could get the figures, or put in a bill without the figures which could be considered by the committee and later amended.

I think I know what the committee probably would want to do.

May I ask you this, Doctor? Why doesn't the F–1, which is the big engine project for 1½-million-pound thrust, with a single chamber engine, why doesn't it have a top DX priority?

Dr. DRYDEN. Merely because it is further in the future and there is more time available on that. We think it will make satisfactory progress without that if we can get sufficient money into it.

The CHAIRMAN. We are going to wake up some day and find ourselves with the F–1, which is our offset to a larger booster of the Russians, in the same shape we are now in with the big booster that the Russians have and we don't.

Dr. DRYDEN. I don't think we have the knowledge at the moment to proceed with an accelerated program on a Nova vehicle. This is quite a jump beyond the Saturn and it will be either next year or the following year that we will begin the development of a vehicle for the F–1 engine. And the current time scale, with somewhat more funding we hope to get on it, will meet this without the necessity of a DX priority.

The CHAIRMAN. Doctor, didn't NASA actually ask for a DX priority for the F–1 program?

Dr. DRYDEN. I do not recall that we ever did.

The CHAIRMAN. I had some information somewhere that that was requested by NASA. You are sure it was not?

Dr. DRYDEN. It may have been considered at the same time that Mercury was put in for DX priority and, if so, there was no formal request transmitted.

The CHAIRMAN. Why wasn't Saturn considered for peaceful use as well as military use?

Dr. DRYDEN. It was.

The CHAIRMAN. So it has a joint use?

Dr. DRYDEN. That is true.

The CHAIRMAN. Now, all of these programs, it seems to me, have a joint use. Is that not true?

Dr. DRYDEN. They do. The only difference is perhaps in the time scale as to when they will be more urgently needed. We need the Saturn right now.

The CHAIRMAN. As I read H.R. 9675, we would try to decide now which is military and which is peacetime and it seems to me they both have peacetime as well as military application.

Dr. DRYDEN. Which bill are you referring to now, sir?

The CHAIRMAN. H.R. 9675.

If that is the case, we are proceeding to dub one program as a military program. On the other hand, we designate another as a peacetime program, when the program themselves have either use or joint use.

Dr. DRYDEN. I have caught up with you now, Mr. Chairman. You are referring, I think to section 309(b).

The CHAIRMAN. Subsection (b) is one of the subsections, but there are several of them there.

Dr. DRYDEN. This merely provides that the President shall decide which agency shall develop a specific new booster. There is no implication in that selection as to whether it is military or civilian. It is developed for joint use.

The CHAIRMAN. May I respectfully refer you, Doctor, to section 309(a) which says:

> Nothing in this act shall preclude the Department of Defense from undertaking such activities involving the utilization of space as may be necessary for the defense of the United States.

So all through the bill there is the thought that you can separate these projects from peacetime and military uses. I don't believe you can.

Dr. DRYDEN. I think the next section, sir, is a qualification of 309(a). It says that—

> The development of each new launch vehicle, whether intended for use by the Administration or the Department of Defense or both, shall be assigned by the President to either the Administration or the Department of Defense.

I take that to mean that neither the Department of Defense nor NASA can develop a new launch vehicle without the specific assignment of responsibility by the President.

The CHAIRMAN. Well, that gives the President the authority, that is true, to designate the Department; but the idea that is there is that he would make designations of one project to the military department because it is a military proposition, and to NASA because it is peacetime.

Dr. DRYDEN. This was not the idea. The idea was to determine which should be the development agency, regardless of the end use.

The CHAIRMAN. So there is no intent in this bill to try to separate the usage of these projects.

I think it would be bad if we got into this position, as we did, for instance, with TVA. When I came to Congress, TVA was under the jurisdiction of the Armed Services Committee because, originally, it was handled by the Army Engineers and they did a good job in working on it. But as time went on, it had no place in the Armed Services Committee and it was dropped out.

I would think this: If we try to designate the ultimate usages of the projects, we will get into trouble if we designate on that basis.

Dr. DRYDEN. It designates only the developing agency regardless of the use and it is a restriction on both NASA and the Department of Defense insofar as freedom to go into these multihundred-million-dollar projects is concerned for new booster vehicles.

The CHAIRMAN. Any further questions?

Mr. FULTON. Yes.

The CHAIRMAN. Mr. Fulton.

Mr. FULTON. I think the chairman has a good point there. I would add to it by saying I don't think we should attempt ahead of time, by statute, to make jurisdictional distinctions which will not hold up.

I would like to clarify one or two things for Mr. King. I would say the communications projects generally are being assigned from the Advanced Research Projects Agency of the Department of Defense to the Air Force because the Air Force is already working on the Agena-B, the upper level booster if you want to call it that, for the Discoverer, the Samos and the Midas. That was done November 17, 1959.

Then, on the navigational program, Transit, as well as Notus, the communications system, they are intended to be transfered to the Air Force by the end of this fiscal year, before June 30th.

The point I am making is that defining is merely a matter of convenience at this particular time in the development of the programs.

I would like to agree with the chairman thoroughly that it is not a division of jurisdiction.

For example, within ARPA there will still be left programs such as the Shepherd program. There will still be left the Defender program. There will be the basic materials program, Pontus, and you can't by any stretch of the imagination say that is done on a jurisdictional basis.

Or, for example, if you look ahead even to this project Vela for the handling of the atomic explosions surveillance, that is being left under ARPA, but I can see that it could be under some other agency completely, maybe the Atomic Energy Commission.

Dr. DRYDEN. If I understand you, Mr. Fulton, you are saying it is impractical to write into legislative language a split which would have validity as you go down the road?

Mr. FULTON. That is right, and I hope that you people, simply because this project Principia—the development of these solid propellants—is left in ARPA, that you do not think that that is an exclusive jurisdiction in ARPA, but that you likewise should keep on going on boron and various——

Dr. DRYDEN. May I correct one statement I made, Mr. Brooks? I am told we did ask for DX priority on the F-1 engine.

The CHAIRMAN. I thought you had, sir.

Mr. FULTON. Let me say on my last question, do you agree with the general principle the chairman and I are enunciating here that it is not a matter of jurisdiction but it is a matter largely of the best place——

Dr. DRYDEN. To apply the talents.

Mr. FULTON. Yes. It is the best place—at the particular time in the various programs—either to combine them or to put them under one administration because they are allied at a particular juncture. Not that there is a jurisdictional giving up of anything by, let's say either yourselves or the DOD, or the Atomic Energy Commission, or this committee.

Do you agree, Mr. Chairman?

The CHAIRMAN. That is right. I certainly agree fully.

Doctor, may I ask you then, since you say that you did ask for a DX priority for the F-1 project, you were turned down, weren't you?

Mr. HORNER. We raised this question with the Department of Defense about a year ago. I think it was in February. This was the mechanism for initiating discussions both with the Department of Defense, the contractor, and the Department of Commerce.

After a rather extensive analysis, we were persuaded—and we now agree—that a DX priority would not accelerate that project.

It was and is at a point in its development cycle where it does not have large demands for materials that are in short supply, which is the main area of application of a DX priority rating.

The CHAIRMAN. When you made the request though, it was in shape where you could have speeded it up at that time; is that it?

Dr. DRYDEN. This was a debatable point. As I explained earlier, the effect of the DX priority is to put you on the list to get materials which are in short supply at an earlier date. It turned out upon examination of what was required for this engine that there was not very much material in that class.

The CHAIRMAN. In other words, you made a mistake in making the request?

Dr. DRYDEN. It turned out to be unnecessary.

The CHAIRMAN. Are there any further questions?

If not, gentlemen of the committee, we have here Dr. Silverstein, who has a statement prepared and ready for delivery.

Now, is it the pleasure of the committee to take it up this afternoon or take it up in the morning? Would you rather proceed, now, Doctor

Dr. DRYDEN. It will take about 30 minutes, probably.

The CHAIRMAN. I hope you gentlemen on the committee will stay with the chairman now and hear the good doctor because he is a very able scientist.

I don't want his statement wasted here by not having full attendance of the committee.

Mr. DADDARIO. I have the full support of this end.

The CHAIRMAN. Doctor, we will be pleased to hear from you now.

Doctor, just a moment. We are swearing in all the witnesses now and we will ask you, if you will, to raise your right hand.

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

Dr. SILVERSTEIN. I do.

STATEMENT OF DR. ABE SILVERSTEIN, DIRECTOR OF SPACE FLIGHT PROGRAMS, NASA

Mr. Chairman, in testimony before the Congress a year ago, the NASA made a detailed technical presentation of the scope of its proposed space program. At that time we had only existed as an agency for a few months. Much of our discussion, therefore, dealt with future rather than current programs.

We have now had over a year of operating experience. In this period we have made an aggressive start on the space program that we described last year. We have already achieved certain scientific goals. We have clarified other areas so that we can now plan our experiments with greater certainty. In the light of our experience, we have been able to sharpen, and in some cases redefine our objectives.

I should like to take this opportunity to review our space flight attempts and accomplishments during the past year and to indicate to you our plans for the next several years.

During calendar year 1959, the NASA attempted 16 major vehicle launchings for various missions in the space program. This chart lists these launchings in chronological order (fig. 25).

This shows our 16 flights with the successful flights in heavy black and the unsuccessful flights shown in gray. We had, as you can see from the listings in gray, our share of unsuccessful launchings. This,

MAJOR NASA LAUNCHINGS
CY 1959

FEB 17	VANGUARD II	SATELLITE
MAR 3	PIONEER IV	LUNAR PROBE
APRIL 13	VANGUARD	
JUNE 22	VANGUARD	
JULY 16	JUNO II	
AUG 7	EXPLORER VI	SATELLITE
AUG 14	JUNO II	
AUG 21	LITTLE JOE	
SEPT 9	BIG JOE	MERCURY SUBORBITAL
SEPT 18	VANGUARD III	SATELLITE
SEPT 24	ATLAS ABLE	
OCT 4	LITTLE JOE	MERCURY SUBORBITAL
OCT 13	EXPLORER VII	SATELLITE
NOV 4	LITTLE JOE	MERCURY SUBORBITAL
NOV 26	ATLAS ABLE	
DEC 4	LITTLE JOE	MERCURY SUBORBITAL

FIGURE 25

we feel, is to be expected at the present state of the rocket vehicle art. We have in each case been able to determine the probable cause of failure and have taken corrective action in subsequent flights. The ratio of successes to failures has increased as the year progressed, and we have every cause to expect our future flight schedule to show an increasing percentage of successful flights.

Let me review each of our launchings for you.

On February 17, a Vanguard rocket placed a satellite into an elliptical orbit. The launch was completely successful. The instrumentation worked as planned and the data transmitters operated longer than was anticipated. The satellite contained two photocells to measure cloud cover over the earth. A wobble occurred in the satellite spinning motion during the launch, however, so that the interpretation of the data has, thus far, been difficult. Analysis is still underway.

On March 3, a Juno II vehicle launched a conical 13.4-pound payload past the Moon and into a virtually perpetual orbit around the Sun. The payload, known as Pioneer IV, yielded excellent radiation data during the more than 82 hours that it was tracked to a distance of 407,000 miles from the Earth. It now courses through space as a new satellite of the Sun.

In the next 4 months we had no successful launches. Two consecutive Vanguard launchings failed. On April 13, there was a failure during second stage separation. This caused the second stage to tumble and led to an impact of the payload only a few hundred miles off Cape Canaveral. On June 22, a regulator on a helium pressurization line failed. This flight also terminated only a few hundred miles from launch as a result.

On July 16, a Juno II vehicle had to be destroyed only 5½ seconds after launch when there was a failure in the guidance power supply. This was the same type of vehicle that performed so well in the Pioneer IV shot.

The Thor-Able vehicle successfully launched the Explorer VI satellite on August 7. This payload weighed 142 pounds and was placed in a highly elliptical orbit extending to more than 26,000 miles from the Earth. This was the most complex payload yet launched by the United States. Fourteen scientific and technological experiments were conducted in this one mission (fig. 26).

On August 14, we experienced another failure with a June II vehicle. The payload, a 12-foot-diameter inflatable sphere designed to measure air density at extreme altitudes, was plunged into the mid-Atlantic after launch when the altitude control system for the upper stages malfunctioned.

A week later, our first test firing of the Little Joe rocket in support of Project Mercury was aborted when the escape rocket on the capsule mockup fired 30 minutes before scheduled booster launching. The Little Joe booster rocket itself was left undamaged on the pad. The separation rocket malfunction was traced to a wiring error.

A little later during the next presentation—I suppose that will be tomorrow—we will have a movie showing some of the Little Joe firings.

On September 9, a very successful firing was made for the Mercury program when an Atlas booster, known as Big Joe launched a boiler-

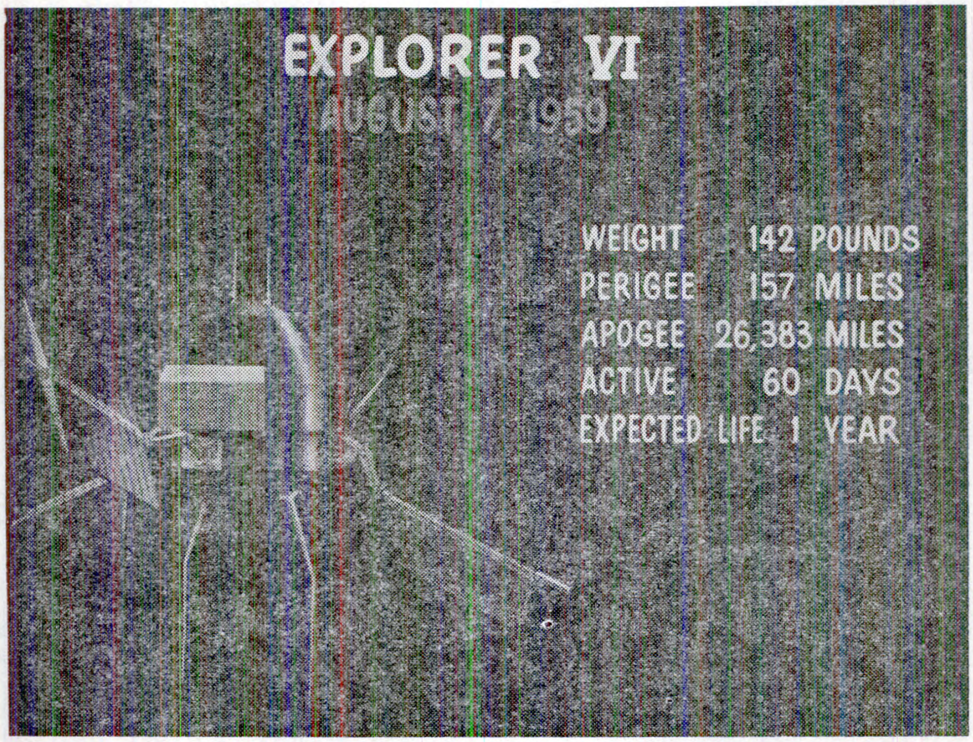

FIGURE 26

plate Mercury capsule into a ballistic trajectory downrange from Cape Canaveral. Although there was some malfunctioning of the booster, thereby exposing the capsule to more severe reentry dynamic conditions than had been planned, the capsule came through with flying colors. So successful was the experiment, in fact, that a second, similar test was eliminated from the Mercury program (fig. 27, p. 246).

On September 18, the last Vanguard rocket, with an alternate third stage solid rocket motor, placed a 50-pound scientific payload into an elliptical orbit. Much valuable scientific information was obtained from the multiple instrumentation. This launching was the third successful launching with the Vanguard vehicle (fig. 28, p. 247).

We were scheduled to make yet another launching during September. An Atlas-Able vehicle was to place a payload in orbit around the Moon, but during a static firing of the booster on September 24 the booster was destroyed by a fire and explosion.

On October 4, the Little Joe booster system for Project Mercury was successfully tested. In this test the rocket was topped by a dummy nonseparating capsule and escape tower. The launching and flight were completely successful in producing the desired information on the integrity of the booster system, including the launcher and the destruct system (fig. 29, p. 248).

On October 13, a Juno II vehicle made another successful launching of a satellite known as Explorer VII. This payload, weighing 91.5 pounds, contained five separate scientific experiments and was a duplicate of the payload that failed to go into orbit during the August 14 launching. The transmitters are powered by solar cells and are still in good active working order. The transmitters will be shut off

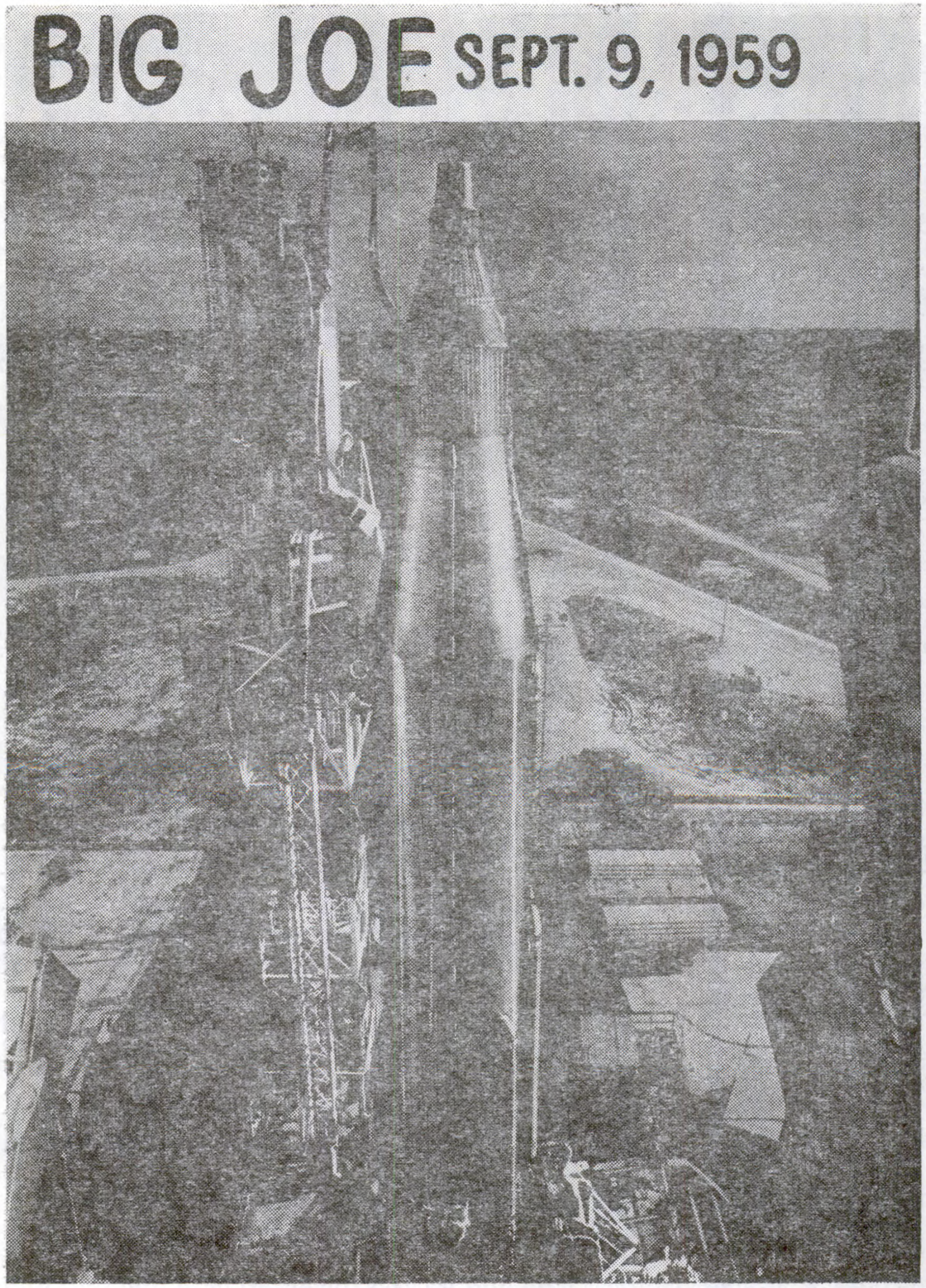

FIGURE 27

after a year of operation, although the satellite is expected to remain aloft for at least 20 years (fig. 30, p. 249).

A second, successful Little Joe firing was accomplished on November 4. It was our objective in this test to evaluate the escape system during a simulated abort at maximum dynamic pressure conditions. The separation of the capsule and recovery was excellent. The capsule was recovered by a Navy fleet tug about 45 minutes after launch. A post-test evaluation indicated that the escape rocket ignition was

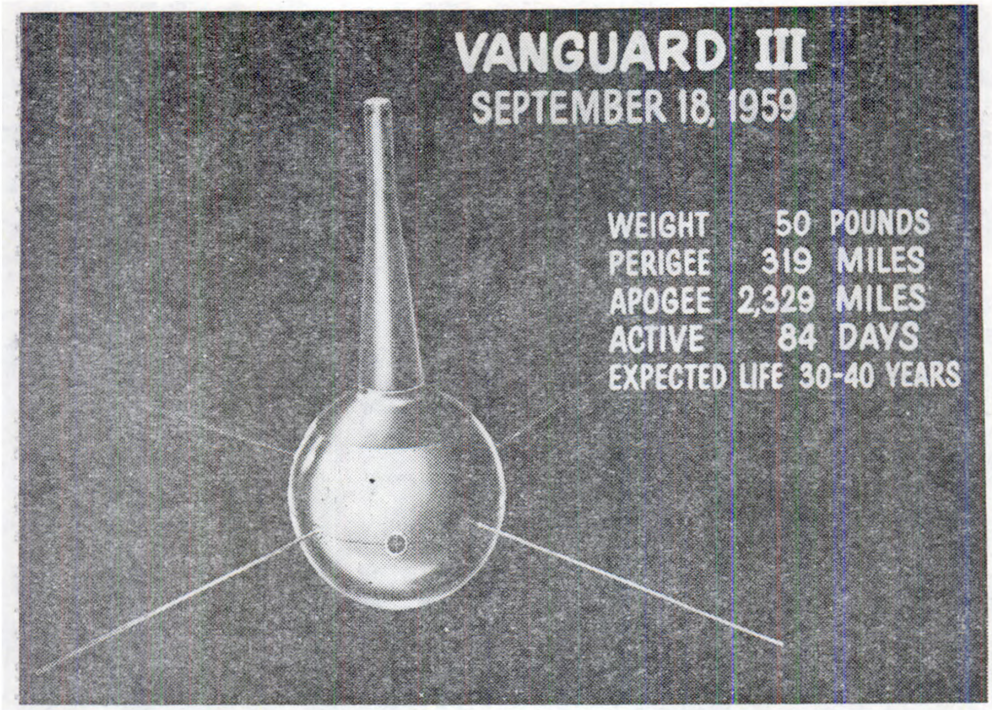

FIGURE 28

delayed a few seconds, so that dynamic pressure at separation had fallen from the anticipate value. Thus, the test, although successful in all other respects, was not as severe as desired. A later successful test was, therefore, made on January 21 to reevaluate this critical point.

On November 26th we suffered a disappointment when a second Atlas-Able lunar orbiter failed during the launch phase. There was no booster difficulty on this flight. Rather it was determined that the fiberglas shield around the payload came off during an early phase of the flight. This led to premature payload separation from the vehicle.

We ended the year with a third successful Little Joe firing on December 4. On this test we planned a simulated abort, or separation of the capsule, at 100,000 feet altitude. This was completely successful. The capsule coasted to 278,000 feet before reentering the atmosphere. It impacted about 177 nautical miles from the launch point at Wallops Island, Va., and was recovered within 1½ hours by a Navy destroyer that was about 25 miles from the impact point at the time of landing. As you probably all know, the capsule contained a biopack with a monkey enclosed. The monkey was in excellent condition upon recovery and still remains so.

The NASA flight record during 1959 shows that we now have underway the start of a sizable, significant space program. You will observe that during the first 6 months of the year we attempted only four launchings, and only two of these were successful. During the last half of the year we increased our tempo to 12 firings, and 7 of these were successful.

I should also like to point out that in addition to the major vehicle launchings shown here, we made seven sounding rocket scientific

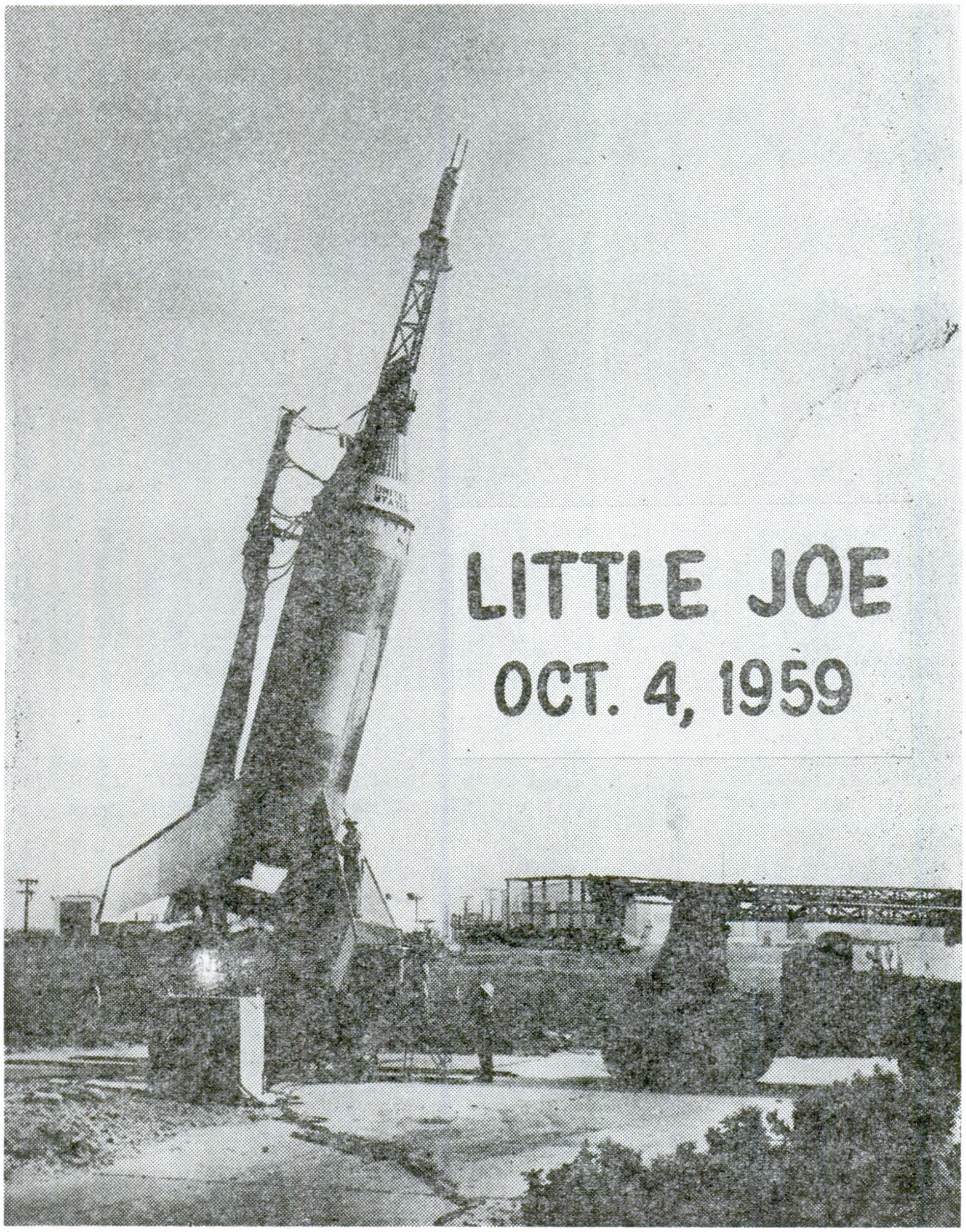

FIGURE 29

flights in the last half of 1959, and a number of sounding rocket development flights.

The pace that we have established will accelerate in the near future. This chart summarizes our planned schedule of Earth satellite firings for the next several years. I should like to point out that only major vehicle flights are shown here. The scientific missions will be supplemented by a sounding rocket program that will rise to and level off at a rate of about 100 to 120 firings per year. This will be about the level established during the IGY by the United States (fig. 31).

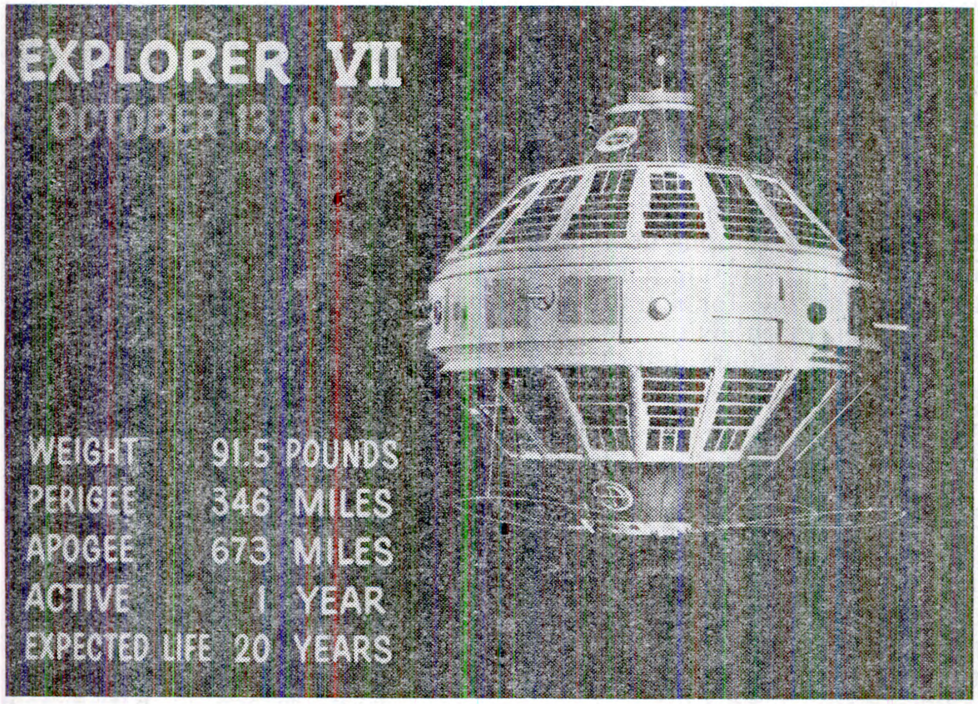

FIGURE 30

EARTH SATELLITE MISSIONS

FY	1960		1961				1962	1963
Q	3	4	1	2	3	4		
JUNO II	S		S	2S				
THOR-ABLE	M							
SCOUT		S	S	S	2S		5S	2S
DELTA		C	M	S	S	C	C 3S	
THOR-AGENA B							2M S	S
ATLAS-AGENA B								C 2S

S-SCIENTIFIC

C-COMMUNICATIONS

M-METEOROLOGICAL

FIGURE 31

During the next year we will complete that part of our scientific satellite program that uses the Juno II launch vehicle. The payloads will all contribute to a further understanding of the energetic particle distributions and of the ionosphere.

The Scout vehicle will also become available during 1960. The initial firings will be primarily concerned with verification of vehicle performance, and hence will carry minimum scientific payloads. As the vehicle development is proven, it will become an increasingly important part of our science program. It will eventually be used in this time period for a number of scientific satellites as well as near-space probe missions.

The Delta vehicle will also become available in the near future. A subsequent witness will present technical performance data on all these vehicles. Suffice it to say at this point that the Delta will give us a satellite capability several times larger than any we have flown to date.

In fiscal year 1962 we expect to add Agena vehicles to our stable of boosters. This was mentioned earlier by Mr. Horner.

The greater capabilities of these vehicles, now under development for Air Force programs, will enable us to incorporate improved instrumentation, both in type and in sensitivity, into our scientific program to give us an increasing insight into the scientific phenomena that are the objectives of this phase of our overall program.

The number of phenomena that we are concerned with is large. Consequently the number and variety of scientific payloads must assume the proportions you see here if we are to obtain a comprehensive understanding of that part of space fairly near the Earth.

We will, in these flights, variously measure atmospheric and ionospheric properties, energetic particle distributions, and magnetic and gravitational field distributions. We already know that some of these phenomena are variable and are affected by a number of external factors such as the Earth's latitude, seasonal changes, solar activity, and so forth.

To evaluate all these factors, it will be necessary to launch our vehicles along various flight paths. Some will be vertical probes to several thousand miles. Some will fly in nearly circular orbits several hundred miles above the Earth; others will be launched on highly eccentric orbits extending as much as 100,000 miles from the Earth at apogee. Some will fly at low angles to the equator, others will be launched in polar paths.

The very nature of the instruments that we fly, further adds to the picture. Certain instruments must operate in a nonmagnetic field and hence cannot be combined with some others that must be made of magnetic materials. Some instruments designed to measure certain phenomena would be saturated and rendered inoperable by very high particle strengths—these cannot be flown in the highly elliptical orbits that pass through the great radiation belt.

When we consider all of these factors and consolidate our findings, we arrive at a scientific satellite program such as shown in the chart.

All of our Earth satellites will not be making purely scientific measurements of the properties of space about the Earth. We shall also be launching a smaller number of satellites in the next several years to directly utilize space for man's benefit.

As you will note, the scientific experiments are in blue. In green are shown the communications experiments and in red, the meteorological.

This spring we shall launch our first payload specifically designed for the acquisition of meteorological data. Known as Tiros, this satellite will be launched by a Thor-Able vehicle (fig. 32).

A second version of the same payload, with additional sensing equipment, will be launched in early fiscal year 1961 using a Delta vehicle. By 1962 it will be possible to launch a more advanced meteorological satellite known as Nimbus. This will contain more instrumentation than Tiros and will be stabilized so that the sensors will point at the earth throughout the flight path (fig. 33).

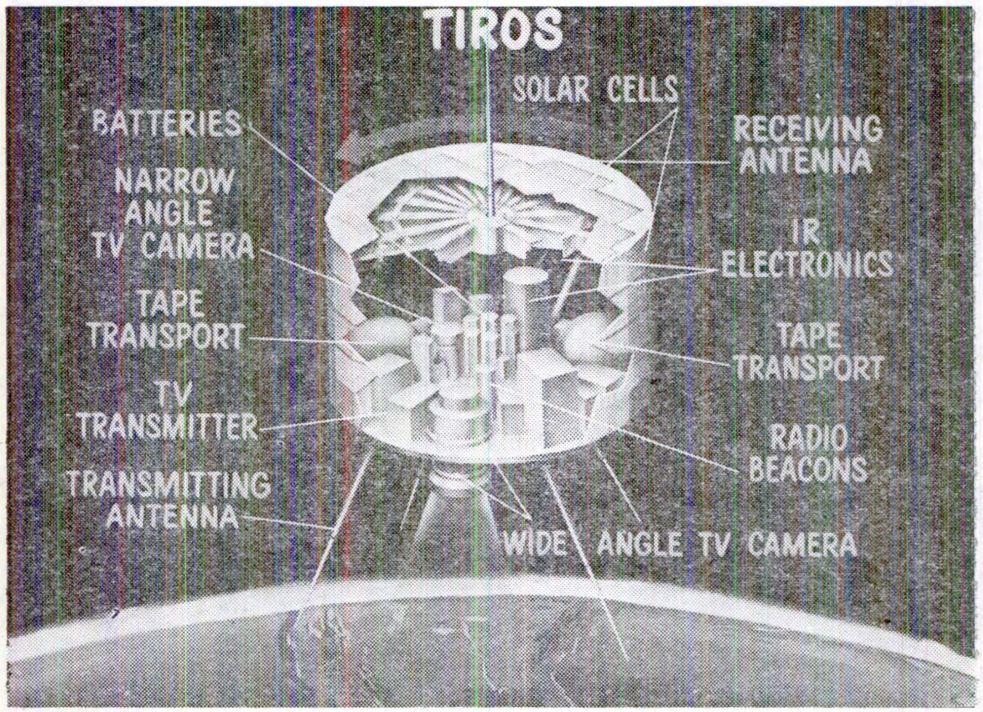

FIGURE 32

Before the end of this fiscal year we will also launch the first of our passive communication experiments known as Project Echo. The very thin aluminum-coated Mylar 100-foot sphere will be used to reflect radio signals from one ground transmitting station to other ground receiving stations. We expect to make a number of such launches to develop the techniques and technologies in this area. We have already made two nonorbital launchings of the spheres from Wallops Island, Va., to evaluate such technical considerations as its separation and inflation (fig. 34).

I should like to caution you that neither the meteorological nor communications experiments in the next several years should be considered as an early approach to an operational system. These are experiments aimed at furthering the science and technology in these areas. Operational systems will come later and only after the problems have been identified and solved.

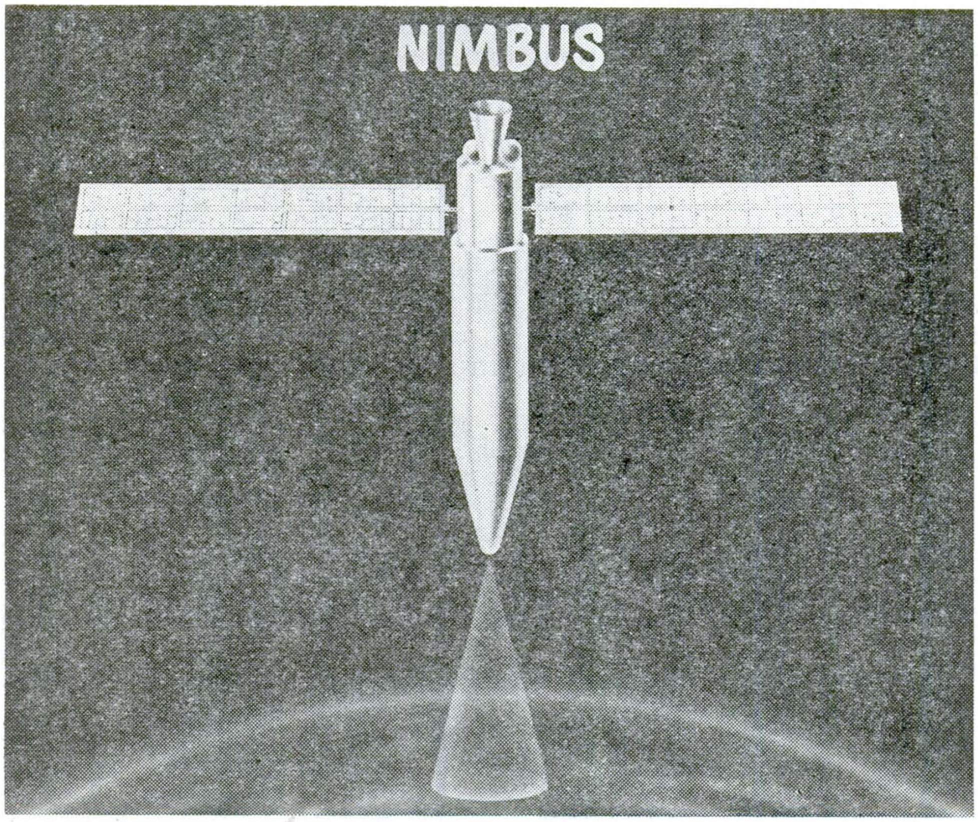

FIGURE 33

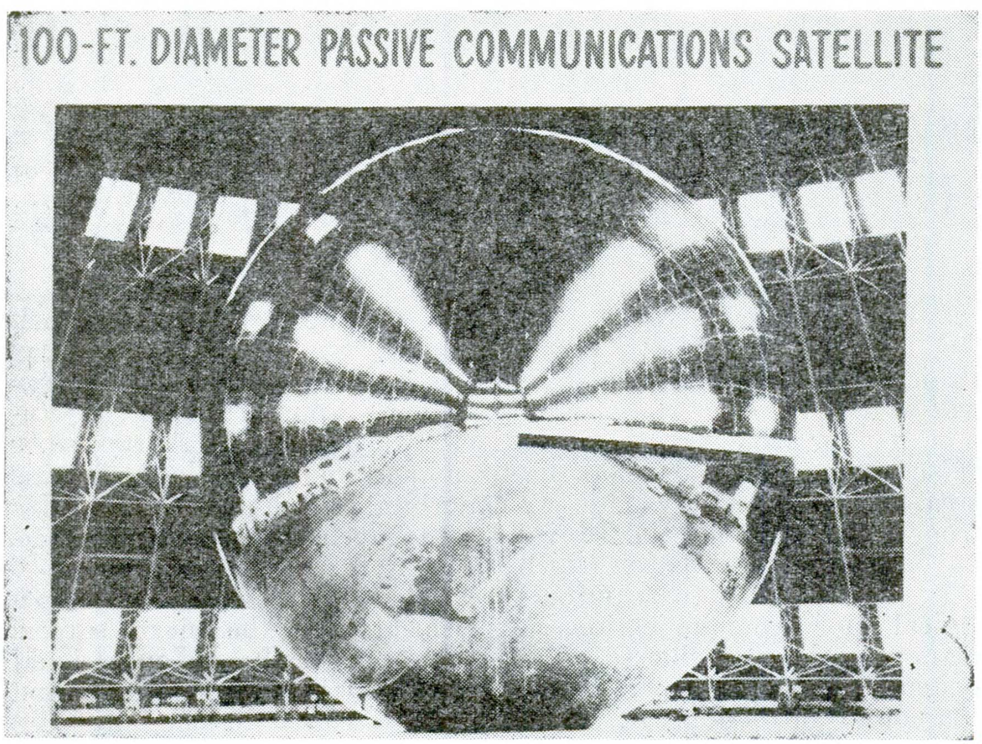

FIGURE 34

In addition to our flights near the Earth, we will be engaged in a vigorous lunar and deep-space program in the next several years. The Thor-Able vehicle will shortly be used to launch a probe into space to great distances from the Earth. This probe should extend inward toward the Sun as far as the orbital path of Venus. A number of scientific measurements will be made in the sweep-out path. One of the primary objectives will be an evaluation of long-distance data communication techniques (fig. 35).

LUNAR AND PLANETARY MISSIONS

FY	1960		1961				1962	1963
Q	3	4	1	2	3	4		
THOR-ABLE	I							
DELTA				I				
ATLAS-ABLE			L	L				
ATLAS-AGENA						L	4L	
CENTAUR								2P

L-LUNAR
P-PLANETARY
I-INTERPLANETARY

FIGURE 35

We shall use a Delta vehicle to launch a very sensitive magnetometer and a plasma probe in toward the Sun. In addition to scientific information on the properties of space, this experiment will serve as a developmental test of the new magnetometer that will be incorporated in many later spacecraft.

You will recall that we had two failures in our lunar orbiter program in fiscal year 1959. We plan to make further attempts to launch similar payloads during fiscal year 1961.

Late that fiscal year the Atlas-Agena B vehicle will give us sufficient capacity to make experiments involving closeup TV pictures of the Moon and the placing of scientific instruments on the Moon's surface in working order. This will be a gradually built-up program, starting with technological developments flights of the vehicle and spacecraft (fig. 36, p. 254).

The Earth and the nearby planets, Venus and Mars, attain favorable positions in fiscal year 1963 relative to the Earth for space missions. The Centaur vehicle, having increased payload capacity because of the use of a hydrogen upper stage, will be used to launch payloads to the vicinity of these planets at that time, shown by the shots marked 2–P, in 1963.

Our Project Mercury program will continue at the fastest pace possible for such a complex research and development program. In 1960 we will have additional Little Joe flights to evaluate and qualify components. We had the first of these about a week ago. It was highly successful. We will begin longer range Redstone flights in a few months. These Redstone vehicles will also be used to evaluate and qualify components and, at an appropriate time, will introduce man to the experiences of short-duration space flight (fig. 37).

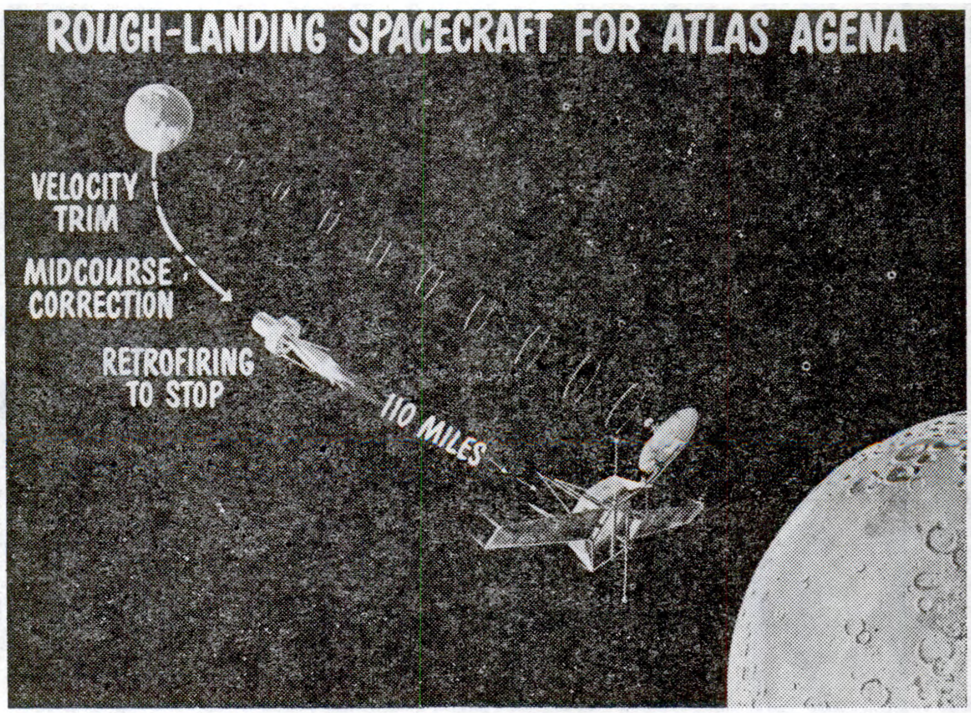

FIGURE 36

I would emphasize that these Redstone flights will not be orbital but will subject the pilot to the launch and reentry dynamics of flight as well as giving a period of weightless flight experience.

Further Atlas flights will be made in the time periods indicated. Some of these will be for technical qualifications of capsule components and for further operational and recovery training. This vehicle will also place man into orbital flight in space around the Earth. I would hope to anticipate your obvious question of when man will make this first orbital flight by simply stating that it will occur at the earliest date that we feel there has been a satisfactory demonstration of the reliability of every element in the whole program.

Among the elements of the program that must be functioning perfectly is our tracking and data acquisition system. Western Electric Co. has been given a prime contract to install the necessary system at a number of places throughout the world. There will be 18 Mercury stations including some ships and a control center at Cape Canaveral. This network is being developed using maximum possible equipment and sites already developed by the military services.

Not only is this tracking net expansion necessary in the conduct of Project Mercury, but other tracking facilities are being expanded or modified as necessary for the conduct of our whole space flight program. A later witness will discuss in some detail the various technical requirements that dictate the need for different data acquisition nets for different missions. Work is underway or has been completed

PROJECT MERCURY

FY	1960		1961				1962
Q	3	4	1	2	3	4	
LITTLE JOE	1	1					
REDSTONE			2	3	2	1	
ATLAS		1	2	2	2	2	5

SUBORBITAL

ORBITAL

FIGURE 37

for all of these stations such as our minitrack network, the optical tracking net, and the deep space net for tracking our lunar and planetary probes.

We at the NASA believe that the space flight program I have outlined is a sound, vigorous program for the exploration of space. We recognize and do not minimize the limitations that are placed on us by the launching vehicle capabilities now available to us. As more advanced vehicles become available, we are increasing and will continue to increase the scope and depth of the space program to the greatest extent possible.

The CHAIRMAN. Thank you, Doctor, for a very detailed and comprehensive statement regarding our launchings.

Will your program as announced here bring us up to date and enable us to catch up with the Russians in their program?

Dr. SILVERSTEIN. There are many aspects of our program that will carry us a long way toward accomplishing this. I think that in the scientific areas the experiments we plan to carry on in all probability will certainly bring us up to the Russians.

The CHAIRMAN. I will ask you this, then. It has been testified that some of NASA's requests for building facilities have been turned down. Will that interfere with the program that you have given us?

Dr. SILVERSTEIN. I think in general the facilities that have been reduced apply to basic research in advanced technology area, rather than the flight area. In the long-distant future, of course, as you move along and need this added technology, you can say that you will reduce your capability.

The CHAIRMAN. In other words, it is not applicable to any one project that you have given us this afternoon, but the discoveries or the developments might be available to all of these projects and to other projects?

Dr. SILVERSTEIN. Yes, sir; that is correct.

The CHAIRMAN. So we just take a chance on that by not having the facility?

Mr. Fulton?

Mr. FULTON. We are glad to have you here, Dr. Silverstein.

Could you have somebody prepare what has been done in the Russian program and what you expect them to do? I realize that the future may not be too clear, but you probably have some idea of their advances.

Could I ask you this. I saw one of the most successful——

The CHAIRMAN. Just a moment. Do you think you could do that, Doctor?

Dr. SILVERSTEIN. It is quite easy to fulfill all his requests with the possible exception of being able to predict very accurately what the Russians will do.

Mr. FULTON. I agree, but just what you may expect.

The CHAIRMAN. Do the best you can.

(The information requested is as follows:)

U.S. AND U.S.S.R. SPACE SCIENCE RESULTS

(By Homer E. Newell, Jr., Assistant Director, Space Sciences, National Aeronautics and Space Administration)

Results obtained

The United States has been using sounding rockets for upper air research and rocket astronomy since the close of World War II. WAC Corporal, V–2, Viking, Aerobee, Aerobee-Hi, Nike-Deacon, Nike-Cajun, Nike-ASP, and Rockoons used. Altitudes attained were below 200 miles for the most part. Many hundreds of rockets were fired prior to the start of the International Geophysical Year; an additional 200 were fired as part of the International Geophysical Year program. Current rate of rocket soundings is somewhat below 100 per year. Higher altitude rockets are being introduced into the work to extend the atmospheric observations to one to several thousands of miles altitude. Launchings have been carried out at White Sands, N. Mex.; Wallops Island, Va.; San Nicolas Island, Calif.; Cape Canaveral, Fla.; Fort Churchill, Canada; Guam, and from shipboard in the North Atlantic, the Mid-Pacific and South Pacific, and the vicinity of Antarctica.

The U.S. program has produced hundreds of research papers and reports giving results on the pressure, temperature, density, winds, and composition of the upper atmosphere, the ionosphere; the earth's magnetic field, the aurora and airglow, cosmic rays, micrometeors, solar radiations, and ultraviolet astronomy. Some experiments have been carried out on modifying the upper atmosphere by the release of special chemicals, and on modifying the radiation belt by nuclear explosions. Some bioscience experiments have been performed.

The U.S.S.R. has also been carrying out a rocket sounding program since the last war. Although the precise number of rocket soundings to date is not known, they number in the hundreds. Firings have been made from Franz Josef Land and from Mirny in Antarctica, as well as from European U.S.S.R. The Soviets have perfected a meteorological sounding rocket that is used for more or less routine soundings of the atmosphere to measure air pressures, densities, and temperatures up to 35 miles altitude. In addition, their "geophysical rocket" is capable of carrying ton and a half payloads up to 300-mile altitudes.

From their sounding rocket program the U.S.S.R. has obtained a broad collection of results. The meteeorological soundings have produced detailed data on the structure of the upper atmosphere just above the troposphere, showing its temporal and seasonal variations. The geophysical rocket program has provided considerable information on the very high atmosphere, including the ionosphere. The description of one of the geophysical rocket payloads is so similar to the description of Sputnik III and its instrumentation as to lead one to conjecture that the payload may have been essentially the Sputnik III payload. Whether or not this is the case, the instrumentation provided for a broad range of measurements on the ionosphere, atmospheric structure, energetic particles, and the earth's magnetic field. The U.S.S.R. rocket program has also include considerable work on biological researches. There have been some 20 tests in which dogs, and/or rabbits were sent aloft and recovered for study. During the flight the behavior of the animals was telemetered to ground.

The U.S.S.R. launched the first successful artificial earth satellite. To date the U.S.S.R. has successfully launched three earth satellites, and three space probes. Two of the space probes achieved earth escape velocity; the first passed within two or three moon diameters of the moon. The second Soviet space probe actually hit the moon. The third space probe was launched so as to pass close enough to the moon to take pictures of the unseen side of the moon's surface, then to loop around the moon returning to the earth. The lunar pictures were successfully obtained.

The United States has to date successfully launched 15 earth satellites; namely 5 Explorers, 3 Vanguards, Project Score, and 6 Discoverers; and 3 space probes, all called Pioneers. Only one of the space probes achieved earth escape velocity, passing by the moon at some 37,000 miles distance.

Both the United States and Soviet satellites and space probes have produced valuable scientific results. Included are some spectacular discoveries and achievements, some of which are given in the accompanying table No. 1. In addition to the more spectacular output, these satellite and space probe flights are turning out a steady flow of information and results that build up gradually to an impressive advancement of mankind's knowledge of the earth and outer space. Some of these are listed in table 2.

Problems being attacked

In attempting to compare the relative stages of advancement of the U.S. and U.S.S.R. in space research, one might proceed by trying to list item by item the individual results from the two programs and to relate these results item to item. This would turn out to be difficult even if one were sure that all the results obtained by the Soviets were actually at hand, for there would be many observations obtained by the Russians that had not yet been obtained by the United States, and conversely, many obtained by the United States that had not yet been obtained by the Russians. A more effective, and perhaps more significant way of comparing the relative stages of advancement, would be to isolate the general areas of investigation and the general problems being attacked by the two countries.

Taking this approach one can say that the U.S. and U.S.S.R. appear to be at about the same stage of advancement in the upper air research. The U.S. results on the atmosphere below 200 miles appear to be more detailed and complete, but the Soviets have made higher altitude measurements by means of their geophysical rocket. The Soviets appear to have done far less than the United States on solar radiations, but the U.S.S.R. has done much more than the United States on bioscience experiments, having conducted numerous flight tests in which dogs were carried aloft in rockets and safely recovered. The U.S.S.R. has carried the technique of ejecting instrumented packages from the rocket carrier farther than has the United States, which has carried the technique of telemetering to a high degree of refinement.

Likewise, the U.S. and U.S.S.R. seem to be at about the same stage of advancement in studies of the earth's environs where satellite techniques are adequate for making the necessary observations. In fact it may be that in this regard the United States has the slight edge. The big advantage the Soviets have in attacking these problems lies in their greater payload capacity. On the other hand, the United States has launched many more satellites than the Soviet Union.

In deep space probe work the U.S.S.R. has definitely taken the lead. This is directly attributable to their clear lead in vehicle technology.

Table 3 provides a comparison of the states of advancement of the U.S. and the U.S.S.R.

A review of table 3 shows fairly clearly that the United States and the U.S.S.R. scientists are at about equal stages of advancement in the problems they are attacking or are about to attack in space research. As groups they undoubtedly have comparable competencies and understandings of the significant problems that ought to be tackled. Their instrumentations are roughly equivalent, althrough the United States may have a slight edge here, as indicated by the fact that the U.S.S.R. quite often simply copies U.S. equipment for its own instrumentation. The conclusion follows then that the side that has the more advanced technology in the way of payload capabilities, guidance, etc., will have the distinct edge and by virtue of the increased flexibility and capabilities provided by the more advanced technology will force steadily ahead. Thus, one may predict a time lead in vehicle technology will be transformed into a corresponding time lead in the exploration and investigation of outer space.

TABLE 1.—*Significant firsts in sounding rocket, satellite, and space probe research*

UNITED STATES

1. A number of firsts in high altitude rocket research, including among others—
   First detailed photo of solar ultraviolet spectrum.
   First photo of complete tropical storm.
   First penetration of equatorial ionospheric current sheets.
   First detection of X-rays in high atmosphere.
   First detection of auroral particles in high atmosphere.
2. Discovery of the Van Allen Radiation Belt.
3. Discovery that the Van Allen Radiation Belt consists of at least two zones.
4. Performance of the Argus experiments.
5. The first precise geodetic use of artificial earth satellites (Vanguard I) to obtain refined information on the size and shape of the earth, providing an improved value for the flattening and showing that the earth is actually slightly pear shaped.
6. First achievement of an elementary communication satellite, in Score.

U.S.S.R.

1. First artificial earth satellite.
2. First lunar near miss.
3. First lunar impact.
4. First pictures of the hiterto unseen of the moon.
5. First direction of what may be a current ring about the earth (the Chapman Strømer ring).
6. First routine recovery of large animals (dogs and rabbits) from high altitude rocket flights.
7. Development and routine use of meteorological sounding rocket, recoverable and reflyable.
8. First launching of a large animal (Laika) in a satellite of the earth.
9. First high capacity, maneuverable, heavily instrumented, spacecraft with fully Successful long-range communications (Lunik III).

TABLE 2.—*Sounding rocket, satellite, and space probe results*

Field	United States	U.S.S.R
Upper atmosphere	1. Rocket observations have been made of pressure, temperature, density, composition, and winds of the high atmosphere at a wide variety of locations, both day and night, and in the various seasons.	1. Rocket observations have been made of pressure, temperature, density, composition and winds of the high atmosphere at a wide variety of locations, both day and night, and in the various seasons.
	2. Upper air densities have been obtained from the tracking of both U.S. and U.S.S.R. satellites.	2. Upper air densities in the higher latitude regions obtained from drags on Sputniks I and III.
	3. It has been shown that the radiation belt may account for much higher atmospheric temperatures observed in the auroral zone atmosphere than in the high atmosphere above the middle and equatorial regions.	3. High enough flux of low energy electrons measured with Sputnik III instruments in the northern regions to account for the higher atmospheric temperatures there.
	4. ----------	4. Direct measurement of upper air densities made with gages in Sputnik III, for heights up to 355 kilometers.
	5. Fluctuation in satellite drag, hence presumably upper air densities, have been shown, from observations on Vanguard I and Sputnik II, to be directly correlated with fluctuations in the 10 centimeters radiation from the sun, and hence solar activity.	5.
	6. ----------	6. The routine meteorological sounding rocket has been used to give atmospheric structure data at middle-European, Arctic, and Antarctic locations showing seasonal variations as well as geographic. It turns out that the seasonal variations are different for the different altitude ranges.
	7. From both satellite and rocket observations high altitude air densities have been shown to vary widely with time of day, season, and geographic position.	7.
	8. The amounts of diffusive separation both below and above the E region of the ionosphere have been measured in sounding rocket experiments, and shown to be very slight below the E region and quite pronounced above altitudes of 110 to 120 kilometers.	8. Diffusive separation in the upper atmosphere below the E region has been measured with results that agree in general with the U.S. observations.
Ionosphere	1. Extensive electron density data have been obtained for a number of locations from rocket soundings.	1. From rocket soundings electron densities have been obtained up to and above the F region maximum.
	2. From radio signals of both U.S. and U.S.S.R. satellites, propagation characteristics of the ionosphere and electron density distributions have been obtained.	2. Electron densities above 300 kilometers were obtained by observation of the radio signals of Sputniks I and III.
	3. ----------	3. Observations on Sputnik I showed 3.5 times as many electrons above the F region maximum as below.
	4. The heavy ions in the ionosphere above White Sands and Fort Churchill have been identified up to the F region in rocket sounding experiments.	4. The ionic composition of the ionosphere has been measured in sounding rockets to above the F region maximum.
	5. ----------	5. Sputnik III observations showed that the predominant ion from 250 to 950 kilometers is positive atomic oxygen, O+.
	6. ----------	6. In Sputnik III the satellite potential in the daytime ionosphere was observed to be as much as −7 volts.
	7. Very low frequency propagation data were obtained from Explorer VI.	7.
	8. ----------	8. In the 2d Lunik, evidence of a lunar ionosphere was obtained.

TABLE 2.—*Sounding rocket, satellite, and space probe results*—Continued

Field	United States	U.S.S.R
Magnetic field	1. Data on earth's magnetic field were obtained from Pioneer I and Explorer VI, and a great deal of additional high-quality data are being obtained from Vanguard III.	1. Data on earth's magnetic field obtained from Sputnik III.
	2. By their magnetic effect, electric current flows were plotted in the E and lower F regions, in rocket sounding experiments in the equatorial regions.	2.
	3. ------	3. On Mechta measurements were made of the earth's magnetic field and its extension into space. A marked dip in the field was discovered in the region of the radiation belt, indicating perhaps the existence of a current ring such as postulated by Chapman.
	4. Rocket measurements of the earth's magnetic field have been made in the auroral regions.	4.
	5. ------	5. Lunik II, on its plunge to the surface of moon, showed that the lunar magnetic field is not greater than 50 gamma.
Cosmic rays	1. Extensive data on cosmic ray intensities, composition, and interactions with matter were obtained from sounding rockets in various locations and throughout all the seasons.	1. Cosmic radiation measurements have been made in U.S.S.R. sounding rockets.
	2. The cosmic ray count was obtained above the atmosphere with counters in Explorer satellites and Pioneer probe.	2. The cosmic radiation was measured in Soviet satellites and space probes.
	3. Cosmic ray counts in the first Explorers gave discovery of the radiation belt.	3. Sputnik II observations showed an increase in counting rate with height (this being at the time, an unrecognized hint of the presence of the radiation belt.)
	4. Details on the cosmic radiation as a function of time and position in space have been obtained from Explorer VI, and are being obtained from Explorer VII.	4. Sputnik III and cosmic rockets provided measurements on the heavy nuclei in the cosmic radiation.
Radiation belt	1. Radiation belt discovered with instruments in Explorer I.	1. Abnormally high cosmic ray counts were observed in Sputnik II, particularly at the high latitudes. Sputnik III showed a very high electron flux in the northern latitudes.
	2. A great amount of additional detail obtained on belt in Explorers III and IV, and the Pioneer probes. Extent of radiation belt shown by Pioneer I. Pioneer III showed belt to consist of at least 2 zones.	2. Sputnik III, Mechta, and other Soviet satellite and space probe observations confirm the U.S. findings.
	3. Pioneer IV showed the extent of the outer radiation belt to have increased greatly following a 5-day period of high solar activity, thus proving that the outer belt is of solar origin.	3.
	4. Argus experiments showed individual inner zones of the radiation belt to be very stable.	4.
	5. Argus observations lend support to conclusion that inner radiation belt produced by cosmic rays. See No. 7 below.	5.
	6. Detailed energy spectrum of radiation in radiation belt was obtained by Explorer VI.	6.
	7. Sounding rocket observations showed that the energetic particles of the inner radiation belt are protons of energy spectrum expected from β decay of neutrons, hence supports cosmic ray origin for hard components of inner belt.	7.

	8. Extensive additional information on the radiation belt was obtained from Explorer VI and is being obtained from Explorer VII and Vanguard III. Huge variations of many orders of magnitude in counting rates were observed in outer zone.	8.
	9. Radiological hazard of radiation belt estimated to be not serious for a direct traverse of the belt; but quite serious for a space station that spends a lot of time in the belt.	9. Radiological hazard of radiation belt estimated to be not serious for a direct traverse of the belt; but quite serious for a space station that spends a lot of time in the belt.
	10. ----------	10. The moon was shown not to have a radiation belt detectable within the sensitivity of Lunik instruments.
Aurora----------	1. Rocket soundings have been used to study the electromagnetic and particle radiations in the aurora. It was found that soft radiation flux above 40 kilometers was many times the primary cosmic ray count.	1.
	2. ----------	2. A very high flux of low energy electrons was observed in Sputniks II and III. This flux was taken to be the cause of the very high atmospheric temperature in these regions.
	3. The particles in the outer radiation belt have been shown to be the likely immediate cause of the aurora.	3. The particles in the outer radiation belt have been shown to be the likely immediate cause of the aurora.
Geodesy----------	1. Vanguard I observations give an oblateness of the earth of 1/298.3----	1.
	2. Vanguard I observations show the earth to be pear shaped with a 50-foot peak at the North Pole, and a 50-foot flattening at the South Pole; this appears to imply an internal strength to the earth, rather than a free flowing plasticity.	2.
Meteors----------	1. A fairly low count of micrometeors corresponding to a total influx of 1,000 to 10,000 tons of material per day, from Explorer and Pioneer observations.	1. Influx of material per day indicated by Sputnik III observations in general agreement with the U.S. results.
	2. A very large amount of additional data are being obtained from the Vanguard III instrumentation.	2. Additional measurements made in Soviet cosmic rocket flights.
Astronomy----------	1. In sounding rocket experiments ultraviolet sources in the sky have been detected and plotted.	1.
	2. The solar spectrum has been observed and photographed down to 303 angstroms.	2.
	3. Solar radiations have been observed and measured in the X-ray regions.	3.
Lunar explorations------	1. ----------	1. First photos taken of the hitherto unseen side of the moon.
	2. ----------	2. The lunar magnetic field shown to be no greater than 50 gamma.
	3. ----------	3. Lunar ionosphere detected.
Miscellaneous experiments.	1. The Argus experiments were carried out----------	1.
	2. Sodium vapor was released in the high atmosphere and observed to measure its radiations, atmospheric winds, and diffusion.	2. Sodium clouds were released from Luniks II and III and observed from the ground.
	3. Various chemical contaminants were released in the high atmosphere to study the photochemical reactions that resulted.	3.
Biosciences----------	1. On numerous sounding rocket flights biological specimens of seeds, fruit flies, etc., have been flown and recovered for study. Larger animals, such as rats and monkeys, have been flown for study of their behavior and the effects of the flight environment on them. Recovery of such animals has been effected on numerous occasions.	1. Large numbers of sounding rocket experiments have been carried out with dogs and rabbits, in which the animals were both studied during flight and recovered after flight for further study.
	2. ----------	2. Observations were made on the behavior of Laika, particularly heartbeat and respiration, in Sputnik II.

TABLE 2.—*Sounding rocket, satellite, and space probe results*—Continued

Field	United States	U.S.S.R
Engineering data	1. U.S. satellites show that moderate temperatures can be achieved in orbiting vehicle.	1. U.S.S.R. satellites and space probes show that moderate temperatures can be achieved by appropriate engineering.
	2. Elementary communications link checked out in Project Score	2.
	3. Based on radiation belt data, it is deduced that satellites may charge to a potential of some hundreds of volts in the radiation belt.	3. Sputnik III measurements show that in the daytime ionosphere the satellite acquired an appreciable negative charge corresponding to a negative potential of several volts.
	4. The meteor erosion and puncture problems have been shown in general to be not particularly serious.	4. The meteor erosion problem appears to be not particularly serious.
	5. An elementary TV scanner was checked out in Explorer VI, while some of the basic elements of a meteorological satellite were checked out in Vanguard II.	5.
	6.	6. Automatic photography of the moon and the televising of the photographs obtained back to earth has been achieved.
	7. Solar cells have been shown to be a practical, reliable source of power	7. Solar cells have been shown to be a practical, reliable source of power.
	8.	8. A complete spacecraft, maneuverable, with temperature control, power supply, long range communications link, complicated instrumentation, etc., has been engineered and flown successfully—namely, Lunik III.
	9. It appears that the radiological hazard to space vehicle crews traversing the radiation belt directly may be relatively low, while the hazard to those in a satellite orbiting through the radiation belt would be quite serious. In addition, marked increases in proton intensities of the cosmic radiation found at the time of solar activity may be a very serious radiological hazard: dose rates of 1,000 roentgens per hour.	9. It appears that the radiological hazard to space vehicle crews traversing the radiation belt directly may be relatively low, while the hazard to those in a satellite orbiting through the radiation belt would be quite serious.
Meteorology	1. Numerous sounding rocket photos of cloud formations and significant weather areas have been taken. In particular a composite photo from one sounding rocket showed a completely developed tropical storm approaching hurricane proportions.	1.
	2.	2. A meteorological sounding rocket was developed and has been used on a routine basis for meteorological studies.
	3.	3. Detailed measures of pressures and temperatures have been obtained with the meteorological rocket for Antarctic, Arctic, and Middle European locations.
	4. Cloud picture data were obtained in Vanguard I, but motions of the satellite have so far prevented reducing the data to useful pictures. Also, very low resolution, elementary television pictures have been taken of cloud formations as seen from Explorer VI. One of these pictures was assembled and released.	4.

TABLE 3.—*Problems currently under attack*

Field	United States	U.S.S.R.
Upper atmosphere	1. A detailed study of the structure, winds, and composition of the ionospheric regions and beyond in the earth's atmosphere is underway by means of sounding rockets and earth satellites. 2. Work is underway to develop a routine rocket sonde for synoptic studies of the lower portion of the upper atmosphere in association with meteorological soundings.	1. A detailed study of the structure, winds, and composition of the ionospheric regions and beyond in the earth's atmosphere is underway by means of sounding rockets and earth satellites. 2. The U.S.S.R. has already achieved the development of a routine rocket sonde for meteorological-type soundings into the lower portion of the upper atmosphere.
Ionosphere	Intensive rocket and satellite studies of the ionosphere in the F region and beyond are underway.	Intensive rocket and satellite studies of the ionosphere in the F region and beyond are underway.
Magnetic field	The United States has used search coils, saturable core magnetometers, and proton precession magnetometers in its measurements of the earth's magnetic field. The United States is preparing to use a much more sensitive instrument, the alkali vapor resonance magnetometer, for further studies of magnetic fields in space and to measure the magnetic field of the moon.	The U.S.S.R. has also used standard-type magnetometers and proton precession magnetometers for observations of the earth's magnetic field. The U.S.S.R. has made a measurement to detect the lunar magnetic field, finding none to within the sensitivity of their instrument. It is not known whether the U.S.S.R. is preparing to use the alkali vapor magnetometer in the near future.
Cosmic rays	Balloon, sounding rocket, and satellite observations of the intensity, nature, and effect of cosmic rays are underway.	Balloon, sounding rocket, and satellite observations of the intensity, nature, and effect of cosmic rays are underway.
Radiation belt	Detailed study of the radiation belt by means of sounding rockets, satellites, and space probes, with occasional use of controlled experiments is underway.	The U.S.S.R. made intensive studies of the radiation belt in Sputnik III, but at the present time appears to be investigating the belt incidentally as part of their concentration on deeper space missions; namely, on their lunik flights.
Aurora	U.S. scientists are tackling the problem of both visible and ultraviolet auroral radiations, the particles connected with the aurora, and the ultimate origin of the aurora.	The U.S.S.R. scientists are tackling the same problems.
Geodesy and celestial mechanics.	The United States is continuing use of satellites for geodetic studies.	The U.S.S.R. shows skill in applications of celestial mechanics, as witnessed by their ability to launch Lunik III with the accuracy achieved, and to predict the motions of the Lunik III spacecraft.
Meteors	The United States continues to collect data on meteors in space, using a wide variety of experimental equipments.	The U.S.S.R. has made an intensive study of micrometeors in their satellites and space probes, appearing to attack the general problem very much along the lines followed by the United States.
Astronomy	Active rocket astronomy in being. Orbiting telescopes, solar, and astrophysical observatories being worked on.	Unknown.
Lunar exploration	The United States is preparing to conduct intensive investigations of the moon, but the actual observation of the moon from space vehicles is yet to begin.	The U.S.S.R. has already achieved significant steps in its investigation and study of the moon. It may be presumed that the Soviets will continue their vigorous efforts in this area.
Planetary investigations	The United States has minimal capability in this area at present, and on the present schedule planetary work is proceeding at a very slow pace.	The U.S.S.R. has an advanced capability in this area, and has declared its definite interest in planetary research.
Miscellaneous experiments.	The United States is using upper atmosphere regions for controlled chemical and Argus type experiments. Also planning relativity and gravity experiments.	Unknown.
Biosciences and man-in-space.	The United States has a first stage man-in-space program in Project Mercury. Support work of a research type is being carried out in the Discoverer program. Some experimental work is being carried out in sounding rocket flights. A well rounded, fully developed program of research in both biotechnology and biosciences is yet to be worked out.	The U.S.S.R. has a highly active program of research on animals under rocket flight and satellite conditions. It is not known how fully developed their biotechnical and fundamental biosciences programs are. It is expected, particularly from recent news releases, that the U.S.S.R. does have a man-in-space program.

TABLE 3.—*Problems currently under attack*—Continued

Field	United States	U.S.S.R.
Meteorology	The United States is developing rocket photographic techniques for meteorological purposes. The United States is developing a meteorological sonde for synoptic soundings. The United States is conducting fundamental satellite experiments associated with meteorology, and is taking the initial steps in the development of a meteorological satellite system.	The U.S.S.R. has already developed a working meteorological rocket sonde, which they have already put to extensive use. It is not known what the U.S.S.R. is doing in the matter of developing a satellite meteorological system.
Communications	In its rocket, satellite, and space probe telemetry the United States has shown good capability. Long-range communication systems are being worked on for deep space probes. Communication satellite systems are being worked on.	The U.S.S.R. rocket, satellite, and space probe telemetry has been successful. In particular the communications and telemetry problems of Lunik III appear to have been worked out with a high degree of competence. It is not known whether they are developing a communication satellite system, but it may be presumed that they are.
Navigation	The United States is working on a navigation satellite of high degree of refinement.	It is not known whether the U.S.S.R. is devoting effort to a navigation satellite.

Mr. FULTON. I saw one of the most successful launchings of a Russian satellite that I hope I will ever be privileged to see. I was a U.S. delegate at the United Nations 14th General Assembly. Toward the close of the General Assembly there was quite a ceremony in the main foyer of the United Nations Building, when the Soviet Government presented the United Nations with a full-scale model, hanging in the hall, of sputnik. Actually, it is a tremendously beautifully engineered item and it is tremendously effective.

Could I suggest to you that we, either from the Vanguard program or from the Mercury program space capsule, make some sort of a presentation to show that we are at least as interested as they are.

They likewise gave away, for desk use, small gold sputniks, with quite a flair. Now, if we are talking as we have been today about how the world is viewing the United States and Russia in this—well, lets call it competition in space—probably you people should be looking ahead to a public launching at the United Nations which will in some way typify what we are doing and do it in a rather dramatic way.

Had you thought of that?

Dr. SILVERSTEIN. I don't think we thought of this particular method of presenting our program to the world, but I think there is merit to it, and I think we ought to give it consideration.

Mr. FULTON. One other thing I would like to ask you on a particular program. I guess it was the November 24 program where you had the lunar problem with the shroud. What was the failure that caused the shroud to drop off? Was the propellant discharged too quickly so there were too many G's? Was it an unprogramed launch so there was a motion or a torque that it was subjected to? Or was it just failure to compute what kind of a stress or a strain that shroud would have at the time it was attached and planned to be attached?

Dr. SILVERSTEIN. That was a very interesting failure actually. It turned out to be a design failure as you indicated in the last part of your remark.

However, tests had been made in wind tunnels to determine the loading on the shroud. These tests were made two mach numbers, one at 0.90, and one at 1.06. However, the maximum loading on the shroud, associated with the air pressures on the shroud occurred at a mach number between these two values where tests had not been made, so that the actual loading at the time of failure on the shroud was higher than had been designed for and had been anticipated.

Mr. FULTON. It was a mighty discouraging one. A good many members of the committee were there.

As a matter of fact, I had Prince Ali Khan there to see it and he said he did better with horses than you people did with missiles.

The CHAIRMAN. Are there any questions to the right?

Mr. Hechler.

Mr. HECHLER. Doctor, at page 13 you make reference to the man in orbital flight. In the excellent chart of goals which was presented to us, the date was pinned down to 1961. I wondered if, since you are testifying here, I wondered if you cared to elaborate just a little bit and set a possible timespan when this will occur?

Dr. SILVERSTEIN. Yes. I think the two charts that I showed and Mr. Horner showed are the same. I think mine are shown in fiscal years and his are shown in calendar, but there is the hope that this flight will be accomplished during the calendar year 1961.

However, you must recognize, as I have said in my prepared statement, that we don't intend to fly until we have qualified every element in the program.

Mr. HECHLER. I would like to concur with the remarks of my colleague, Mr. Fulton, on the nature of this business.

You would agree that our international prestige is at stake, in relation to our progress in this whole area?

Dr. SILVERSTEIN. I certainly would concur heartily in that statement.

The CHAIRMAN. I would go much further than that and say our security and in fact our survival is at stake.

Mr. HECHLER. There is a particular reason I used that phrase "international prestige." The President said the other day at his news conference that our international prestige was "not particularly" at stake.

Mr. DADDARIO. Dr. Silverstein, I have just one question. Are you satisfied with the program as it is now established and with its ability to do all we should be doing in space?

Dr. SILVERSTEIN. I think myself it is an excellent program. I think I am prejudiced because I have had a rather substantial part in putting it together, so that I think we should ask others, to get an unbiased point of view, but I think it has, from a scientific point of view, and from the mission's point of view and from the man-in-space point of view, good character and an aggressive intent.

Mr. DADDARIO. And how do you feel about the relationship of NASA with the Department of Defense in the field of cooperation and coordination? Do you feel this is being accomplished properly? Do you feel you are getting the right kind of support, or do you believe there may be a certain amount of hindrance which will prevent you from doing what you have said you are doing? Sharpening and redefining your objectives in space?

Dr. SILVERSTEIN. I would like to make a rather special point and say that the cooperation between the Department of Defense and our own agency is very, very fine.

Now, for example, in the Mercury program, the Department of Defense has set up in support of Mercury a special group headed by General Yates who is, as you know, at the head of the Cape Canaveral operation, to support our work in the tracking area and make available to NASA, in this whole program, the full resources of the Department of Defense tracking system.

Also, the Navy, in the Department of Defense support, is providing us full cooperation in the recovery operation of our capsules from the water.

I think that those of us who have worked closely on it and in detail on the program feel that there has been the finest spirit of cooperation throughout the whole program.

Mr. DADDARIO. And when you look at the section involving coordination and cooperation, proposed section 309(a) and all of its features, do you believe that properly establishes the kind of relationship between NASA and the Department of Defense so that it will eliminate the need of having one overall agency in charge of our space program?

Dr. SILVERSTEIN. I think, speaking most generally on your statement, that cooperation is a matter of spirit and intent. I am not sure any organizational system can be set up that will guarantee cooperation, but it eventually rests upon the desire of the individuals who are participating on both sides to get the job done.

Now, I find it difficult to say whether this particular organizational alinement, or another one, might be better, but I feel that in any event the results will depend on the people involved and their desire to get the job done. That is a quite general answer, but I don't think I can be more specific.

Mr. DADDARIO. Well, do you think it might be easier to do this job if, let's say, NASA were put in charge of everything involving space with one person at the top? It would then be dependent, let's say, on the military to propose those projects which fit together with the developments in space as they progress, so that there would be one person deciding where, along the line, there would be this area of cooperation and of effort?

Dr. SILVERSTEIN. I think there are good and bad points on both systems.

When you leave it up to one man or organization or segment you run certain risks. For example, there is the risk that this particular man may not be imaginative enough or may have a particular interest in one area and not in another. If you make it in two areas, on the other hand, you might find some overlapping. I don't think I can really say which might be the better.

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

The CHAIRMAN. There being no further questions, I want to thank you, Dr. Dryden, Mr. Horner, and Dr. Silverstein, for the help that you have given our committee.

I appreciate your statements. They are long, detailed, comprehensive, and helpful.

If there is no further business, the committee will stand adjourned until tomorrow morning at 10 o'clock.

(Whereupon, at 4:30 p.m., the committee was adjourned, to reconvene at 10 a.m., Friday, January 29, 1960.)