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INDEPENDENT OFFICES AND DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT APPROPRIATIONS FOR 1971

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HEARINGS

BEFORE A

SUBCOMMITTEE OF THE COMMITTEE ON APPROPRIATIONS HOUSE OF REPRESENTATIVES

NINETY-FIRST CONGRESS

SECOND SESSION

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G. HOMER SKARIN and HUNTER L. SPILLAN, *Staff Assistants*

[1] Served on subcommittee until Feb. 20, 1970.
[2] Assigned to subcommittee Feb. 20, 1970.

PART 4

Budget Amendment, General Services Administration
Budget Amendments, Veterans' Administration
Council on Environmental Quality
National Aeronautics and Space Administration
National Aeronautics and Space Council
Office of Science and Technology
Selective Service System
Testimony of Members of Congress and Interested Individuals and Organizations

Printed for the use of the Committee on Appropriations

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INDEPENDENT OFFICES AND DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT APPROPRIATIONS FOR FISCAL YEAR 1971

MONDAY, MARCH 23, 1970.

OFFICE OF SCIENCE AND TECHNOLOGY

WITNESSES

DR. LEE A. DuBRIDGE, DIRECTOR
DAVID Z. BECKLER, ASSISTANT TO THE DIRECTOR AND EXECUTIVE OFFICER, PRESIDENT'S SCIENCE ADVISORY COMMITTEE
ROBERT BARLOW, SPECIAL ASSISTANT TO THE DIRECTOR
FRANK R. PAGNOTTA, EXECUTIVE OFFICER

SALARIES AND EXPENSES

PROGRAM AND FINANCING (IN THOUSANDS OF DOLLARS)

Identification code 03-50-0700-0-1-903	1969 actual	1970 estimate	1971 estimate
Program by activities:			
Scientific policy development and program evaluation (costs—obligation)	1,796	1,958	2,175
Financing:			
Unobligated balance lapsing	4		
Budget authority (appropriation)	1,800	1,958	2,175
Relation of obligations to outlays:			
Obligations incurred, net	1,796	1,958	2,175
Obligated balance, start of year	582	660	640
Obligated balance, end of year	−660	−640	−635
Adjustments in expired accounts	−226		
Outlays	1,492	1,978	2,180

OBJECT CLASSIFICATION (IN THOUSANDS OF DOLLARS)

Personnel compensation:			
Permanent positions	767	970	973
Positions other than permanent	121	170	180
Other personnel compensation	25	28	30
Special personal service payments	12	30	25
Total personnel compensation	925	1,198	1,208
Personnel benefits: Civilian employees	57	78	78
Travel and transportation of persons	270	280	285
Transportation of things	2	7	9
Rent, communications, and utilities	37	60	60
Printing and reproduction	38	75	80
Other services	404	210	400
Supplies and materials	22	25	25
Equipment	41	25	30
Total obligations	1,796	1,958	2,175

PERSONNEL SUMMARY

	1969 actual	1970 estimate	1971 estimate
Total number of permanent positions	54	57	57
Full-time equivalent of other positions	11	15	16
Average number of all employees	57	67	68
Average GS grade	11.4	11.4	11.6
Average GS salary	$14,701	$17,854	$18,048

Mr. EVINS. The committeee will come to order.

We will consider the justifications this morning for the Office of Science and Technology, headed by the able and genial director, Dr. Lee A. DuBridge, accompanied by those set forth above.

Dr. DuBridge, we have looked over your budget. I notice you have a lengthy statement. Would you like to put it in the record and summarize it?

OPENING STATEMENT

Dr. DUBRIDGE. I can summarize the statement and put the whole thing in the record to describe in some detail the activities of the office.

I would like to go over the first part of this in order to set the stage.

Mr. Chairman, members of the subcommittee, it is a pleasure to meet with you once again to discuss the activities and requirements of the Office of Science and Technology. When I appeared in this room last year, as a member of the new administration, I had been in office for relatively little time as Director of the Office of Science and Technology and Science Adviser to the President. Now, of course, I can speak from considerably more experience.

The roles of the Science Adviser and OST have remained in this administration essentially the same as they were envisaged when these institutions were established, in 1958 and 1962 respectively; that is, to advise and assist the President wherever science and technology have a major bearing on the national welfare. Of course, the emphasis and working relationships of the Office have changed in accord with the needs of the President and the different staffing arrangements in the Executive Office of the President.

We continue to rely on the help of outstanding expert consultants through the President's Science Advisory Committee and utilize the Federal Council for Science and Technology to coordinate the R. & D. policies and programs of the Federal agencies. I chair both of these committees, and the Office of Science and Technology both supports and draws on these mechanisms to help carry out its responsibilities.

The OST is broadly concerned with the contributions of science and technology to the adequacy of our national defense, the strength of our economy, the health of our citizenry, and the quality of our environment. We are concerned with the need to assure an adequate base of knowledge and trained manpower to make these scientific and technological contributions possible today and in the future. This is a large task. It includes many things besides science and technology, but science and technology nonetheless are critical elements for success in every area I have mentioned. Obviously, we have had to be highly selective in identifying specific problems and issues for con-

centration in this office that are appropriate to and require attention at the presidential level.

APPROPRIATIONS REQUEST

We are requesting appropriations of $2,175,000 for OST for fiscal year 1971. This is an increase of $217,000 over our fiscal year 1970 appropriations. One hundred and sixty-seven thousand dollars of the net increase—most of it—is to provide the Office with the ability to conduct contractual in-depth studies.

In doing our job, we rely on a small expert staff. We try to bring to bear the best and most informed thinking and to couple it to decision-making and action through discussion and interchange with other members of the White House and Executive Office staff, the Federal agencies and departments, and the scientific and technical community at large. Our small staff needs the help of many outside groups and agencies. Contracted studies is one method of supplementing our own brainpower and energy.

ACTIVITIES OF OST

In my statement today I will review some of the activities of the OST during the past year, both to inform you of the progress we have been making and to provide necessary background and justification for our fiscal year 1971 budget request. I am submitting for the record a list of published reports issued during the past year by the OST, by the Federal Council for Science and Technology and by the President's Science Advisory Committee. Also listed are appearances by OST before congressional committees.

The statement goes on to outline the activities in each of several major problem areas. I will not try to read all of this into the record, but simply mention them.

ENVIRONMENTAL QUALITY

Environmental quality has been a very important area of activity, in accordance with the interest of the President in improving environmental quality throughout the country, and we have been concerned with many of the problems in this area.

As you know, the President initially asked me to serve as Secretary of his Cabinet Committee on the Environment, and we had planned to develop the staff necessary to do that.

During the year, however, Congress passed the Environmental Quality Act of 1970, which created another agency in the Executive Office of the President, which will take over most of the servicing of the Cabinet Committee. Nevertheless, the new Environmental Council headed by Russell Train has indicated they must depend on OST for back-up on all of the scientific and technical matters concerned with the environment since they will not have the scientific and technical capacity to cover these areas and should not try to duplicate the capacities and talents that exist in OST and in our advisory committees.

We have done a lot in the environmental field in the past year and continue to do so with regard to air and water pollution and other matters.

SPACE SCIENCE AND TECHNOLOGY

Space science and technology has been of continued interest to this office ever since the space program was initiated, and particularly this year our office assisted in the preparation of the Space Task Group report which was given to the President and has served as a basis for the President's policies on the space program of the future. We will continue, of course, to follow the space program and develop ideas and proposals for keeping it scientifically and technologically sound during the coming year.

NATIONAL SECURITY

A great deal of attention of the office has to do with national security problems as set forth in my prepared statement. These are in many highly classified areas but concern ground warfare, strategic matters, disarmament problems, naval problems, and many others. During the last few months we have paid special attention to the bacteriological warfare problem and assisted in preparing the material for the Security Council on which the President based his new policy in the field of biological and chemical warfare.

We are now investigating the question of what to do with the biological-warfare facilities at Camp Detrick, Md., and Pine Bluff, Ark., which will no longer be needed for their current purposes in biological warfare.

AIR TRAFFIC CONTROL

Air traffic control is obviously a problem of very great importance and interest to the entire country and it is a problem of very great technological complication in which we have been trying to work with the FAA and the Department of Transportation in evolving plans and research programs. Among other things, we have studied the possibility of using the Electronics Research Center (ERC) at Cambridge as a possible laboratory to carry on research programs related to air traffic control and other transportation programs.

Mr. JONAS. Has any decision been made on that?

Dr. DUBRIDGE. This is now in the hands of the President and I think a decision is imminent. We explored with the Bureau of the Budget and the other agencies whether this was a proper type and adequate facility for DOT to use. As you will recall, the ERC had been abandoned by NASA for budgetary reasons. It looks promising that there will be another use for that very important and very valuable facility. Possibly not solely for the use of DOT, but the DOT would be a major user with other agencies participating.

COMMUNICATIONS POLICY

In the field of communications policy, there have been many interests and activities throughout the Government which have involved our office and, as you know, there has now been proposed the establishment of a new Office of Telecommunications Policy in the Executive Office of the President. We have assisted in the deliberations leading to that as well as in some of the technical problems in connection with international satellite communication negotiations.

LIFE SCIENCES

In the life sciences area, which is a very important one, we have worked with many other agencies on the scientific and technical problems in basic biological research and medical research and in health care and medicare and so on, as well as in the problems of nutrition and hunger, and are continuing quite energetic activities in the general health area.

ENERGY POLICY

In the field of energy policy, energy is probably the most widely used and available commodity in modern civilization. Generating adequate energy and doing so in such a way as to avoid environmental and other problems is a large, technical problem and involves collaboration of many agencies in the Government. We have helped in studying the problem of oil import controls and the problems of pollution at the various types of powerplants and the problems relating to nuclear energy.

RESEARCH AND DEVELOPMENT IN EDUCATION

My statement includes a few words on the field of research and development problems in the educational area. As the President indicated in his education message, we have been carrying on education at all levels in this country for a very long time, but research on how well we are doing and how we can do better has been at too low a level. We have had a President's Science Advisory Committee group at work on how research and development in education—at all levels, from early childhood through to graduate school—can be improved. As you know, the President has proposed in his education message that there be an institute for research in the educational field, and in his higher education message that there be a foundation for higher education to assist in the improvement of our programs and plans in higher education.

Mr. JONAS. Are you familiar with the experiment at Texarkana, Ark.? We heard testimony in here last week that the Government made a grant, signed a contract with a private business-type organization, which contracted to improve the level of reading and mathematics to a substantial degree in the public schools and if they failed to do so they wouldn't get any pay. The testimony indicated that as a result of their program they brought up the level of reading and knowledge of mathematics I forget how much, but it was a fantastic increase.

Now, what I would like to know is, what is wrong with the public schools? Maybe we better turn them over to private enterprise, if that Texarkana example is typical.

Dr. DUBRIDGE. I think there are many areas where private contracts can do a great deal of good to break the traditions that are so evident in all parts of any educational system.

Mr. JONAS. I think you might be interested in having somebody on your staff look at that Texarkana situation.

Dr. DUBRIDGE. I remember the case now. I am not immediately familiar with precisely how it was done. I hope that private organizations will be heavily used in connection with these research activities which are proposed in both the education messages that the President

has sent up in which he sets forth the need for more knowledge, new experiments, and innovation in all areas of education.

CIVILIAN TECHNOLOGY

Civilian technology is, of course, another area of very considerable interest throughout the Government. It involves many areas of interest in the Department of Transportation—transportation safety, safety on the highways and, of course, lower pollution—and the development of various kinds of technologies in the construction of housing and buildings, and so on.

SCIENTIFIC AND TECHNICAL INFORMATION

In scientific information and communications, OST has tried to monitor, consult with and advise the many agencies of Government that have to do with data processing, communication information storage and retrieval and so on. It is a growing and complex field and we have tried to keep the various agencies of Government together in having somewhat uniform standards and procedures so that our communications system in Government can be as efficient and effective as possible.

ACADEMIC SCIENCE

In academic science, as you know, the basic research in a country is the foundation of all current and future technology and therefore the basis of future events in welfare and education and health, and in the advancing industrial prosperity of the country.

There have been very great problems because of budget limitations during this past year, and these will continue into the coming years.

One part of the problem is that a number of different agencies, the Department of Defense, the Atomic Energy Commission, NASA, have had reductions in their levels of budget for very good reasons, but this has forced them to withdraw from certain areas of basic science which they have been supporting. Their support has been very critical to a balanced scientific program in the country.

The National Science Foundation attempts to make sure that we have a balanced basic science program, but its resources have been inadequate to do that. It has become even more important that we support the National Science Foundation budget request this year because there are important activities which DOD, NASA, and AEC will be tapering off or stopping. It is very important to the future of the country that these activities be continued at some level. The National Science Foundation budget for the coming year makes provision for the NSF to support the best and the most important of the activities which other agencies are relinquishing.

We have worked with the Bureau of the Budget and with the Science Foundation on the mechanisms for this. Incidentally, I hope when this committee considers the NSF budget you will try to support fully the President's request for its budget because it is a very minimum level at which we can still maintain the health of our basic science.

INTERNATIONAL SCIENTIFIC COOPERATION

In international scientific cooperation, the President expressed very early in his administration his interest in having more extensive and more friendly scientific collaboration with other countries. As a result, he asked me to head a small scientific delegation to Europe last fall and we visited in Western European countries and also Yugoslavia and Romania. We also had a visit with Canada and we have had many conferences in this country with scientific representatives from many countries around the world.

I attended an Inter-American Council on Education, Science, and Culture in Trinidad last summer for discussions among the Latin American countries and another such conference is to be held this summer in Chile. One of the men in our office follows these activities very closely, and works closely with AID on its technical programs, as well as, of course, with the State Department.

INTERGOVERNMENTAL SCIENCE RELATIONS

Intergovernmental science relations is a somewhat new activity of OST. Many States and even local municipal governments have recognized the need for additional scientific and technological competence and are developing plans for using science and technology to improve whatever situations in their localities are in need of improvement, whether it is improving the quality of their industry, of their schools, of their environmental problems, their general decisionmaking in critical areas.

We mention here the visits we have made and the discussions we have had in Massachusetts, Illinois, Connecticut, Pennsylvania, California, Georgia, Louisiana, Mississippi, Missouri, New York, Tennessee, Colorado, and so on.

This, I think, will be a very valuable activity to bring these State and local agencies in touch with Federal agencies to see to what extent Federal information and experience is useful to the localities and the States and to their technological problems. We want to make sure that there is good communication and exchange of ideas and information.

IN-DEPTH CONTRACT STUDIES

I should like to return to the question of enhancing our technological capabilities beyond what our staff alone can provide by contracting out to expert agencies, universities, nonprofit agencies, companies, and so on for special studies in various fields.

I have touched on a variety of issues involving science and technology of direct concern to OST as well as other offices in the Executive Office of the President. Our ability to analyze issues of this complexity and develop policy alternatives is severely circumscribed by lack of multidisciplinary staff capabilities to undertake in-depth policy studies and analyses of selected problems requiring such studies preparatory to policy decisions.

One example is the problem we are continuing to work on in connection with the eventual use of our uranium separation facilities. It is not feasible or even desirable to build a large in-house OST staff

for this purpose since a staff with sufficient professional diversity, competence, and experience can best be mobilized outside of government on a temporary basis and relating to particular problems as they are identified. There are qualified teams at nonprofit research centers and universities and in private industry which can be called upon for such studies. By making use of outside resources, it is possible to increase the effectiveness of the OST full-time staff and the effectiveness of the members of the various advisory committees and panels which we have. OST has had sufficient experience with this approach to justify the request for additional funds. This is particularly important in view of the fact that the President has asked that permanent personnel in the Executive Office of the President be kept at a fixed level and that we not increase the number of our permanent employees. Therefore, we must go out for this additional help.

ENERGY POLICY STUDIES

As I indicated earlier in my testimony, the OST energy policy staff has made very effective use of modest funds by contracting for small scale studies directly related to policy questions.

One such study provided an analytical framework for analyzing the oil import problem considered by the cabinet task force on oil import control. Another OST study used by the task force was an up-to-date assessment of North American oil and gas resources. While we will continue to request interested Federal agencies to undertake studies both in and out of house to assist on OST efforts, there are OST requirements that cannot be satisfied by this route—where the subject matter transcends responsibilities of an individual agency, where governmentwide perspective is required, or where the time constraints on the selection of the study group require a direct approach by OST. In the next year we hope to initiate further in-depth studies on selected problems of energy policy, and on key aspects of the health policy and science policy issues to which I have already alluded. An initial effort in the area of technological assessment is planned to develop both the analytical methods and substantive understanding of the full range of effects and consequences following from the introduction of a particular technology into our society. Technical studies of air and water pollution and solid waste disposal are also needed.

I hope that your committee will favorably consider this request for additional funds for the conduct of in-depth policy studies since this additional capacity would constitute an important means for substantially increasing the effectiveness of OST in providing advice and assistance to the President in a number of complex problem areas where there has been insufficient analysis of underlying questions.

That concludes what I want to say. I will be glad to answer any questions.

Mr. EVINS. Thank you, Dr. DuBridge, for an overview statement of the work of the Office of Science and Technology. Added to your statement is a list of reports issued last year by the President's Science Advisory Committee and a list of appearances before congressional committees. You have been quite busy. We know you do great

and essential work. We will place in the record at this point your prepared statement, the list of reports, and the list of appearances before congressional committees.

(The information follows:)

STATEMENT OF DR. LEE A. DUBRIDGE

Mr. Chairman, members of the subcommittee, it is a pleasure to meet with you once again to discuss the activities and requirements of the Office of Science and Technology. When I appeared in this room last year, as a member of the new administration, I had been in office for relatively little time as Director of the Office of Science and Technology and Science Adviser to the President. Now, of course, I can speak from considerably more experience.

The roles of the Science Adviser and OST have remained in this administration essentially the same as they were envisaged when these institutions were established, in 1958 and 1962 respectively; that is, to advise and assist the President wherever science and technology have a major bearing on the national welfare. Of course, the emphasis and working relationships of the Office have changed in accord with the needs of the President and the different staffing arrangements in the Executive Office of the President.

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In my statement today I will review some of the activities of the OST during the past year, both to inform you of the progress we have been making and to provide necessary background and justification for our fiscal year 1971 budget request. I am submitting for the record a list of published reports issued during the past year by the OST, by the Federal Council for Science and Technology, and by the President's Science Advisory Committee. Also listed are appearances by OST before congressional committees.

ENVIRONMENTAL QUALITY

I will now turn to the area of OST activitiy which has been most visible publicly during the past year, and which certainly is second to none in importance—environmental quality. The President, as you know, established a Cabinet-level Committee on the Environment last May, which he personally has chaired, and named me as the first Executive Secretary of this body. The OST, and, in particular, Dr. John Buckley of my staff, has borne the principal staffing responsibility for the Cabinet Committee until the recent establishment of the Environmental

Quality Council in the Executive Office of the President. The Cabinet Committee has dealt with a wide range of topics. The President has asked subcommittees to work on problems of air pollution, solid wastes, noise, and the handling of toxic materials. Just recently a subcommittee on international aspects of the environment was established.

The OST staff has been actively involved in the work of these subcommittees. I would like to mention especially the matter of automotive air pollution. This was selected for special attention because it poses a very serious problem in a number of urban areas in the country and is certain to get far worse if nothing is done about it. There is good reason to believe that something can be done about it rather soon if enough well-directed effort is devoted to the problem.

Following the meeting of the Cabinet Committee on the Environment on November 29, 1969, at which executives of the automotive industry were present, OST established an ad hoc panel to investigate the state of development of unconventional automotive vehicle propulsion systems that would meet long-term emission requirements. This panel now has completed its activities and will present its final conclusions and recommendations to the Council on Environmental Quality. As a result of requests for assistance by both the automotive and petroleum industries, OST encouraged the Commerce Technical Advisory Board to establish a Panel on Automotive Fuels and Air Pollution. The objectives of this panel are to help industry arrive at a schedule of events that will permit the elimination of lead additives from motor vehicle fuel as rapidly as feasible while minimizing the total cost to the consumer.

With regard to pesticides and herbicides, OST has taken leadership to bring together the several agencies with related responsibilities and to assure that coordinated action is taken where the public interest so requires to limit their use. Restrictions on the use of DDT, for example, were announced by the White House following the meeting of the President's Cabinet Committee last November.

Some of the other aspects of recent OST involvement in the environmental quality issue include the following:

Following the Santa Barbara oil spill of early 1969, and at the initiative of Secretary Hickel, I was requested by the President to establish a technical panel to assess our ability to prevent and to deal with such oil spills and to recommend steps to improve our capabilities. The report of this panel was made public in October 1969. A separate panel was established, also under the aegis of my office, to recommend what should be done with regard to the Union Oil lease in the Santa Barbara Channel where the leak occurred. The conclusions of this panel were made public in June 1969.

OST assisted in the preparation of the President's messages to the Congress on Environmental Quality and on Population, and is assisting in the planning for U.S. participation in the U.N. International Conference on the Environment to be held in Stockholm in 1972.

A significant report on "The Universities and Environmental Quality" was prepared for the Cabinet Committee on the Environment by Dr. John Steinhart of the OST staff and Miss Stacie Cherniack, a White House executive intern. It was made public in November 1969.

As you know, the Jackson-Dingell legislation has established the Council on Environmental Quality in the Executive Office of the President. The Council, already at work under the direction of its chairman, Russell Train, is intended to be the focal point for consideration of environmental issues by the Federal Government. The President has assigned to Mr. Train my former responsibility as Executive Secretary of the Cabinet Committee on the Environment. I shall remain as an observer on the Committee. The OST's involvement in environmental questions will continue at a high level, for many of the central questions depend to a considerable extent on science and technology for their satisfactory solution. Furthermore, I anticipate an expansion of the efforts of the President's Science Advisory Committee and its panels concerned with environmental quality which depend on OST staff support. I have discussed the OST and PSAC activities with Mr. Train who stresses his need for our support. We will work closely together so that our efforts are mutually reinforcing.

SPACE SCIENCE AND TECHNOLOGY

During the past year I served as a member of the Space Task Group, established by the President under the chairmanship of the Vice President to recommend directions for our space program in the years ahead. The report of that group was made public last fall. As you know, the President has recently issued a

statement on space, based to a considerable extent on the Space Task Group report. Although a great deal of very good staffwork was performed for the Space Task Group by other agencies, especially NASA, the leading staff role in the development of the Task Group's report and recommendations was played by Russell Drew of OST as head of the Staff Directors Group of agency representatives.

The President's Science Advisory Committee, with OST staff support, made two major contributions this past year to the consideration of national space policy. One of these is a report, just issued, entitled "The Next Decade in Space." The material for this report was initially prepared as a contribution to the Space Task Group study, and a summary of it was released with the task group report in September. The second contribution was a report published last November on "The Biomedical Foundations of Manned Space Flight," which assessed the state of our knowledge and the further programs required to assure that man can safely participate in foreseeable space flights.

NATIONAL SECURITY

A significant fraction of the OST effort is devoted to the technological aspects of national security programs and policies. The staff assists me in providing advice to the President and the White House staff on selected topics in military and national security areas. We work closely with the Bureau of the Budget and the National Security Council in reviewing defense programs and budget issues and in analyzing policy alternatives on matters of high technical content. The OST staff also provides support to the military panels of the President's Science Advisory Committee and leans heavily on the expertise of these panels for advice on specific issues.

For example, OST assisted the National Security Council in developing the background information needed by the President in his revision of the Nation's policy with respect to chemical and biological warfare. Dr. Vincent McRae of my staff participated in the interagency studies on BW/CW and provided support to the President's Science Advisory Committee, which made a significant contribution to the examination of this area, as indicated in the White House statement on BW/CW policy. The President has specifically asked me to coordinate the consideration being given by several agencies to possible new uses of discontinued biological warfare facilities at Ft. Detrick, Md., and the Pine Bluff Arsenal in Arkansas. We have also aided the NSC staff in providing technical information on other security matters, including ABM and the SALT discussions.

AIR TRAFFIC CONTROL

In January of this year, my Office undertook a special study of the needs and future requirements for air traffic control systems in the United States. A panel of the President's Science Advisory Committee has been actively reviewing the current status of research and development activities and systems planning within the Federal Aviation Administration and the Department of Transportation and will be working closely with them in the definition of longer-range requirements for air traffic control.

COMMUNICATIONS POLICY

Since the beginning of this administration, the OST has participated with other White House staff in a review of communications policy activities of the Government. As a result of this review, several significant actions have been taken.

(*a*) A reorganization plan has been submitted to the Congress calling for the establishment of a new Office of Telecommunications Policy in the Executive Office of the President.

(*b*) A statement of executive branch policy was sent to the chairman of the Federal Communications Commission recommending action regarding the introduction of satellites into the domestic communications environment.

(*c*) The Office assisted in discussions of policy positions to be taken by the United States in the current INTELSAT negotiations.

LIFE SCIENCES

On the initiative of the OST an Ad Hoc Group on Population Research of the Federal Council for Science and Technology conducted an inventory of population research by Federal agencies, and made suggestions and recommen-

dations for Federal emphasis. The OST also participated in preparation of the President's message to Congress on population.

OST participated in the administration's efforts to improve nutrition deficiencies, including the White House Conference on Food, Nutrition, and Health. It also assisted in planning U.S. participation in the international biological program, and in planning expanded U.S. programs of research related to ecology.

In response to OST's concern about satisfying our national needs for health care, the President's Science Advisory Committee has established a panel to examine in depth the Government policies and programs in biomedical science. A member of the OST's staff with medical research experience has played a leading role in organizing and supporting the work of this panel.

ENERGY POLICY

The OST Energy Policy Staff has been involved in a number of major energy policy questions through ad hoc interagency working groups, contract studies, and day-to-day coordination involving proposed legislation and the energy research and development budgets of the agencies.

The problems associated with powerplant siting and transmission line routing continue to receive a good deal of attention, to provide adequate electric supply without despoiling the environment. A little over a year ago an interagency group led by OST published a factual report on the problems of powerplant site selection. This group which includes representatives from AEC, Interior, HEW, HUD, FPC, REA, and TVA as well as other groups within the Executive Office is currently working on a second report dealing with the administrative mechanisms as well as research and development needed to solve these problems. I have testified on this issue before both the Joint Committee on Atomic Energy and the Senate Subcommittee on Intergovernmental Operations. It is a key example of the conflict between our need for industrial economic development and our growing concern for protecting the environment. We hope to make a contribution toward our evolving policy in this area in the coming year.

We also took part in the Cabinet Task Force on Oil Import Control, which has recently completed an exhaustive study of the oil import question. Mr. Freeman, Director of OST's Energy Policy Staff, participated as an observer. The OST contributed to the work of the task force by submitting the results of two of its contract studies. One of the studies provided an analyical framework for analyzing the problem, while the other provided an up-to-date assessment of North American oil and gas resources.

Currently several other analytical studies are underway involving energy forecasting; natural gas supply demand and regulation; Federal fuel tax policy; and a framework for considering the total environmental costs of energy. We are also cooperating with the Bureau of Mines in studies involving a systematic plan for R. & D. to improve the health and safety and productivity of coal mining. A report covering the first phase of our effort on energy demand forecasting was released earlier this month. Prepared by Battelle-Northwest, it summarizes and analyzes a number of existing energy forecasts, providing a basis for future work in this area.

RESEARCH AND DEVELOPMENT IN EDUCATION

The office of Science and Technology is concerned with science education itself and with improving education through research and development including the natural, behavioral and social sciences. The OST, working with the Bureau of the Budget and White House staffs, participates in the coordination and development of programs in this area involving several agencies including the National Science Foundation, the Department of Health, Education and Welfare, the Office of Economic Opportunity and others.

An OST staff member, Dr. John Mays, assisted by the Panel on Educational Research and Development of the President's Science Advisory Committee, is working with the Office of Economic Opportunity, the Office of Child Development, and the Office of Education in assuring that existing research and development results are fully utilized in the Federal day-care programs, especially those that are proposed by the President as part of the family assistance plan. Of particular concern is the improvement of these programs through research and development and seeing that parents and prospective parents have up-to-date knowledge of what research and development has shown will be helpful in the intellectual, emotional, and physical development of their children.

The OST and the PSAC Panel are also actively involved with HEW in the planning of the National Institute of Education, proposed by the President. This Institute is expected to improve markedly the quality of educational research and development in this country through involving a much broader group of scientists and other professionals and through concentration of resources on pressing problems such as education of the disadvantaged.

CIVILIAN TECHNOLOGY

The OST is working closely with the Department of Transportation in the experimental highway safety vehicle program. In addition, we are involved with a number of agencies in developing a Federal research program on rapid excavation. The potential benefits of improved excavation technology are enormous, not only in terms of direct cost savings but in terms of permitting new urban form, transportation systems, et cetera. At the present time we are participating in various ad hoc groups and committees to consider problems such as the use of military helicopters in emergency highway accident situations, the use of new techniques in telecommunications to help solve urban problems, the development of performance specifications for construction of Federal office buildings, the promotion of adoption of intragency standards, and study of the problems of metrification.

SCIENTIFIC INFORMATION AND COMMUNICATIONS

OST has for some time played a leadership role in national and Federal agency efforts to organize, communicate, report and apply their information resources to problems of national importance. It has engaged in similar cooperative efforts with professional societies and the private community. Part of this leadership is effected through OST working groups, and part through the operations of the OST-chaired Committee on Scientific and Technical Information (COSATI) of the Federal Council for Science and Technology. Examples of such efforts in the past year include:

(*a*) Recommendations to Federal agencies leading to a coordinated but decentralized system for improved comprehensive interchange of information about on-going research projects;

(*b*) Completion of a draft report on agency and interagency programs on technology transfer and technology utilization for private industry;

(*c*) Initiation of an inventory of information resources, activities and centers relevant to programs for improving environmental quality;

(*d*) Organization of a National Engineering Information Conference, held June 24–25, 1969, in Washington, D.C., which brought together internationally known, outstanding engineers to discuss future engineering data programs and needs;

(*e*) Participation in international programs (primarily under OECD and ICSU/UNESCO) for worldwide cooperation and planning in developing scientific information resources, communications programs, and computer utilization efforts.

ACADEMIC SCIENCE

The Federal policies and programs for the support of university research have always been high on the agenda of the OST and the President's Science Advisory Committee. As the result of Federal support, U.S. science has enjoyed spectacular success. Yet the philosophy and support mechanisms underlying this success no longer seem adequate to assure a continued high rate of scientific advance. The principle of multiple sources of support of academic science by departments and agencies with applied missions has foundered on tight budgets. It is becoming increasingly clear that the whole of the national interest is no longer the mere sum of the partial interests of the supporting agencies. Attempts to strengthen the role of the National Science Foundation in assuming a greater fraction of the Federal support have met with very limited success. The question remains as to whether or how the present system of Federal support of academic science can be modified to provide a more coherent overall approach that can sustain U.S. excellence in science—excellence that is essential to the understanding of many complex problems of the environment and human health as well as providing the necessary foundation for American technological leadership.

We plan to undertake a major effort by the OST staff and the President's Science Advisory Committee to thoroughly examine all aspects of this problem leading to proposals which can be placed before the President. Through a special

interagency committee established for this purpose, we will work closely with the BOB, NSF and the major R. & D. agencies.

INTERNATIONAL SCIENTIFIC COOPERATION

The Director and the OST staff have been active in following-up on specific international initiatives of the President. For example, the exchange of visits between myself and the French Minister of Science has given rise to a bilateral cooperative program with France, which may prove to be an important prototype for international cooperation in the applied sciences between government agencies of two countries. Each side supports its own work and benefits from the research efforts and unique facilities of the other. Specific activities in oceanography, housing technology, regional planning, meterology, and transportation are already underway in the United States/French program.

Last September I headed a delegation of PSAC members and OST staff to Romania. This visit resulted from the President's expression of interest in that eastern European country. A small scientific exchange program with Romania, administered by the NSF, has already resulted from that visit.

As reflected in the Environmental Quality Act and in the President's recent foreign policy statement, international cooperation in addressing the world's environmental problems is essential. The OST staff is providing the technical backup for the President's environmental initiative in NATO—the Committee on Challenges of Modern Society (CCMS) ; has been deeply involved in preparation of the U.S. position for the new East-West environmental initiatives within the ECE ; is continuing to participate in the active environmental cooperation within OECD, and is contributing to preparations in the United States for the UN Conference on the Environment to be held in Stockholm in 1972.

Consultations between OST and the science policy leaders of Great Britain and Canada continue to contribute to the special relationships the United States maintains with these countries. A recent meeting between myself and my Canadian counterpart has resulted in plans for a United States-Canadian Planning Meeting on Arctic Research.

Regarding the vital region of Latin America, I was asked to head the U.S. Delegation to the Inter-American Council on Education, Science, and Culture meeting in Trinidad last summer to discuss cooperative programs. Another such conference is to be held in Chile this summer in implementation of the President's pledge to increase our involvement in the scientific development of the Latin countries.

INTERGOVERNMENTAL SCIENCE RELATIONS

My concern for better utilization of Federal science and technology capability to help State and local governments improve planning and decisionmaking, enhance economic development, and better utilize and coordinate Federal, State and local academic and industrial resources, prompted me to recommend to the Federal Council for Science and Technology the formation of an interagency committee on intergovernmental science relations.

The committee was formed in the fall of 1969 and has recently completed a series of 10 State visits and has had presentations from other Federal and State officials describing specific areas where science and technology can and should be used more effectively.

The State visits, all made at the invitation of the Governors, have shown that the States understand their own problems and competence in science and technology. Some specific examples are :

Massachusetts is using science and technology for planning, decisionmaking and reorganization.

Illinois emphasized education, and particularly how a major National Laboratory (Argonne) in cooperation with universities can be used to make education and research relevant to specific social problems, for example, improving the quality of the environment.

Connecticut described its effective use of systems engineering and computer simulations to help predict future impact of present policy decisions. The achievements of the State-supported Connecticut Research Council were significant in supporting applied research to solve specific State problems, that is, highway noise and the removal of water pollution from brass plants.

Pennsylvania described its effective use of the science advisory mechanism to

aid the Governor and the Legislature in defining and utilizing the State's science and technology resources to help solve the State's problems.

Other States visited included California, Georgia, Louisiana, Mississippi, Missouri, New York, and Colorado (the Federation of Rocky Mountain States).

Presentations to the Committee on Intergovernmental Science Relations have been made by other States.

Dean Alvin Bisco of the University of Tennessee described the important service role of the University to direct its educational program and facilities to solve local problems. Also, the Oak Ridge National Laboratory has been a leader in bringing the capability of a major mission-oriented government facility to bear on problems such as environmental pollution.

North Carolina described the Research Triangle and how science and technology are being used to help with economic development. North Carolina also illustrated interstate cooperative efforts, for example, with South Carolina and Georgia to optimize and coordinate use of coastal resources.

A committee report and recommendations will be completed in the next few weeks.

IN-DEPTH CONTRACT STUDIES

I would like to return now to the major new element in the fiscal year 1971 budget request, an increase of $167,000 over the fiscal year 1970 budget to be used for the conduct of in-depth studies through contracts with qualified organizations.

I have touched on a variety of issues involving science and technology of direct concern to the OST as well as other offices in the Executive Office of the President. Our ability to analyze issues of this complexity and to develop policy alternatives is severely circumscribed by lack of multidisciplinary staff capabilities to undertake in-depth policy studies and analyses of selected problems requiring such study preparatory to policy decisions.

It is not feasible, or even desirable, to build a large in-house OST staff for this purpose since a staff of sufficient professional diversity, competence and experience can best be mobilized outside of government in relation to particular problems as they are identified. There are qualified teams in non-profit research centers and universities, as well as in private industry, that can be called upon for such studies. By making use of outside resources, it is possible to substantially increase the effectiveness of the OST full-time staff members and the use of part-time consultants of the President's Science Advisory Committee.

The OST has had sufficient experience with this approach to justify this request for additional funds. As I indicated earlier in my testimony, the OST Energy Policy Staff has made very effective use of modest funds by contracting for small-scale studies directly related to policy questions. One such study provided an analytical framework for analyzing the oil import problem considered by the Cabinet Task Force on Oil Import Control. Another OST study used by the task force was an up-to-date assessment of North American oil and gas resources.

While we will continue to request interested Federal agencies to undertake studies, both in-house and out-of-house, to assist the OST efforts, there are OST requirements that cannot be satisfied by this route: Where the subject matter transcends the responsibilities of an individual agency, where a Government-wide perspective is required, or where the time constraints on the selection of the study group require a direct approach by the OST. In the next year we hope to initiate further in-depth studies on selected problems of energy policy, and on key aspects of the health policy and science policy issues to which I have already alluded. An initial effort in the area of technology assessment is planned to develop both the analytical methods and substantive understanding of the full range of effects and consequences following from the introduction of a particular technology into our society. Technical studies of air and water pollution and solid waste disposal are also needed.

I hope that your committee will favorably consider this request for additional funds for the conduct of in-depth policy studies since this additional capability would constitute a very important means for substantially increasing the effectiveness of the OST in providing advice and assistance to the President in a number of complex problem areas where there has been insufficient analysis of underlying questions.

I will be pleased to answer any questions you may have with regard to this or any other aspect of my statement on the fiscal year 1971 budget request for the Office of Science and Technology.

LIST OF REPORTS MADE PUBLIC BY THE PRESIDENT'S SCIENCE ADVISORY COMMITTEE, THE OFFICE OF SCIENCE AND TECHNOLOGY, AND THE FEDERAL COUNCIL FOR SCIENCE AND TECHNOLOGY, 1969–70

President's Science Advisory Committee

Biomedical Foundations of Manned Space Flight (November 1969).
The Next Decade in Space (March 1970).

Office of Science and Technology

Steam Power Plant Site Selection (January 1969).
Control of Agricultural-Related Pollution (OST-Agriculture) (January 1969).
Report of the Special Panel on the Future of the Union Oil Lease (June 1969).
MHD for Central Station Power Generation: A Plan for Action (June 1969).
Federal Research and Development for Civilian Energy Production (September 1969).
The Universities and Environmental Quality—Commitment to Problem Focused Education (September 1969).
A Comprehensive Assessment of Solid Waste, Problems, Practices and Needs (October 1969).
Oil Spill Problems (Part 1) Offshore Mineral Resources (Part 2) (October 1969).
A Review and Comparison of Selected U.S. Energy Forecasts (March 1970).

Federal Council for Science and Technology

National Atmospheric Science program fiscal year 1970 (May 1969).
Federal Council for Science and Technology 1968 Annual Report (June 1969).
Education and Federal Laboratory-University Relationships (June 1969).
The Federal Program in Population Research (October 1969).
Progress in Scientific and Technical Communication (COSATI Progress Report—1968) (November 1969).
Systematic Biology—A Survey of Federal Programs and Needs (December 1969).
Catalog of Federal Laboratory-University Programs and Relationship (January 1970).
Review of Activities of Committee on Water Resources Research (January 1970).
Annual Report on Government Patent Policy (February 1970).

CONGRESSIONAL APPEARANCES 1969–70

Dr. Lee A. DuBridge, Director, Office of Science and Technology

Nomination hearing, February 6, 1969.
House Subcommittee on Science, Research, and Development, Committee on Science and Astronautics—H.R. 35, February 19, 1969.
House Subcommittee on Independent Offices and HUD, Committee on Appropriations, February 25, 1969.
Senate Committee on Government Operations, May 1, 1969.
House Subcommittee on Science, Research, and Development, Committee on Science and Astronautics—IBP, May 7, 1969.
Senate Committee on Aeronautical and Space Sciences—NASA, May 5, 1969.
Subcommittee on Fisheries and Wildlife Conservation, Committee on Merchant Marine and Fisheries, June 27, 1969.
House Subcommittee on Conservation and Natural Resources, Committee on Government Operations, July 9, 1969.
House Subcommittee on Science, Research, and Development, Committee on Science and Astronautics, July 10, 1969.
Senate Subcommittee on Independent Offices, Committee on Appropriations, July 15, 1969.
House Subcommittee on Oceanography, Committee on Merchant Marine and Fisheries, October 21, 1969.
Joint Committee on Atomic Energy, October 28, 1969.
Senate Subcommittee on Intergovernmental Relations, Committee on Government Operations, February 3, 1970.
Senate Subcommittee on Science and Technology, Select Committee on Small Business, February 10, 1970.
Senate Subcommittee on Oceanography, Committee on Commerce, February 26, 1970.

Dr. Hubert Heffner, Deputy Director, Office of Science and Technology

Nomination hearing, July 9, 1969.

Senate Subcommittee on Air and Water Pollution, Committee on Public Works, October 1, 1969.

Dr. John L. Buckley, technical assistant, Office of Science and Technology

Senate Subcommittee on Air and Water Pollution, Committee on Public Works, July 9, 1969.

Mr. S. David Freeman, Director, energy policy staff, Office of Science and Technology

Senate Subcommittee on Minerals, Materials and Fuels Committee on Interior and Insular Affairs, July 9, 1969.

Joint Committee on Atomic Energy, November 20, 1969.

Dr. S. William Gouse, technical assistant, Office of Science and Technology

Senate Subcommittee on Energy, Natural Resources and Environment, Committee on Commerce, January 28, 1970.

Dr. John Steinhart, technical assistant, Office of Science and Technology

Special Studies Subcommittee, House Government Operations Committee, May 7, 1969.

COORDINATION OF ENVIRONMENT POLICY

Mr. EVINS. The Congress just created a Council on Quality of the Environment and Mr. Russell Train has just been appointed as head of that Council as you alluded to in your statement. Everybody is concerned with the quality of environment. In nearly every agency we have heard before this subcommittee.

If you will coordinate all these activities and get them directed in an area of some accomplishment, you will have rendered a great public service. I hope that you will see to it that there is not too much overlapping, that each one will be concerned with its particular area. Would you comment on the problem of overlapping?

Dr. DUBRIDGE. The new environmental council, Dr. Train, and our office, have been and will continue to be in close contact. They will depend on us primarily for the scientific and technological studies of problems and actions that are needed, but the environmental question goes far beyond science and technology into jurisdictional matters between the Federal Government and the States and local agencies. It gets into broad problems of urban affairs, construction, housing, and so on.

Environment as you know covers practically everything and it has to be broken down into particular areas. Within HEW, for example, there is an agency having primary concern with air pollution, including automobile pollution.

Mr. EVINS. I believe there is also some work being done by the Department of Transportation?

Dr. DUBRIDGE. Yes, Transportation is working with HEW on better automobiles, to reduce automobile pollution.

Water pollution is primarily now within the Department of the Interior. The Federal Water Pollution Control Agency is doing a very intense job, especially right now in connection with municipal sewerage treatment plants.

ENVIRONMENTAL ORGANIZATION PLANNING

The President's Advisory Council on Executive Organization, known as the Ash Council, is intensely considering whether changes in the Government organization to handle environmental problems are necessary and, if so, what changes they would recommend. I do not know just what plans they are going to come up with, but they have consulted us about where the problems are.

You are correct in making sure that we do not overlap. On the other hand, there are so many different parts to the environmental picture that many people can be independently working without overlapping, each working on a particular part. How the automobile contributes to air pollution is a rather independent problem from how industries contribute to water pollution.

Mr. EVINS. Dr. BuBridge, you are not only the Director of the Office of Science and Technology, you are the President's Science Advisor—you head the President's Science Advisory Committee and also the Federal Council for Science, so you wear several hats.

Dr. BUBRIDGE. These two things, the Science Advisory Committee and the Federal Council, are simply advisory bodies to support the President's Science Advisor and the President.

BIOLOGICAL WARFARE POLICY

Mr. EVINS. Doctor, did you recommend that the Defense Department do away with its biological warfare facilities as inhuman?

Dr. BUBRIDGE. The President has already announced that the United States will no longer develop offensive biological warfare capabilities and will not use biological mechanisms.

Mr. EVINS. Did the President make that decision on your advice or the advice of the Department of Defense?

Dr. DUBRIDGE. Both. The National Security Council, the Department of Defense, our office and a special panel of the President's Science Advisory Committee fed in all the information and points of view.

Mr. EVINS. When the President made this major decision, did he call you in for counsel on whether or not he should take these actions or was that following a memorandum from DOD?

Dr. DUBRIDGE. Our office was asked to contribute material to the National Security Council papers that were to be presented to the President, and so we fed in all the technical information we could find which bore on the biological and chemical warfare problem. Those ideas and information were incorporated into a book of facts and options which were presented to the President. The President called a National Security Council meeting where I was asked to be present to discuss the pros and cons of various possible policies which the President might adopt, or the United States might adopt in the biological and chemical warfare field. Each of us expressed our views—the State Department, the Arms Control Agency, the Defense Department, the Joint Chiefs of Staff——

Mr. EVINS. Are they going to stop production of the biological warfare mechanisms and sell the facilities?

Dr. DuBridge. There are two major facilities that have been used for research on offensive biological warfare agents and for production of biological warfare weapons. The research has been done at Fort Detrick in Maryland. The production has been done at Pine Bluff Arsenal in Arkansas.

Both of these will no longer be needed. We hope they will be converted to other nonwarfare uses. We think that the facilities at Fort Detrick can be used by HEW for studies on communicable diseases and how they can be controlled and so on.

URANIUM SEPARATION FACILITIES

Mr. Evins. Are you going to recommend that the uranium separation facilities be sold?

Dr. DuBridge. We recommended, and the President has implemented this recommendation, that we look forward toward the day when uranium fuel shall be treated in the private segment of our economy just as are coal and oil and gas. We recognize, however, that this cannot be suddenly accomplished and that there are many problems.

Mr. Evins. Coal and oil are privately owned whereas uranium separation is owned by the Government. I imagine the electric power utilities of this Nation would like very much to get their hands on this monopoly so they could have the entire production and separation of uranium for the production of electric power. I hope you will look with great caution on this recommendation. As one member of this committee, I am expressing my views.

Dr. BuBridge. We shall, I assure you, use great caution. We are not proposing there should be now a private takeover, but that the Atomic Energy Commission should somewhat segregate this uranium treatment operation into a separate operation. There is no reason why the private utilities should not pay the full cost of the uranium they buy for power generation. We want to make sure that the bookkeeping and the management is done in such a way that the Government is fully reimbursed for its costs in separating uranium for the benefit of energy production for the country. If this is a separate operation within the Atomic Energy Commission, then the country will have the option in the future as to whether to convert it into a private, Government, quasi-private, quasi-Government corporation, or whether to sell it. I would not like to see a private monopoly take this over and I don't think anybody else would.

OST BUDGET

Mr. Evins. Dr. DuBridge, you are asking for 57 positions, is that correct?

Dr. DuBridge. That is correct. That is what we are authorized at the present time.

Mr. Evins. Your budget was $1,800,000 in 1969, it is $1,958,000 in 1970, and you are requesting $2,175,000 in 1971. Is that right?

Dr. DuBridge. That is right.

Mr. Evins. How much of this $2,175,000 do you propose to utilize in awarding private contracts?

Dr. DuBridge. Approximately $200,000 of the $2,175,000.

Mr. EVINS. What do you expect to get from this $200,000 that you don't have in your expert staff, with your great capability and all the resources of the Government?

Dr. DUBRIDGE. We would call upon the resources of universities and nonprofit corporations and private corporations around the country. There is a lot of talent outside the Government and much of this talent can be tapped.

When we use intergovernmental personnel from an agency or various agencies, each of them, of course, is restricted by the policies, programs, and interests of that agency.

We will use Government personnel to the maximum possible extent, but there are great talents that are not in Government and sometimes there are greater talents in a particular area, and more unbiased talents, more imaginative talents than one can find in Government agencies, for a certain, particular problem. This is only a small part of the total operation.

JUSTIFICATION OF ESTIMATES

Mr. EVINS. Place in the record the justification for the Office of Science and Technology.

(The pages follow:)

STATEMENT OF JUSTIFICATION, FISCAL YEAR 1971

The Office of Science and Technology was established June 8, 1962, by Reorganization Plan No. 2 of 1962, in accordance with the provisions of the Reorganization Act of 1949, as amended. Its primary purpose is to provide the President with permanent staff resources capable of advising and assisting him on matters of national policy affected by or pertaining to science and technology.

The Director and Deputy Director of the Office of Science and Technology are appointed by the President with the advice and consent of the Senate. They are assisted by a small full-time professional staff highly qualified in a variety of specialized fields. The service of some 220 expert consultants in the fields of science and engineering are called upon to provide judgments and evaluations as required.

The Director of the Office of Science and Technology also currently serves as science adviser to the President.

The Office draws on the capabilities of the President's Science Advisory Committee and the Federal Council for Science and Technology (both of which the Director currently chairs), the Federal departments and agencies engaged in research and development, and scientists and engineers outside of Government, particularly the National Academy of Sciences. The President's Science Advisory Committee, consisting of 18 eminent scientists and engineers, considers scientific and technological matters having national policy implications. The Federal Council for Science and Technology consists of policy-level representatives from the major agencies supporting research and development. It is primarily concerned with interagency planning, administration, and coordination of Federal research and development programs.

The workload of the Office is shaped by requirements for providing advice and assistance to the President as well as working directly with the Bureau of the Budget and the heads of the departments and agencies on budget issues of high technical content. A high degree of flexibility is required.

The Office concentrates on policy and program issues involving science and technology of importance to the President. These usually involve matters of unusual national security, fiscal, international, and scientific significance. The Office is principally concerned with problems that transcend the interest of any single agency of the Federal Government.

Results of a number of major studies last year under the auspices of this Office justify our belief that a handful of highly qualified and key professional people serving in the Executive Office of the President, backed up by many of the country's top scientists and engineers, constitutes a wise and necessary in-

vestment for the Government and the Nation. These people are providing much needed advice and assistance to the President in assuring that funds are being spent wisely and prudently for multibillion dollar programs of the Federal agencies and that new opportunities afforded by scientific and technological advance are realized.

The total estimated requirement for the fiscal year 1971 budget—$2,175,000 represents an increase of $217,000 over the fiscal year 1970 budget. The increase is due to an added cost of approximately $25,000 for conduct of full field investigations by the FBI for security clearances and $167,000 for additional contractual in-depth research studies conducted by OST, and $25,000 disbursed amongst several other object classifications in the budget.

PERSONNEL SUMMARY

	1969	1970	1971
Total number of permanent positions	54	57	57
Full-time equivalent of other positions	11	15	16
Average number of all employees	57	67	67.7
Average GS grade	11.4	11.4	11.6
Average GS salary	$14,701	$17,854	$18,048

JUSTIFICATION OF ESTIMATES—OTHER OBJECTS FISCAL YEAR 1971

12.0 PERSONNEL BENEFITS

Staff benefits include reimbursement to the employees retirement fund, health, and life insurance. This figure is approximately 8 percent of the amount required for permanent personnel compensation.

21.0 TRAVEL

Approximately $110,000 will be required for staff travel, both to provide attendance of the Director or his staff at important scientific conferences, and to enable members of the staff to convene panel meetings in locations other than Washington, when this is necessary. The remainder of the total requested will be used to cover the travel costs of the more than 220 panel members and consultants. This will include the travel costs for panelists who serve without compensation, but who usually request reimbursement for travel expenses incurred.

22.0 TRANSPORTATION OF THINGS

To provide for transportation of household effects of new employees who are in the CSC shortage categories.

23.0 RENT, COMMUNICATIONS, AND UTILITIES

To provide the necessary telephones, telegraph, and teletype services as well as postage expenses anticipated in the budget year.

24.0 PRINTING AND REPRODUCTION

To reimburse the GPO, other Government agencies, and private contractors for the printing and reproduction of numerous reports, publications, and allied material prepared by this Office, or prepared under the auspices of the President's Science Advisory Committee and the Federal Council for Science and Technology, and the Energy Policy Staff.

25 OTHER SERVICES

To provide for studies and reports prepared by non-Government organizations on behalf of this Office, and to provide for the necessary contractual services required, such as repair of typewriters, adding machines, and other office equipment, furniture rehabilitation, photographic and art work. Also includes reimbursement to other agencies such as public health unit services, the White House mailroom services, General Services Administration for messenger and related services, and to OEP for library services. In addition, it provides for

necessary security clearances for staff, panel members, and consultants. An estimated 100 clearances will be required for the fiscal year, at a unit cost of approximately $1,425, totaling $142,500.

26 AND 31 SUPPLIES, MATERIALS, AND EQUIPMENT

This amount will enable the Office to provide the items required for normal operations throughout the year, and to institute a program of gradual replacement of equipment which is no longer usable. It will also provide for the purchase of necessary periodicals and books.

PROFESSIONAL POSITIONS

Director (also serves as science adviser to the President).
Deputy Director.
Executive Officer, President's Science Advisory Committee.
Executive Secretary, Federal Council for Science and Technology.
Special Assistant to the Director.
Executive Officer.
National security affairs, including military systems and technology, arms control and intelligence (3 positions).
Space science and technology; aeronautical sciences and aircraft noise; communications.
Earth sciences, including the atmospheric and geophysical sciences—solid earth.
Academic science, including high energy physics, chemistry, materials, and computer research and utilization.
Civilian technology, including transportation, housing technology, urban research and development, industrial innovations and economic growth.
Water resources management and research.
Education.
Scientific and technical information.
Life and biological sciences.
Research and development program planning and policy development including systems research and cost-benefit analysis.
Energy policy coordination and energy research and development (3 positions).
Environmental quality and pollution abatement (2 positions).
Health and biomedical services.

ENERGY STUDIES

Mr. EVINS. Mr. Jonas, have you any questions?

Mr. JONAS. To what extent have you engaged in the energy study we discussed last year?

Dr. DUBRIDGE. This has been a very large activity in the Office, relatively. There are three people in the energy field—three full-time people in my office who devote themselves to energy policies and studies. This is more than we have in any single area other than national defense. They have worked on many intergovernment and cabinet groups and committees, on nuclear energy, oil imports, energy transmission, environmental problems relating to energy production, and the siting of powerplants to give maximum efficiency but also to give minimum environmental interference.

There are many problems in the future. As we face the use of our oil, and the transportation of oil and gas, we must consider the problem of a pipeline across Alaska to tap the Alaskan resources, and to avoid interference with the environment in that operation. What is the best mechanism for getting oil from the Alaska oil fields to the United States, to the west coast, and to the east coast? We are considering various technical solutions to the problems of transportation of the oil and its possible utilization.

The problem of sulfur content of oil and coal and gas is a serious one. When sulfur-containing fuels are burned in powerplants or industrial plants of any sort, sulfur dioxide is emitted to the air and this is a harmful, undesirable pollutant. We have been looking into questions of how to get sulfur-free fuels, which does not seem to be possible in adequate quantities, and how to remove the sulfur from the stacks when one is burning sulfur-containing fuels.

These are just a few examples of the many problems concerned with energy. The cost of energy, the taxation of energy sources, the question of what is the most economic use of natural resources in the future, that is, developing additional fossil fuel powerplants compared to uranium fuel plants, and so on.

POWERPLANT SITING

Mr. JONAS. As I read the papers about the situation in New York City, it seems to me someone is going to have to make a decision as to whether those people are going to have power or a better environment.

Dr. DUBRIDGE. That is right. It is a tough problem.

Mr. JONAS. They are running out of sites, aren't they?

Dr. DUBRIDGE. Every site proposed for a new powerplant meets some objection from some people. Therefore, powerplant construction has been delayed by long periods in many cases because of troubles within the environmental area and the objections of individual people or residents. Sometimes these are very valid objections which need to be met. Sometimes there are objections more imaginary than real, but in any case there will always be some objections to a powerplant at any place because somebody is going to be near it and will be fearful of its effect on his air, his traffic, or whatever. So this is a very serious problem as to how one can get the number of powerplants we need because the very people who object to a powerplant here are the ones who go home and turn on their air-conditioners and will be angry if they don't work.

Mr. JONAS. I have no further questions. I would just like to say, as usual, Dr. DuBridge has been very persuasive and has presented a very comprehensive picture of what is going on in the field of science. I have listened to him with profit.

Mr. EVINS. Mr. Marsh, do you have any questions?

OIL SPILLS

Mr. MARSH. I notice you people submitted your report on that oil slick off Santa Barbara. Are you working on the oil leakage problem they are having down in the gulf?

Dr. DUBRIDGE. We haven't been called in on that. The offshore problem is primarily a responsibility of the Department of the Interior and they have greatly increased their attention to the coastal oil problems in the past year. We were asked to do two things at Santa Barbara. First, in a quick way, recommend how to stop the leak which had emerged from the Union Oil platform. A very expert panel examined that situation, looked at the geology and the petroleum engineering problem involved at that particular installation, that particular oil dome, that particular oil pool, and recommended that, in view of the fact that the leak was there and that no method of plug-

ging up the leaks in the rock had been invented that was effective, the only way to stop the leak was to pump the oil as rapidly as possible to reduce the pressure so it would no longer ooze to the surface. That proved effective because the leak rate was reduced. When a pipeline was injured and they had to stop pumping for a few days, then the leaks began to emerge around the channel as the pressure built up again. As soon as they got it fixed and started pumping again, the leak receded. Therefore, it is clear that keeping the pressure in that particular oil dome down is absolutely critical to preventing further leaks from it.

Another panel also studied the longer term problem of oil drilling in the Santa Barbara Channel and elsewhere and submitted a report on that which the Interior Department will use as a basis of its policies and development of regulatory mechanisms for determining the extent to which future drilling operations will be allowed and under what conditions drilling may take place.

INTERDEPARTMENTAL COORDINATION

Mr. MARSH. I would like to emphasize the point made earlier by the Chairman on the real possibility of duplication, overlap, and possible lack of coordination between various Federal agencies that become involved in the environmental health problem. This has become quite evident in the Interior Subcommittee where you find many of the agencies like the Bureau of Land Management, the National Park Service, Water Resources, and Recreational Resources, in that particular department which don't seem to have a single guiding force at this time and it is reflected also in the National Science Foundation. You get the impression that no one at the present time is trying to draw together the various programs that may or may not be developed in the various agencies of Government.

Dr. DUBRIDGE. I realize interdepartmental coordination in government is always a very difficult problem. However, to a large extent the specific functions of different agencies are determined by law or by assignment. For example, the National Science Foundation's interests in the environmental problem are only to see if there are university activities, research and training activities, which will contribute to a better understanding of the problems and which should be supported by the Science Foundation. These will be more or less basic activities in ecology, pollution, and so on, and will in no way impinge on or overlap university research programs of other agencies.

The Science Foundation is in contact with all universities and will see to the coordination of university programs in the environmental field, and will simply support those programs which seem to be aimed at things that the universities are competent to do and which are not being done elsewhere.

As to the regulation of programs, sometimes these are within a single department where there are different bureaus that have different interests and different responsibilities, and it is a departmental job to see to the coordination there.

There is a limited amount which our office can do with our small staff, but we can watch the problem and are trying to watch it very carefully.

Mr. EVINS. Mr. Clawson.

Mr. CLAWSON. Thank you, Mr. Chairman. I have no questions but I would like to make the observation that Dr. DuBridge's expertise in this field, and the areas which he serves here, are well known to the people of California and we appreciate it.

AVOIDANCE OF DUPLICATION IN STUDIES

Mr. EVINS. We want to commend you, Dr. DuBridge, for your great work. I want to emphasize again that I see a real and important role for a coordinator in this field because there are so many agencies involved. Your role, as I envision it, is to gather these things together, coordinate them and present them to the President.

Dr. DUBRIDGE. That is true. We don't try to infringe on or impinge on the responsibilities of a particular agency, but where there are problems that involve several agencies and where we need an overall look, that is where we try to come in and do our best.

The trouble, Mr. Chairman, is that coordination if it is successful is never visible. If it is unsuccessful, then the lack of coordination becomes visible. I would now only suggest that the coordination that has been done is sort of hidden and it is the coordination that hasn't been done which always comes to our attention. We try to hit those spots.

Mr. EVINS. Again I think the matter of environment is a new area where there is need for coordination.

Dr. DUBRIDGE. That is true.

Mr. EVINS. Mr. McDade.

PROPOSED MHD RESEARCH

Mr. MCDADE. Doctor, I have found your statement most interesting and informative. I notice one of the reports that was issued was titled "MHD for Central Station Power Generation: A Plan For Action."

We have before us in another committee a request on this particular project and I wonder if you could put it in focus for me in terms of its importance as you view it.

Dr. DUBRIDGE. There is a very interesting and very forward looking field of endeavor to try to convert heat energy into electrical energy at very high temperatures through the process known as magnetohydrodynamics, in which very hot and therefore highly charged gases flow along a channel; with a magnetic field these ionized gases flowing through a channel generate a current and this can be used directly for power purposes.

One of the limitations on the efficiency of converting fuels to electrical energy is the temperatures at which you can operate. The higher the temperature in which you can operate and get your power off, the more efficiently do you use your fuel. But using steam at very high temperatures offers great difficulties. Here is a way; magnetohydrodynamics requires high temperatures to operate at all and allows you to operate and get power off at very high temperatures.

By using this in fossil fuel power stations, you can get more energy out of the same amount of fuel.

By getting more energy out of the fuel, you also reduce the amount of waste heat you have to discharge into the nearest river or into the air, so you not only use your fuel resources more efficiently, but you reduce the amount of waste heat you discharge. Waste heat is a repre-

sentation of inefficiency and the more efficiency you have, the more you use the heat and don't waste it. So we recommend there be a Government-private collaboration in developing the MHD process. It has been shown in the laboratory to work. It has not been shown on pilot plant installations yet, so there is a great deal of engineering to do to bring this mechanism into practical use. It will take a number of years to do the engineering and pilot plant test and so on, but we think it is so promising for a way of topping off our fossil fuel plants and making them considerably more efficient that it is worth an additional investment by the Government and by private industry.

The Government has spent great sums of money to develop uranium energy. We have spent very little Government money on the use of fossil fuels, which is just as valuable a resource as uranium.

COSTS OF MHD DEVELOPMENT

Mr. McDade. It is estimated to cost as much as $100 million to develop this, is that correct?

Dr. DuBridge. It may cost that in the end.

Mr. McDade. How does that compare with the money we have spent in developing uranium as a source of energy or in terms of our resources, potentially fossil fuels, that this might make more attractive to us?

Dr. DuBridge. It is far less than we have spent and what we are going to spend on the development of fission reactors. We are spending hundreds of millions of dollars during the next few years, probably billions, to get breeder reactors to utilize uranium fuel more efficiently. Fossil fuels are a valuable resource too that we should use more efficiently. A modest expenditure per year, as suggested here, with sharing between the Government and the industry, is significant. If it gets to the engineering pilot plant stage, it will require a larger expenditure, but a few million dollars to prove it out seems to be a very good investment.

Mr. McDade. What do you mean by a few million dollars?

Dr. DuBridge. I think $2 million is proposed this year to be matched by about an equal amount of private money to carry on the next stage of research.

Mr. McDade. Doctor, is there any question in your mind that perhaps at the very time we got MHD developed, if indeed it could be done, the country would then be shifting to atomic energy as a source for electric power?

Dr. DuBridge. I think the energy needs in this country are going to continue to rise at such a rate that we will need all of our energy sources. Fossil fuel, as well as uranium.

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

Mr. Jonas. May I ask one more question?

Mr. Evins. Surely.

SUPERSONIC TRANSPORT STUDIES

Mr. Jonas. I forgot to mention this: I was surprised not to read anything in your statement or see any study on the SST.

Dr. BuBridge. This isn't the complete catalog of all the things we did. The President established an interagency committee early last

year to bring together all the facts, ideas, and problems in connection with the SST, and so representatives of the Council of Economic Advisers studied the economic problems, and the Treasury representatives studied the Government expenditure problem. Our group studied some of the technical problems. The FAA did a further analysis on the technical problems and we all threw our ideas into this committee, which issued a report to the President which showed costs, benefits, options, and so on. We indicated our views as to the technical potentialities of the SST, the uncertainties of technical performance and economic returns, as well as the potentialities. So we did have an input in the SST study.

Mr. JONAS. What did you find with respect to the sonic boom?

Dr. DUBRIDGE. The sonic boom is a problem that no one knows how to solve now and the only way of avoiding the sonic boom being damaging is for the Government to adopt, as it has adopted, the policy that the SST will not fly at supersonic speeds over the continental United States. It would be largely for transoceanic travel where the extra speed is especially important anyway.

Mr. CLAWSON. Mr. Chairman, may I be permitted one more question?

Mr. EVINS. Surely.

INVENTORY OF CONTRACTS

Mr. CLAWSON. Is your office in a position to be a single source of inventory for all of the contracts that are being let by agencies of the Government?

Mr. DUBRIDGE. I am afraid not.

Mr. CLAWSON. Is there any single source for this type of information?

Dr. DUBRIDGE. That would be a huge problem.

Mr. PAGNOTTA. The Bureau of the Budget does play an important part in doing such a thing.

Mr. CLAWSON. Do they attempt to bring together an inventory of all these things?

Mr. PAGNOTTA. Not an inventory, but they are well informed and well aware and they do review the need for a great many of the contracts.

Dr. DUBRIDGE. When we develop the idea for a contract to study a specific problem, it is the business of our people who are interested in that specific problem to know what is going on in other agencies on that particular problem. They determine what the necessary studies are and whether they are being conducted by the other agencies, and only when they see they are not and where we have a need for studies not being carried on elsewhere do we then go ahead with it. In any particular problem that comes along we will make the necessary study to make sure that we need to make a study. We only do it where there is no other possibility.

SPACE PROGRAM RECOMMENDATIONS

Mr. EVINS. Doctor, you are familiar with both the Space Task Group report and the President's science advisory report.

Give us some insight on this. What do these two reports recommend?

Dr. DuBridge. Very broadly, both the Space Task Group report and the President's science advisory committee report, which focused more on the scientific aspects, recommend that we proceed with our programs of scientific exploration of the earth and of the solar system. This can be done by scientifically instrumented spacecraft circling the earth and going to the various planets, including the so-called grand tour, where there is an opportunity to hit several planets in one swoop, for scientific purposes.

Secondly, it is proposed that we continue and enhance a program of getting practical values out of our earth satellite program by using satellites which will give us more information about the weather, about meteorology generally, about coast and geodetic problems; studying forests, crops, coastlines, and so on to get more information about earth resources; to study the entire world with regard to agricultural production, forestry production, and so on. We will share this information with the world and have the other countries share in the cost of analyzing and using this information, so substantial international collaboration will be involved as well as interstate and interagency collaboration. Agriculture, Interior, and many other agencies are interested.

REUSABLE ROCKETS

The third general goal is to advance space technology so that we can get improved and more economical methods of carrying men and equipment into space. The so-called "shuttle program" is the step that is now envisaged in that, to create reusable rocket vehicles so that you don't launch a big load into space and throw away the enormous rocket which it took to launch it, but will take that rocket, convert it into an airplane and bring it back home, refuel it and use it again. And the same with the second stage. It will be a reusable rocket, so that one could have a technology to take loads, even large loads, into orbit and bring them back and take another load into orbit, or take men into orbit and bring them back and so on, and do this at a cost hopefully 10 times less per pound than it now costs.

BALANCE BETWEEN MANNED AND UNMANNED FLIGHT

Mr. Evins. What will be the effect of manned lunar landing on scientific applications in the future?

Dr. DuBridge. It is a balanced program, Mr. Chairman; the intensity of activity in the manned field will be reduced since we have completed the very expensive task of sending men to the Moon and bringing them back. We will continue to send the Apollo vehicles to the Moon until they are used up to get additional scientific information about the Moon, but the cost of the manned program will be substantially less in the next few years than it was during the last few years, which peaked up because of the Apollo program.

There will be continued emphasis on scientific and practical applications, but a smaller emphasis on manned flights until the new technology is developed which will allow us to do manned operations more cheaply in the future.

I would anticipate that as we get ready to launch a manned space station for a variety of scientific and technical objectives, manned

flight will then accelerate again. It will be used again, especially when, as and if we find it desirable and possible to send a manned expedition to the planet Mars. But during the next few years we will be giving less attention to actual manned flight than to scientific and technological unmanned flight and to the development of a better technology for the future, for both manned and unmanned flights.

Mr. EVINS. Doctor, let me read from your report:

"If no weight were given to the indirect or sociopolitical values from this Nation's space activity, and we view the space program only for its scientific and technical content and the direct applications benefits that result, what would be the recommended content and level of effort? The Panel believes that these restricted grounds alone would justify a civilian space program about half the magnitude of the present level. This program would include vigorous application of space technology, a substantial program in space science, and a strong research program aimed at future space applications. This Panel believes that, on these narrow grounds alone, the cost of manned space flight operations imposed by today's expendable booster technology do not justify the conduct by astronauts of space science or space application activities in light of the automated alternatives and the opportunities for advantageous investment in other areas of science. The development of recoverable and reusable space transportation might, when complete, reopen the question of cost-effective use of man in space."

Are you recommending in your report some reduction in the space program?

Dr. DUBRIDGE. Yes, and that is what the President has done in his budget. You see, the space program peaked up at something around $6 billion and a large chunk of that at the peak was the manned program, something like one or two billion dollars.

Mr. EVINS. What does your report say, should it be less than $3 billion?

Dr. DUBRIDGE. We are saying $3.3 billion is about the right level and most of the reduction has been taken out of the manned program, leaving the scientific and unmanned programs about at the same level.

Mr. EVINS. We thank you, Doctor, very much.

In summary, your appropriation last year was $1,958,000 for 57 jobs. Next year, $2,175,000 with the same number of jobs, 57 jobs. An increase of $217,000. Is this correct?

Dr. DUBRIDGE. Yes.

Mr. EVINS. Thank you very much, Doctor. Thank you for your interesting presentation.

Dr. DUBRIDGE. Thank you very much.

MONDAY, MARCH 23, 1970.

NATIONAL AERONAUTICS AND SPACE COUNCIL

WITNESSES

WILLIAM A. ANDERS, EXECUTIVE SECRETARY
CHARLES FRIEDLANDER, ASSISTANT
RUSSELL HALE, ASSISTANT

Mr. EVINS. Next we will consider the National Aeronautics and Space Council, headed by Mr. William A. Anders, the Executive Secretary. Place in the record the budget justifications for the National Aeronautics and Space Council.

(The information follows:)

SALARIES AND EXPENSES

PROGRAM AND FINANCING (IN THOUSANDS OF DOLLARS)

	1969 actual	1970 estimate	1971 estimate
Program by activities:			
Policy coordination (program costs, funded)[1]	477	571	560
Change in selected resources[2]	22	−22	
Total obligations	499	549	560
Financing: unobligated balance lapsing	1		
Budget authority	500	549	506
Budget authority:			
Appropriation	500	500	560
Proposed supplemental for civilian pay act increases		49	
Relation of obligations to outlays:			
Obligations incurred, net	499	549	560
Obligated balance, start of year	20	50	57
Obligated balance, end of year	−50	−57	−68
Adjustments in expired accounts	1		
Outlays, excluding pay increase supplemental	470	495	547
Outlays from civilian pay act supplemental		47	2

[1] Includes capital outlay as follows: 1969, $3,000; 1970, $10,000; 1971, $8,000.
[2] Selected resources as of June 30 are as follows: Unpaid undelivered orders: 1968, none; 1969, $22,000; 1970, none; 1971, none.

OBJECT CLASSIFICATION (IN THOUSANDS OF DOLLARS)

Personnel compensation:			
Permanent positions	384	450	422
Positions other than permanent		1	3
Other personnel compensation	5	5	5
Special personal services payments	20		
Total personnel compensation	409	456	430
Personnel benefits: Civilian employees	27	36	34
Benefits for former personnel	2		
Travel and transportation of persons	4	14	38
Rent, communications, and utilities	9	10	15
Printing and reproduction	8	10	12
Other services	23	16	20
Supplies and materials	8	3	3
Equipment	9	4	8
Total obligations	499	549	560

PERSONNEL SUMMARY

	1969 actual	1970 estimated	1971 estimated
Total number of permanent positions	26	26	21
Average number of all employees	23	24	21
Average GS grade	11.1	11.3	10.3
Average GS salary	$15,227	$16,956	$18,150
Average salary of ungraded positions	$18,017	$21,316	$28,655

National Aeronautics and Space Council

JUSTIFICATION OF ESTIMATES FOR FISCAL YEAR 1971

1970 Appropriation	$500,000
1970 Proposed pay raise supplemental	49,000
Total	549,000
1971 Estimate	560,000

The National Aeronautics and Space Council is responsible for advising and assisting the President on policies, plans, and programs of the United States in aeronautical and space activities.

The Vice President of the United States is Chairman of the Council. Other members include the Secretaries of State and Defense, the Administrator of the National Aeronautics and Space Administration, and the Chairman of the Atomic Energy Commission. This appropriation provides salaries of the Council staff and expenses of Council operations.

The National Aeronautics and Space Council was established by section 201 of the National Aeronautics and Space Act of 1958. The current membership was fixed by amendment in 1961 at which time the Council, as an agency, was placed in the Executive Office of the President.

The Council's functions include surveying policies, developing programs, designating responsibilities, providing for cooperation, and resolving differences. Performance of these functions applies to all aeronautics and space activities and to all departments and agencies of the Government engaged in such activities.

The budget estimate provides for a reorganized staff of capable and knowledgeable personnel able to carry out the statutory functions in both aeronautics and space. Detailed operating responsibilities and administrative program supervision will continue to be exercised by other agencies with larger staffs or with specialized capabilities. The Council staff seeks to guide, to plan, and to coordinate in order to avoid duplication in both expenditures and functions of other Government agencies.

Plans call for maintaining a total staff of approximately 21 individuals, including the Executive Secretary, skilled in both policy and technical areas. Under the supervision of the Executive Secretary, the staff is responsible for preparing policy recommendations and taking other actions which enable the Council to advise and assist the President throughout the broad spectrum of aeronautics and space activities, and also to assist the President in his management of national resources—men, money, and materials. The Council meets at the call of the Chairman to take up major issues which requires joint consideration by the members. The Executive Secretary is responsible for bringing such issues to the attention of the Chairman, and making the necessary preparations for constructive sessions. Frequent meetings, briefings, and consultations are conducted or participated in by the staff with policy-level members of other agencies in order to resolve such issues of interagency concern which may be dealt with before they become a problem warranting Council attention.

The Executive Secretary personally maintains close contact with the agency heads and their designated assistants in order to insure top level coordination of Council staff activities. Close cooperative relationships are being developed with appropriate committees of the Congress as well as with industrial and scientific groups with interests in the fields of aeronautics and space.

Provision is made in this request for salaries and expenses including travel

and transportation, rental of motor vehicles, communications, and utilities; printing and reproduction; supplies and materials; equipment; personnel benefits; and other services shown in the accompanying object classification schedules.

PERSONNEL COMPENSATION AND STAFFING—$430,000 FOR 21 PERMANENT POSITIONS

	1969	1790	1971
Permanent positions	26	26	21
Average employment	23	24	21

Summary statement on "Other objects" for 1971, $130,000

12. *Personnel Benefits, $34,000.*—Includes contributions to retirement fund, health benefits, and group insurance.

21. *Travel and transportation of persons, $38,000.*—Includes funds for travel to space research and development sites for firsthand study by Council staff. Also includes funds for hire of automobiles when needed for transportation of officials and staff of the Council on official business in the Washington area.

23. *Rent, communications, and utilities, $15,000.*—For telephone services and equipment usage and other utilities as required. Also included are telegraph and postage.

24. *Printing and reproduction, $12,000.*—Provides for printing and binding of reports, studies, and other publications as needed, and normal duplicating done on a commercial or reimbursable basis.

25. *Other services, $20,000.*—Provides for reimbursement to GSA for administrative services; for office machine repair, furniture repair, personnel security checks, health room services, and for commercial contracts.

26. *Supplies and materials, $3,000*—For office supplies and other work materials such as legislative bills, reports, enacted legislation, and periodicals.

31. *Equipment, $8,000.*—For office furniture, furnishings, and specialized equipment.

Mr. EVINS. Mr. Anders is a very distinguished American. He has been a successful astronaut and is now Executive Secretary. We will be pleased to hear you.

GENERAL STATEMENT

Mr. ANDERS. Thank you, sir.

This is my first appearance before your committee and I welcome this opportunity to talk to you about the National Aeronautics and Space Council and about my plans for staff activities to support the Council and to assist in the decisionmaking process which results in policy decisions by the President.

In one of our meetings last fall, soon after I assumed my responsibilities as Executive Secretary, the Council approved my plans for staff operations; I am grateful to its members for the help and support they have given me. The Council fully supports the proposal made to the President by the Space Task Group, and the Council is prepared to be utilized in the future as a mechanism for continuing reassessment of the character and pace of the space program.

AERONAUTICS SIGNIFICANCE

One of the things which I would like to underscore at the outset is the significance of aeronautics, as well as space, in our task and in our national perspective. Perhaps it is due to my personal experience,

both as an aviator and as an astronaut, that I lay stress on the importance of both fields. I am carrying this concept forward in the reorganization and revitalization of the Council staff. There is much interest developing in aeronautics and I feel that the Council can serve as a focal point or catalyst for national planning and coordination in this field. Accordingly, within the Council staff, I am developing a strong aeronautics group as well as a space group on which I will be able to rely for solid technical expertise to support policy planning.

Insofar as Council membership is concerned, the Secretary of Transportation, although not a formal member, is invited to participate in Council meetings whenever matters affecting aeronautics are under discussion. Other invited participants are the Directors of the Office of Science and Technology and the Bureau of the Budget.

A current area for study and review involves staff research on the past issues and studies on aeronautics done for the Congress, for governmental agencies, and for others in this field. In due course, we hope to propose for Council consideration some recommendations on the appropriate direction and scope of the Government's aeronautics policy.

During the 1960's insofar as space was concerned, our Nation's goal was to establish a capability for both manned and unmanned exploration of space. The lunar landing and return was the most prominent goal for nearly a decade and was the focal point for most of our energies. The first landings have now been accomplished and more lunar exploration lies before us.

FUTURE GOALS

The new space program for the 1970's was outlined in President Nixon's statement on March 7 on this subject. He provided three general purposes to guide the program: exploration; acquisitions of greater scientific knowledge; and practical applications for the early benefit of life on earth.

Having reviewed the programs to be carried out under the President's budget request for fiscal year 1971, it now becomes important that the National Aeronautics and Space Council continue to examine these plans as they unfold in the future to assure that the purposes and the objectives of the President are met. We all realize that contributions to the quality of life here on earth are imperative. Our space capabilities, as they mature and develop to a natural and powerful part of our lives, can and must contribute in the future as aeronautics has contributed in the past. The practical applications of our science, technology, and operational capabilities will be used as the President has guided for "the early benefit of life on earth." Our communications, navigation, earth resources survey, and other satellites meet that guideline.

It is my view that action by the Council and skillful and diligent effort by my staff in its support of the Council and other agencies of the Executive Office of the President can help to bring about efficient use of funds for the national program. We must all help to make every dollar count.

THE VICE PRESIDENT'S LEADERSHIP

This has been recognized by our Chairman, the Vice President, and there is renewed opportunity for the Council and for my staff to provide a focal point and exercise vigorous leadership in aeronautics and space under the direction of the President.

Our budget is austere when one considers the responsibilities that lie ahead, but I feel that by controlling our outlays carefully, we can do the job laid down for us by the Congress with 21 employees and the requested funds. There is much at stake in our Nation's aeronautics and space activities and there are heavy demands from all quarters on our national resources. I feel that providing the capability for competent advisers in the President's Executive Office is a very sound investment.

Gentlemen, that is my statement. Now I hope that I can answer any questions which you may have. If I do not have the answers in hand, I will attempt to provide them promptly for the record.

LEGISLATIVE BACKGROUND

Mr. EVINS. Thank you, Mr. Anders. The Council was created by the Congress as a part of the Space Act. Cite for the record the legislation which created your office.

Mr. ANDERS. It is set up by section 201 of the National Aeronautics and Space Act of 1958, as amended.

Mr. EVINS. Your job is to advise the Vice President who in turn advises the President on matters of national space policy.

Mr. ANDERS. Also including aeronautics.

Mr. EVINS. Mr. Anders is a distinguished aviator, a distinguished astronaut, and you can perform a very effective role.

ADVISORY REPORTS

We have before us two reports, one is "The Next Decade in Space," and the other is entitled "Directions for the Future of the Apollo Space Program." Would you tell us about these Mr. Anders?

Mr. ANDERS. The report entitled "The Next Decade in Space," was written by the President's Scientific Advisory Committee, which was part of the President's Space Task Group STG.

It is our understanding that this is essentially the same report that was submitted as part of the input into the formulation of the STG report. I think the summary of this input, plus several others, and the great deliberations that went into the formulation of the Space Task Group report, makes this the basis for the President's future space program.

I must say that the President, in his statement from the White House about 2 weeks ago, took the recommendations as proposed here which included the advice from the Science Advisory Committee, the NASA, the DOD, and has made a departure from this report——

Mr. EVINS. Would you tell us something about the STG report?

OPTIONS RECOMMENDED

Mr. ANDERS. The STG report represented three options. Essentially a technology limited program, a crash program, if you will, which would represent the most expensive program now and in the future.

The report also recommends an option which is very austere in the space program. I do not recommend that one either. I recommend the middle road, which is essentially the one that the President has followed.

Mr. EVINS. There are three options in this report; is that right?

Mr. ANDERS. Yes, sir. The Vice President recommended three possibilities. He wanted to present to the President various options which he might follow. He said, here are the limits which we think fall within the realm of possible reason; either a very economic, austere program, or a crash program. The Vice President personally recommended the middle road.

From the Vice President's recommendation of option 2, in the Space Task Group report, the President, after analyzing recommendations of the STG group and the other competing demands on his resources, has taken an even slightly more conservative program for the future than recommended by the option 2.

Mr. EVINS. We look upon you as an authority. You are an advisor to the Vice President and in turn the President, and we want you to advise this committee. What do you recommend this committee do with respect to the space program which begin hearings tomorrow?

Mr. ANDERS. Sir, I heartily support the President's program as outlined in his statement, which is a modification of option 2 of the Space Task Group report.

Mr. EVINS. What does that modification of option 2 embrace?

THE PRESIDENT'S DECISIONS

Mr. ANDERS. It essentially stretches out some of the timing of the various programs that the Space Task Group recommended. In other words, I have a summary here that probably Dr. Paine will show you tomorrow. For instance, it recommends a meterological satellite in 1971. The President has chosen to make that launch in 1972. In other words, to try to cut down the total expenditures.

Mr. EVINS. Read some of the other modifications.

Mr. ANDERS. Synchronous meteorological satellites have been slipped each year. This is up through 1973. The applications technology satellite has been moved from 1972 to 1973.

The Apollo applications program has been slipped roughly a year. I think the most significant change between the Space Task Group report and the President's program for space is associated with the follow-on lunar landings after Apollo 19. The Space Task Group recommended to the President that the Saturn 5 production be continued after Apollo 20. Now, the President's decision is to terminate production of the Saturn V and that future lunar landings will wait until the development of things like the space shuttle, space transportation system, and the nuclear-powered rocket. Possibly in the late seventies or early eighties as the costs are reduced.

Mr. EVINS. In the next decade will emphasis be on scientific applications and approaches or on the manned lunar landings in your view?

Mr. ANDERS. The manned lunar landings in the Apollo program, sir, will terminate in the 1974 or 1975 program. We will not have the hardware.

I would say that the follow-on landings will be balanced—and this

is in the eighties, after this hiatus when we have the development of the space transportation—the follow-on landings, if any, would be balanced against the scientific applications aspects of space.

Mr. EVINS. What do you recommend for the space program in the next 10 years?

Mr. ANDERS. I recommend that the Apollo program be continued through Apollo 19 and that we then concentrate our resources in the area of manned flight to the development of economical methods to transport men and materials into earth orbit and beyond.

Mr. EVINS. The space budget before us has both approaches, manned and unmanned, and you recommend that budget, don't you?

Mr. ANDERS. Yes, sir.

Mr. EVINS. Both manned and unmanned flights?

Mr. ANDERS. Yes, sir. I think there is certainly reason and value in both, particularly in the areas of applications where the meteorological satellites and earth resources survey satellites are grouped.

SPACE SHUTTLE PROGRAM

Mr. EVINS. Have you looked into the need for a space shuttle payload of 50,000 pounds against a smaller one, say 10,000 pounds? Would it be better to build a smaller vehicle initially?

Mr. ANDERS. That is a very complicated question, Mr. Chairman. I have people on my staff who are looking at this particular point very closely because certainly it is one of great interest between the Department of Defense and NASA. We would like very much to make any space shuttle vehicle a truly national program; that is, one that can be utilized both by the civilian space program and also has application to the Department of Defense and its requirements. One of the requirements in the Department of Defense is this 50,000-pound payload and cross-range requirement. These must be traded off, as we learn more about the difficulty of building such a vehicle, with the capability of actually realizing success.

At this stage, though, we are not able to say it would be better to build a smaller vehicle. It is not clear that a small vehicle would be that much easier to build than a big one. If it would be possible to have a successful flight on a vehicle that would perform the national mission, then we would like to do that, but, on the other hand, we do not want to jeopardize our plans or chances for success at all by starting out too big at first.

Mr. EVINS. In other words, the Department of Defense has recommended the 50,000-pound space shuttle, but NASA and other advisers are looking this over and they haven't come up with a decision as yet?

Mr. ANDERS. Yes, sir.

Mr. EVINS. Mr. Jonas, have you questions?

Mr. JONAS. I think any questions I might have had have been answered in the colloquy that has occurred.

Mr. EVINS. Mr. Marsh.

Mr. MARSH. It is a pleasure to have the Executive Secretary here today.

DUPLICATION AND OVERLAP

Earlier in the hearing that was held here for Dr. DuBridge, the question came up as to duplication and overlap that exists in the Federal system on several tiers in which we are moving, specifically in environmental health and a whole series of things.

This question also occurs in the space program. Now, in reference to the function of your committee, assume that in looking at the shuttle load we were talking about earlier, you reach one conclusion as to what that shuttle load should be, and Defense reaches another and NASA reaches another, and Dr. DuBridge's task force reaches another. Whose recommendation will be followed?

Mr. ANDERS. It might be helpful for me to explain just one relationship here, Congressman Marsh, that I think is important. The task group, the Space Task Group report was made last summer prior to my arrival at the National Aeronautics and Space Council. It was undertaken originally by Dr. DuBridge—I think it is safe to say—because the Council I am involved with had not been utilized particularly in the near past. In fact, it did not then have an executive secretary. People from my staff had input into this report, though not much. We feel it is the National Aeronautics and Space Council's roll, and it is recommended in the Space Task Group report, to continually reevaluate and assess the program and essentially rise to the responsibilities outlined in the Space Act and that is what I am trying to form up to do.

The reason I mention this is because such questions as payload for a shuttle—the STG sort of thing; it is something to work from. It does not represent any particular formula that must be applied or that the administration thinks must be applied in space.

The question of payload and other facets of the space shuttle that come as coordinating items between the Department of Defense and the NASA, in trying to establish a nationally capable vehicle, would hopefully be worked out on their levels with people from my staff keeping aware. We are on the requirements panel as observers between the DOD and the NASA with respect to the shuttle. I am an observer on the Aeronautics and Astronautics Coordinating Board between NASA and DOD. One of the things specifically stated in our charter is the coordination aspect. To prevent overlap and also in the case you are bringing up, sir, to make sure that both parties have an equal day in court and that no one gets the bit in their teeth and runs with it.

Our staff will be aware of the various facets of the argument, or discussions with respect to payload, cross-range and those aspects of the shuttle and if these are unresolvable on an agency-to-agency basis, with possibly some stimulation on our part, then it would be the responsibility of the National Aeronautics and Space Council, which is made up of the Secretary of Defense, the Administrator of NASA and others, to meet in executive session to consider the points of the argument, and then make a recommendation to the President.

Since this is a very technical aspect of our program, the cross-range and payload, it probably will not reach the policy and planning functions of the NASC, as they meet in executive session and we hope to get technical details solved before we surface to that level and I feel certain we will, sir.

AERONAUTICS EMPHASIS

Mr. MARSH. I was impressed by your statement that you tended to put increased emphasis on aeronautics. In the field of aeronautics, where do you think your principal thrust is likely to occur? Air traffic control, airport congestion, the problem of noise abatement, air pollution, hijacking? What will be the principal thrust as you see it within the field of aeronautics?

Mr. ANDERS. I think it has been assumed in the past that the National Aeronautics and Space Council had a parallel interest with NASA with respect to aeronautics. NASA's role has classically been a research and development one. It is my view that you cannot separate aeronautics R. & D. from those things that might sometimes be referred to as aviation. I think this is more than just a semantical point. I think that the R. & D. that NASA does must consider the requirements of the Department of Defense, must consider the requirements of FAA, the airlines, and aviation industry and therefore in building up my staff to address the question of aeronautics, I am trying to find people who are knowledgeable, not just in R. & D., but in operations and in the military aspects of aeronautics. Certainly the environmental factors of aviation that you mentioned, pollution and noise, are very important and we are working with aeronautical specialists, but also in coordination with the President's Council on Environmental Quality and with the Office of Science and Technology.

We would like to address aeronautics across the entire spectrum as our capabilities will permit. That is my long-range plan. I think this Nation needs more clearly stated national goals in aeronautics and it would be my attempt to try to help the President formulate these goals.

Mr. MARSH. Thank you, Mr. Chairman.

Mr. EVINS. Mr. Clawson.

Mr. CLAWSON. I have no questions, Mr. Chairman.

CURRENT EXPENDITURES

Mr. EVINS. Can your budget officer tell us the expenditures to date?

Mr. HALE. We have been running within 5 percent of our quarterly allotments which the Bureau of the Budget gives us.

Mr. EVINS. Place in the record the expenditures to date.

(The information follows:)

Outlays for 8 months (to February 28)	$342,118
Interim estimate through March 20	385,891

Mr. EVINS. Why can't your small agency absorb your pay raise?

Mr. HALE. Because the agency is small and we don't have that many places in which we can absorb so much and because the law required the changes in the salary level.

Mr. EVINS. What is the requested increase for?

Mr. ANDERS. Mr. Chairman, our increases requested this year essentially are for a reorganized staff and amounts to cover additional increases in costs of operations, and to cover the expanded activity in

travel that I think is very necessary for our staff to enable the men to acquire reasonable knowledge and give informed advice in the area of our responsibilities.

NUMBER OF EMPLOYEES

Mr. EVINS. Can you tell us the number of employees now on board?

Mr. ANDERS. We have on board 20 employees with six vacancies, three of which are unfunded this year. There are three for which we are trying to find qualified people in this fiscal year. We have several under evaluation at the moment and we have three unfunded vacancies.

Mr. EVINS. Last year Congress authorized you $500,000 and 26 jobs and to date you have 20 filled.

Mr. ANDERS. We have had several retirements since my arrival.

Mr. EVINS. That is why I asked if you couldn't absorb that little pay raise. You haven't filled your positions to the authorized level.

Mr. ANDERS. I agree with what Mr. Hale said; because of the limited number of our employees, we would face hardship if we were unable to receive our needs from the pay supplemental—I understand now it is pending before another committee.

SUPPLEMENTAL REQUESTS

Mr. EVINS. The Appropriations Committee doesn't look with favor upon supplementals. We like to give you an appropriation for a year and have you operate within those funds.

Mr. ANDERS. Yes, sir.

It is my view had it not been for the pay raise, we would have been able to operate with the money we had. But, frankly, the requirement to do the job as outlined in the National Aeronautics and Space Act, I believe, is an important one and one that I feel unless we are able to get the plan we have requested for the next fiscal year without supplementals——

Mr. EVINS. The Council has been in effect for a number of years. The space program is down and yours is going up.

Mr. ANDERS. Yes, sir.

Mr. EVINS. When you said you had 26 jobs and only 20 aboard, it looks like there is enough difference there to absorb the pay raise.

Mr. ANDERS. We have very recently had three retirements within the last month.

Mr. HALE. Two on March 6.

Mr. ANDERS. And therefore these vacancies are very transient, since replacements are needed. I hope very much to be able to do a better job with respect to helping the space program in the future than has been done previously as a matter of fact. I think it is particularly important in a time of a decreasing space budget that the President have people who can help him maximize the return on his dollar and so, though I recognize the space budget is going down, I don't think it is completely inconsistent that ours is going up.

Mr. EVINS. We congratulate you, Astronaut Anders.

EXECUTIVE OFFICE OF THE PRESIDENT

Council on Environmental Quality

WITNESSES

RUSSELL E. TRAIN, CHAIRMAN, COUNCIL ON ENVIRONMENTAL QUALITY
DR. GORDON J. F. MacDONALD, MEMBER
ROBERT CAHN, MEMBER
BOYD GIBBONS III, SECRETARY TO THE COUNCIL
ALVIN ALM, SENIOR STAFF MEMBER
W. G. SAVAGE, ADMINISTRATIVE OFFICER

Mr. Evins. The committee will come to order.

We have with us this morning the Chairman and members of the newly created Council on Environmental Quality.

The Chairman is Russell E. Train, accompanied by those set out above.

This is a very distinguished group.

Mr. Chairman, we know of the importance of your work and will be pleased to hear you. Have you a statement for the committee?

Mr. Train. Yes, sir, I do.

Mr. Evins. You may proceed as you wish.

Mr. Train. Thank you very much. I will read the statement, if that is agreeable to you, Mr. Chairman.

Mr. Evins. Surely.

GENERAL STATEMENT

Mr. Train. Mr. Chairman and members of the committee, I appreciate this opportunity to appear before you for the first time in my capacity as Chairman of the Council on Environmental Quality, to report on our programs toward implementing the provisions of the National Environmental Policy Act of 1969, Public Law 91–190, and to support the President's request for $300,000 for fiscal year 1970 and $700,000 for fiscal year 1971 to carry out the provisions of the act.

I should mention at this point, Mr. Chairman, that on either last Thursday or Friday, the President signed additional legislation under the title of the Water Quality Improvement Act of 1970. That was legislation known here in the House as H.R. 4148 and essentially contains provisions dealing with oil spill cleanup liability but also contains a title II which establishes an Office of Environmental Quality. I am simply mentioning this for your information. It is not before us here, today, but I think this committee should be aware of this other legislation and have it in mind.

Mr. Evins. Is it envisioned that other legislation will be assigned to you as additional work?

Mr. Train. That is right, sir.

The congressional intent was to mesh the new Office of Environmental Quality with the Council and, through the new office, provide additional staff and funding for the Council.

Mr. Evins. I dare say, Mr. Train, there will be other legislation in this field before the Congress adjourns. There is a lot of interest, a

lot of activity, a lot of overlapping, and you have a big job to coordinate it and prevent duplication.

We understand you have more legislative authority.

Mr. TRAIN. That is right, sir.

In signing into law on January first the legislation establishing the Council on Environmental Quality, President Nixon noted that this was his first official act of the decade of the seventies, thus giving dramatic emphasis to the commitment of his administration to protecting and restoring the American environment. The President has assured the new Council of his full support and backing.

The Congress has given the Council a very broad mandate, and the President has promulgated Executive Order 11514 to spell out in greater detail its functions and authority in carrying out that mandate.

With your permission, I will summarize the more important responsibilities assigned to the Council and then comment briefly upon its role.

CONDITION OF ENVIRONMENT

First, the Council is directed to study and report the condition of the Nation's environment. This responsibility will require a continuing process of monitoring, evaluation, and prediction. The results of this process will become a part of the President's annual Environmental Quality Report. The identification and measurement of environmental trends would seem to require the establishment of data baselines in atmospheric, terrestrial, aquatic, and marine environments, among others. Much of this fundamental data is not presently available at all. It will be necessary to develop systems, some of which will be international in nature as in the case of atmospheric data. Wherever possible, agencies with direct program responsibilities will be encouraged to undertake the necessary tasks. Finally, assuming that effective systems are established for procuring and measuring needed information, the Council will have the ultimate responsibility of synthesizing and interpreting this data so as to be useful in policy and decisionmaking.

DEVELOP NEW PROGRAMS

Second, the Council will be the President's primary instrument in the development of new environmental programs and policies. For this purpose, the Council will monitor and evaluate all Federal environmental programs. Perhaps even more important, the Council will explore new problems for which present programs are either nonexistent or inadequate. In this connection, the President has spoken of the need to establish an environmental early warning system. We must undertake advance planning to meet critical problems which may still lie below the horizon of public awareness.

COORDINATION

Third, the Council will promote coordination of environmental programs scattered throughout the executive departments and agencies. In carrying out this coordinating function, the Council will keep exit-

ing organizational arrangements under continuous review and recommend organizational changes as appropriate.

Fourth, the Council will seek to insure that all the activities of the Federal Government take environmental considerations into account. Many Government activities—highway and airport development, dam construction, and public works generally, among others—can have important environmental effects. The President has directed the Council to review such activities and to issue guidelines to insure that they will be conducted in a way which does not degrade the environment.

ANNUAL REPORT

Fifth, the Council will assist the President in preparing an annual Environmental Quality Report. The first report will be due this July 1, and will identify major environmental problems. It could help stimulate public understanding of environmental problems and guide Government decisionmaking. Plainly, in the brief space of time available to us before the first report is due, the report will be less comprehensive than in subsequent years.

Already the Council has begun work on a variety of environmental problems. These include the reuse and recycling of solid waste, tanker oil spills, agricultural pollution, unconventional vehicles, ocean dumping, detergents, pesticides, land use planning, and environmental monitoring.

While the Council will necessarily direct attention to these issues of national significance, I believe we must avoid becoming a sort of environmental fire brigade rushing from one brush fire to another. The temptation will be great on the part of committees of the Congress, Federal agencies, and perhaps the public at large to refer controversial environmental issues—often local in nature—to the Council for review and recommendation. The fact is that the Council is not equipped for such a role. It must be carefully selective in its choice of issues, and, indeed, must exercise strict self-discipline in this matter because the temptation to respond will be great. It is my belief that the Council should deal with local issues only when they possess national significance.

PURPOSE OF COUNCIL

The Council is conceived by the Congress and intended by the President to be the focal point for environmental policy development in the executive branch. At the same time, it is important to understand that neither the Council nor any other single mechanism should be expected to produce "instant" answers to our environmental problems. These are too complex, too deeply imbedded in the entire fabric of our society, to lend themselves to simplistic solutions. The task ahead must engage the cooperation and the dedicated effort of all elements of the Federal Government, of both parties, of State and local governments, of industry, of private organizations and, most important of all, of individual citizens and their families, young and old, all across the Nation.

PUBLIC ANXIETY

Public anxiety over environmental deterioration has reached a high level, and rightly so. Yet the problems with which we must deal have been years in the making. They will not be cured overnight. It is

important that the public, as well as Government agencies, understand that the road ahead will be long and hard. Even were we to eliminate all forms of environmental pollution, we would still not have guaranteed a high quality environment. Environmental quality is a more complex, more subtle objective. It involves the development of new attitudes and new values. Thus, while we must make the investment and achieve the technological breakthroughs necessary to clean up our environment, we must at the same time develop a new perception of man's relation to nature, learn to control our own numbers, develop effective land-use policies, and find new measures of public and private success which emphasize quality rather than mere quantity.

However, I assure you, Mr. Chairman, that while these broader concerns are of great importance, the Council does not conceive of its role as simply a long-range, academic exercise. Many environmental problems have already been studied to death. In many areas, firm decisions should and can be made now. A case in point is the order issued recently by the President directing cleanup of air and water pollution by Federal agencies in their own activities. The Council will keep progress by the agencies in this area under active review.

I believe that the appropriation request for $300,000 for this fiscal year and $700,000 for fiscal year 1971 to be very modest amounts to begin work on the important functions and responsibilities we have been assigned. This will enable us to assemble the principal members of our staff, prepare our office space and procure the necessary furniture and office equipment.

In his state of the Union message, President Nixon declared the goal of the seventies is to be "a new quality of life in America."

We are grateful to be given a part in that great task.

Thank you. I shall be happy to respond to any questions you may have.

BIOGRAPHICAL SKETCHES

Mr. EVINS. Thank you, Mr. Train.

Mr. Chairman, at this point I would have you add in the record a biographical sketch showing your background and achievements, and also that of the other two members of the Commission. A lot of people are going to be reading about you and your activities. Place these biographies in the record.

(The biographies follow:)

BIOGRAPHICAL SKETCH OF RUSSELL E. TRAIN

Russell E. Train became Under Secretary of the Interior on February 7, 1969.

Born in Washington, D.C., in 1920, Train has served in all three major branches of the National Government, executive, legislative, and judicial. He began as an attorney for the Joint Congressional Committee on Internal Revenue Taxation in 1947, and became clerk and then minority adviser to the House Ways and Means Committee in 1953–56. From 1956 to 1957 he headed the Treasury Department's tax legislative staff.

In 1957, Train was appointed to the Tax Court of the United States by President Eisenhower. He was reappointed to a full 12-year term in 1959.

Train became active in conservation work while serving on the Tax Court. He founded and became the first president of the African Wildlife Leadership Foundation, which led to participation in the work of other conservation groups at home and abroad. On August 1, 1965, he resigned from the Tax Court to become president of the Conservation Foundation, a nonprofit research, educa-

tion, and information organization concerned with a broad range of environmental matters.

While president of the Conservation Foundation, Train was named by President Johnson to membership on the National Water Commission in 1968. Following the elections of that year, President-elect Nixon appointed him chairman of a special task force to advise the incoming administration on environmetnal problems.

Train resigned from the Conservation Foundation to accept appointment as Under Secretary of the Interior.

He holds a B.A. degree from Princeton University and a law degree from Columbia. He served in the Army from 1941 to 1946, rising to the rank of major. Mrs. Train is the former Aileen Bowdoin; they have four children.

Sworn in as Chairman, Council on Environmental Quality, on February 9, 1970.

GORDON J. F. MACDONALD

On leave from the University of California, Santa Barbara, where he was appointed vice chancellor for research and graduate affairs in September 1968, Dr. MacDonald is serving as a member of the President's Council on Environmental Quality. While receiving his higher education at Harvard University, he was awarded his A.B. summa cum laude, M.A., and Ph. D. degrees and served as a junior fellow from 1952 to 1954. Dr. MacDonald taught at MIT and did research at Carnegie Institute's Geophysical Laboratory before going to UCLA in 1958 as a professor of geophysics. At UCLA, he became director of the Atmospheric Research Laboratory, associate director of the Institute of Geophysics and Planetary Physics, and chairman of the new department of planetary and space science.

Dr. MacDonald was a member of the President's Science Advisory Committee from 1965 to 1969. He has served the Department of State as a member of the United States-Japan Committee on Scientific Cooperation and as a consultant; and the Department of Commerce as a member of the Commerce Technology Advisory Board. In addition to these responsibilities he has been most active as a consultant to NASA serving on the Lunar and Planetary Missions Board, the Science and Technology Advisory Committee for Manned Space Flight, and the Science Advisory Committee. For the National Academy of Sciences, Dr. MacDonald served on the Committee on Atmospheric Sciences from 1961 to 1970, the Space Science Board from 1962 to 1970, the Environmental Studies Board from 1968 to 1970, and he served as the Board's Chairman. He also was Chairman of the Executive Committee of the Earth Sciences Division of the National Research Council.

The earth's interior, the upper atmosphere, weather modification, and the origin of the moon and planets are subject to which Dr. MacDonald has made important contributions. In 1960 he was awarded the American Academy of Arts and Sciences Monograph Prize in physics and biological sciences for his book "Rotation of the Earth," coauthored wtih Walter Munk. He is the author of over a hundred articles on scientific subjects. He founded and was the first editor of the Reviews of Geophysics as well as coeditor of the Journal of the Atmospheric Sciences; he is now associate editor of six other journals.

Dr. MacDonald is a member of the National Academy of Sciences, the American Philosophical Society, the American Academy of Arts and Sciences Council on Foreign Relations, and 13 other professional and scientific societies. He was elected as associate of the Royal Astronomical Society in 1970.

BIOGRAPHY: ROBERT CAHN

Robert Cahn, who was appointed by President Nixon to the new three-man Council on Environmental Quality, comes to his new position from many years' experience in journalism. As a Washington correspondent for the Christian Science Monitor, he specialized in environmental reporting. For a 16-part series of articles on present and future problems in the National Parks he was awarded the 1969 Pulitzer Prize for national affairs. For this series and other environmental coverage, he also eceived the Department of the Interior's Conservation Service Award, the National Literary Award of the National Recreation and Park Association, and a Distinguished Service Award from the National Wildlife Federation.

Cahn was born in Seattle, Wash., March 9, 1917. He received his B.A. from the University of Washington in 1939, majoring in journalism.

He was a sports reporter for the Seattle Star from 1939 until he joined the U.S. Army in 1942. He graduated from Armored Force Officer Candidate School at Fort Knox, Ky., in June 1943. He was awarded the Bronze Star Medal for meritorious service as deputy public information officer with the 1st U.S. Army in Belgium and Germany during 1944 and 1945.

He resumed his journalism career after the war as a general reporter for the Pasadena, Calif., Star-News, 1947–48. He joined the Los Angeles staff of Life magazine as a correspondent in 1948 and moved to the Los Angeles Bureau of Collier's magazine in 1951 as an associate editor. He became a senior editor of Collier's and chief of the Los Angeles bureau in 1955 and served in that capacity until Collier's ceased publication in December 1956.

Cahn spent the next 4 years as freelance writer, making his home in the Washington, D.C., area, but ranging across the United States and Europe in search of article material. He contributed articles to the Reader's Digest and Air Force magazine, plus a total of 20 during the period to the Saturday Evening Post.

Cahn joined the staff of the Saturday Evening Post in 1961 as its Midwest editor.

He became White House reporter for the U.S. Information Agency's wire service in 1963, covering the activities of President Kennedy and Johnson until he joined the Christian Science Monitor in February 1965.

Cahn's recent Monitor coverage has included a series on environmental law, the politics of the environment, nine articles on the environmental effects of oil exploration on Alaska's North Slope, extensive reporting on the Everglades jetport dispute, and other environmental issues.

Cahn is married to the former Patricia Lovelady, who is the editor of American Education magazine for the U.S. Office of Education, Department of Health, Education, and Welfare.

CREATION OF COUNCIL

Mr. EVINS. I want to place in the record Executive Order No. 11514 and the brief act passed by Congress.

(The documents follow:)

FOR IMMEDIATE RELEASE MARCH 5, 1970

Office of the White House Press Secretary

THE WHITE HOUSE

EXECUTIVE ORDER

11514

PROTECTION AND ENHANCEMENT
OF ENVIRONMENTAL QUALITY

By virtue of the authority vested in me as President of the United States and in furtherance of the purpose and policy of the National Environmental Policy Act of 1969 (Public Law No. 91-190, approved January 1, 1970), it is ordered as follows:

Section 1. Policy. The Federal Government shall provide leadership in protecting and enhancing the quality of the Nation's environment to sustain and enrich human life. Federal agencies shall initiate measures needed to direct their policies, plans and programs so as to meet national environmental goals. The Council on Environmental Quality, through the Chairman, shall advise and assist the President in leading this national effort.

Sec. 2. Responsibilities of Federal agencies. Consonant with Title I of the National Environmental Policy Act of 1969, hereafter referred to as the "Act", the heads of Federal agencies shall:

(a) Monitor, evaluate, and control on a continuing basis their agencies' activities so as to protect and enhance the quality of the environment. Such activities shall include those directed to controlling pollution and enhancing the environment and those designed to accomplish other program objectives which may affect the quality of the environment. Agencies shall develop programs and measures to protect and enhance environmental quality and shall assess progress in meeting the specific objectives of such activities. Heads of agencies shall consult with appropriate Federal, State and local agencies in carrying out their activities as they affect the quality of the environment.

(b) Develop procedures to ensure the fullest practicable provision of timely public information and understanding of Federal plans and programs with environmental impact in order to obtain the views of interested parties. These procedures shall include, whenever appropriate, provision for public hearings, and shall provide the public with relevant information, including information on alternative courses of action. Federal agencies shall also encourage State and local agencies to adopt similar procedures for informing the public concerning their activities affecting the quality of the environment.

(c) Insure that information regarding existing or potential environmental problems and control methods developed as part of research, development, demonstration, test, or evaluation activities is made available to Federal agencies, States, counties, municipalities, institutions, and other entities, as appropriate.

(d) Review their agencies' statutory authority, administrative regulations, policies, and procedures, including those relating to loans, grants, contracts, leases, licenses, or permits, in order to identify any deficiencies or inconsistencies therein which prohibit or

more

limit full compliance with the purposes and provisions of the Act. A report on this review and the corrective actions taken or planned, including such measures to be proposed to the President as may be necessary to bring their authority and policies into conformance with the intent, purposes, and procedures of the Act, shall be provided to the Council on Environmental Quality not later than September 1, 1970.

(e) Engage in exchange of data and research results, and cooperate with agencies of other governments to foster the purposes of the Act.

(f) Proceed, in coordination with other agencies, with actions required by section 102 of the Act.

Sec. 3. Responsibilities of Council on Environmental Quality. The Council on Environmental Quality shall:

(a) Evaluate existing and proposed policies and activities of the Federal Government directed to the control of pollution and the enhancement of the environment and to the accomplishment of other objectives which affect the quality of the environment. This shall include continuing review of procedures employed in the development and enforcement of Federal standards affecting environmental quality. Based upon such evaluations the Council shall, where appropriate, recommend to the President policies and programs to achieve more effective protection and enhancement of environmental quality and shall, where appropriate, seek resolution of significant environmental issues.

(b) Recommend to the President and to the agencies priorities among programs designed for the control of pollution and for enhancement of the environment.

(c) Determine the need for new policies and programs for dealing with environmental problems not being adequately addressed.

(d) Conduct, as it determines to be appropriate, public hearings or conferences on issues of environmental significance.

(e) Promote the development and use of indices and monitoring systems (1) to assess environmental conditions and trends, (2) to predict the environmental impact of proposed public and private actions, and (3) to determine the effectiveness of programs for protecting and enhancing environmental quality.

(f) Coordinate Federal programs related to environmental quality.

(g) Advise and assist the President and the agencies in achieving international cooperation for dealing with environmental problems, under the foreign policy guidance of the Secretary of State.

(h) Issue guidelines to Federal agencies for the preparation of detailed statements on proposals for legislation and other Federal actions affecting the environment, as required by section 102(2)(C) of the Act.

(i) Issue such other instructions to agencies, and request such reports and other information from them, as may be required to carry out the Council's responsibilities under the Act.

(j) Assist the President in preparing the annual Environmental Quality Report provided for in section 201 of the Act.

(k) Foster investigations, studies, surveys, research, and analyses relating to (i) ecological systems and environmental quality, (ii) the impact of new and changing technologies thereon, and (iii) means of preventing or reducing adverse effects from such technologies.

Sec. 4. Amendments of E.O. 11472. Executive Order No. 11472 of May 29, 1969, including the heading thereof, is hereby amended:

(1) By substituting for the term "the Environmental Quality Council", wherever it occurs, the following: "the Cabinet Committee on the Environment".

(2) By substituting for the term "the Council", wherever it occurs, the following: "the Cabinet Committee".

(3) By inserting in subsection (f) of section 101, after "Budget, ", the following: "the Director of the Office of Science and Technology, ".

(4) By substituting for subsection (g) of section 101 the following:

"(g) The Chairman of the Council on Environmental Quality (established by Public Law 91-190) shall assist the President in directing the affairs of the Cabinet Committee. "

(5) By deleting subsection (c) of section 102.

(6) By substituting for "the Office of Science and Technology", in section 104, the following: "the Council on Environmental Quality (established by Public Law 91-190)".

(7) By substituting for "(hereinafter referred to as the 'Committee')", in section 201, the following: "hereinafter referred to as the 'Citizens' Committee')".

(8) By substituting for the term "the Committee", wherever it occurs, the following: "the Citizens' Committee".

RICHARD NIXON

THE WHITE HOUSE,

March 5, 1970

# # # #

Public Law 91-190
91st Congress, S. 1075
January 1, 1970

An Act

83 STAT. 852

To establish a national policy for the environment, to provide for the establishment of a Council on Environmental Quality, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "National Environmental Policy Act of 1969". National Environmental Policy Act of 1969.

PURPOSE

SEC. 2. The purposes of this Act are: To declare a national policy which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the Nation; and to establish a Council on Environmental Quality.

TITLE I

DECLARATION OF NATIONAL ENVIRONMENTAL POLICY

SEC. 101. (a) The Congress, recognizing the profound impact of man's activity on the interrelations of all components of the natural environment, particularly the profound influences of population growth, high-density urbanization, industrial expansion, resource exploitation, and new and expanding technological advances and recognizing further the critical importance of restoring and maintaining environmental quality to the overall welfare and development of man, declares that it is the continuing policy of the Federal Government, in cooperation with State and local governments, and other concerned public and private organizations, to use all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans. Policies and goals.

(b) In order to carry out the policy set forth in this Act, it is the continuing responsibility of the Federal Government to use all practicable means, consistent with other essential considerations of national policy, to improve and coordinate Federal plans, functions, programs, and resources to the end that the Nation may—

(1) fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;

(2) assure for all Americans safe, healthful, productive, and esthetically and culturally pleasing surroundings;

(3) attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences;

(4) preserve important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity and variety of individual choice;

(5) achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities; and

(6) enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

(c) The Congress recognizes that each person should enjoy a healthful environment and that each person has a responsibility to contribute to the preservation and enhancement of the environment.

Administration.

SEC. 102. The Congress authorizes and directs that, to the fullest extent possible: (1) the policies, regulations, and public laws of the United States shall be interpreted and administered in accordance with the policies set forth in this Act, and (2) all agencies of the Federal Government shall—

(A) utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and in decisionmaking which may have an impact on man's environment;

(B) identify and develop methods and procedures, in consultation with the Council on Environmental Quality established by title II of this Act, which will insure that presently unquantified environmental amenities and values may be given appropriate consideration in decisionmaking along with economic and technical considerations;

(C) include in every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment, a detailed statement by the responsible official on—

(i) the environmental impact of the proposed action,

(ii) any adverse environmental effects which cannot be avoided should the proposal be implemented,

(iii) alternatives to the proposed action,

(iv) the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and

(v) any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.

Prior to making any detailed statement, the responsible Federal official shall consult with and obtain the comments of any Federal agency which has jurisdiction by law or special expertise with respect to any environmental impact involved. Copies of such statement and the comments and views of the appropriate Federal, State, and local agencies, which are authorized to develop and enforce environmental standards, shall be made available to the President, the Council on Environmental Quality and to the public as provided by section 552 of title 5, United States Code, and shall accompany the proposal through the existing agency review processes;

Copies of statements, etc.; availability.

81 Stat. 54.

(D) study, develop, and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources;

(E) recognize the worldwide and long-range character of environmental problems and, where consistent with the foreign policy of the United States, lend appropriate support to initiatives, resolutions, and programs designed to maximize international cooperation in anticipating and preventing a decline in the quality of mankind's world environment;

(F) make available to States, counties, municipalities, institutions, and individuals, advice and information useful in restoring, maintaining, and enhancing the quality of the environment;

(G) initiate and utilize ecological information in the planning and development of resource-oriented projects; and

(H) assist the Council on Environmental Quality established by title II of this Act.

Review. SEC. 103. All agencies of the Federal Government shall review their present statutory authority, administrative regulations, and current policies and procedures for the purpose of determining whether there are any deficiencies or inconsistencies therein which prohibit full compliance with the purposes and provisions of this Act and shall propose to the President not later than July 1, 1971, such measures as may be necessary to bring their authority and policies into conformity with the intent, purposes, and procedures set forth in this Act.

SEC. 104. Nothing in Section 102 or 103 shall in any way affect the specific statutory obligations of any Federal agency (1) to comply with criteria or standards of environmental quality, (2) to coordinate or consult with any other Federal or State agency, or (3) to act, or refrain from acting contingent upon the recommendations or certification of any other Federal or State agency.

SEC. 105. The policies and goals set forth in this Act are supplementary to those set forth in existing authorizations of Federal agencies.

TITLE II

COUNCIL ON ENVIRONMENTAL QUALITY

Report to Congress. SEC. 201. The President shall transmit to the Congress annually beginning July 1, 1970, an Environmental Quality Report (hereinafter referred to as the "report") which shall set forth (1) the status and condition of the major natural, manmade, or altered environmental classes of the Nation, including, but not limited to, the air, the aquatic, including marine, estuarine, and fresh water, and the terrestrial environment, including, but not limited to, the forest, dryland, wetland, range, urban, suburban, and rural environment; (2) current and foreseeable trends in the quality, management and utilization of such environments and the effects of those trends on the social, economic, and other requirements of the Nation; (3) the adequacy of available natural resources for fulfilling human and economic requirements of the Nation in the light of expected population pressures; (4) a review of the programs and activities (including regulatory activities) of the Federal Government, the State and local governments, and nongovernmental entities or individuals, with particular reference to their effect on the environment and on the conservation, development and utilization of natural resources; and (5) a program for remedying the deficiencies of existing programs and activities, together with recommendations for legislation.

Council on Environmental Quality. SEC. 202. There is created in the Executive Office of the President a Council on Environmental Quality (hereinafter referred to as the "Council"). The Council shall be composed of three members who shall be appointed by the President to serve at his pleasure, by and with the advice and consent of the Senate. The President shall designate one of the members of the Council to serve as Chairman. Each member shall be a person who, as a result of his training, experience, and attainments, is exceptionally well qualified to analyze and interpret environmental trends and information of all kinds: to appraise programs and activities of the Federal Government in the light of the policy set forth in title I of this Act; to be conscious of and responsive to the scientific, economic, social, esthetic, and cultural needs and interests of the Nation; and to formulate and recommend national policies to promote the improvement of the quality of the environment.

SEC. 203. The Council may employ such officers and employees as may be necessary to carry out its functions under this Act. In addition, the Council may employ and fix the compensation of such experts and consultants as may be necessary for the carrying out of its functions under this Act, in accordance with section 3109 of title 5, United States Code (but without regard to the last sentence thereof).

80 Stat. 416.

Duties and functions.

SEC. 204. It shall be the duty and function of the Council—

(1) to assist and advise the President in the preparation of the Environmental Quality Report required by section 201;

(2) to gather timely and authoritative information concerning the conditions and trends in the quality of the environment both current and prospective, to analyze and interpret such information for the purpose of determining whether such conditions and trends are interfering, or are likely to interfere, with the achievement of the policy set forth in title I of this Act, and to compile and submit to the President studies relating to such conditions and trends;

(3) to review and appraise the various programs and activities of the Federal Government in the light of the policy set forth in title I of this Act for the purpose of determining the extent to which such programs and activities are contributing to the achievement of such policy, and to make recommendations to the President with respect thereto;

(4) to develop and recommend to the President national policies to foster and promote the improvement of environmental quality to meet the conservation, social, economic, health, and other requirements and goals of the Nation;

(5) to conduct investigations, studies, surveys, research, and analyses relating to ecological systems and environmental quality;

(6) to document and define changes in the natural environment, including the plant and animal systems, and to accumulate necessary data and other information for a continuing analysis of these changes or trends and an interpretation of their underlying causes;

(7) to report at least once each year to the President on the state and condition of the environment; and

(8) to make and furnish such studies, reports thereon, and recommendations with respect to matters of policy and legislation as the President may request.

SEC. 205. In exercising its powers, functions, and duties under this Act, the Council shall—

(1) consult with the Citizens' Advisory Committee on Environmental Quality established by Executive Order numbered 11472, dated May 29, 1969, and with such representatives of science, industry, agriculture, labor, conservation organizations, State and local governments and other groups, as it deems advisable; and

34 F. R. 8693.

(2) utilize, to the fullest extent possible, the services, facilities, and information (including statistical information) of public and private agencies and organizations, and individuals, in order that duplication of effort and expense may be avoided, thus assuring that the Council's activities will not unnecessarily overlap or conflict with similar activities authorized by law and performed by established agencies.

SEC. 206. Members of the Council shall serve full time and the Chairman of the Council shall be compensated at the rate provided for Level II of the Executive Schedule Pay Rates (5 U.S.C. 5313). The other members of the Council shall be compensated at the rate provided for Level IV or the Executive Schedule Pay Rates (5 U.S.C. 5315). Tenure and compensation. 80 Stat. 460, 461. 81 Stat. 638.

SEC. 207. There are authorized to be appropriated to carry out the provisions of this Act not to exceed $300,000 for fiscal year 1970, $700,000 for fiscal year 1971, and $1,000,000 for each fiscal year thereafter. Appropriations.

Approved January 1, 1970.

LEGISLATIVE HISTORY:

HOUSE REPORTS: No. 91-378, 91-378, pt. 2, accompanying H. R. 12549 (Comm. on Merchant Marine & Fisheries) and 91-765 (Comm. of Conference).
SENATE REPORT No. 91-296 (Comm. on Interior & Insular Affairs).
CONGRESSIONAL RECORD, Vol. 115 (1969):
July 10: Considered and passed Senate.
Sept. 23: Considered and passed House, amended, in lieu of H. R. 12549.
Oct. 8: Senate disagreed to House amendments; agreed to conference.
Dec. 20: Senate agreed to conference report.
Dec. 22: House agreed to conference report.

Mr. EVINS. The purposes of this act are: To declare national policy which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and to stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the Nation; and to establish a Council on Environmental Quality.

This is very broad language and has a very high and noble purpose. Mr. Chairman, we hope under your able leadership that this will not develop into an academic exercise. You state that many environmental problems have already been studied to death. Every agency of the Government is concerned. In our review of budget justifications this year the question of the environment is the foremost thing. Every agency is in the act, every agency is claiming great work and asking for funds to participate in the program.

Am I correct in assuming that the principal function of your office is to coordinate all of this effort on environmental problems and to make a report?

Mr. TRAIN. Yes, sir. Report to the President.

Mr. EVINS. You have high goals and objectives. If you do an effective job of coordination, then you will be justifying your existence.

Mr. BOLAND. Are you really coordinating the efforts of all the agencies and departments that are involved, and every one of them are involved.

Mr. TRAIN. Obviously we are just getting underway now. We are, in some specific areas, already calling meetings together of agency groups to discuss together certain common problems, such as pesticides, oil tanker spills, to name two examples. I cannot claim we are already coordinating all of the agencies effectively.

JOINT COMMITTEE OF CONGRESS

Mr. EVINS. Mr. Chairman, we have noted in the February 1970 issue of *News Report* of the National Academy of Sciences an article in which it recommends the establishment of a select Joint Committee of the Congress to provide a public forum for the discussion of environmental affairs. Do you make such a recommendation?

Mr. TRAIN. Is it safe for me to make recommendations as to what Congress should do?

No; I am happy to express an opinion on that, Mr. Chairman. I don't know that it would be appropriate for the Council to take a position on it, but personally I think it is a good idea and I think my colleagues share that opinion. I think Dr. MacDonald served as cochairman of the board which made this recommendation.

Mr. EVINS. This is an interesting report. They say, "At present responsibility for managing parts of the environment is spread over a great variety of Government agencies, including the Departments of Agriculture, Commerce, Defense, Health, Education, and Welfare, Housing and Urban Development, Interior, Transportation, and even the Department of State. In addition the Atomic Energy Commission, the Federal Power Commission, the General Service Administration, and the Tennessee Valley Authority."

There is a recommendation for a regrouping. What do you propose by way of regrouping, Dr. MacDonald?

Dr. MACDONALD. We didn't go into a detailed reorganization plan, recognizing that such a reorganization would require rather detailed understanding of internal management, and also because it is so closely tied to the congressional committee system.

We did feel in writing the report that this vast array of agencies, often acting independently of each other, does not provide us with the kind of program that the Nation requires. My own personal feeling is that certain of those agencies that are directly concerned with improving the environment, maintaining environmental quality could be regrouped into a single agency.

DEPARTMENTAL PROGRAMS

Mr. EVINS. Tell us what Agriculture is doing with respect to the environmental problems.

Mr. ALM. Agriculture has a wide variety of research and action programs in the research area. They do studies on pesticides, and animal wastes and other pollutants from agriculture.

Mr. EVINS. They have been studying it for years. What have they done about it after all the studies?

Mr. ALM. Well, we will supply that for the record, sir.

Mr. EVINS. You don't know at this time. What action have they had?

Mr. ALM. Action programs generally are with respect to soil erosion. They have a series of programs like the conservation program where they assist farmers to put grass on the land to hold soil in place. They have the soil conservation program.

Mr. EVINS. Their work in the Soil Conservation Service is very important in preserving the soil and, of course, this also effects the quality of the environment.

Tell us in a few words what the Department of Commerce is doing relative to the quality of the environment.

Dr. MACDONALD. Commerce has the responsibility for the Environmental Sciences Service Administration. Among their functions is the Weather Bureau. They provide for forecasts as you know. In addition, the Environmental Sciences Service Administration conducts geodetic work under the Coast and Geodetic Service.

Mr. EVINS. Can you supply us with some of their results, some of their achievements? This will get your Council into finding out what has been accomplished by the money spent in the past; what results have been achieved.

We now see on television weather and pollution reports. Where are they getting this information? They must be getting data that is available already.

Dr. MACDONALD. Yes, and again this points up one of the difficulties with our current organization; the unit of Government charged with looking after air pollution is in Health, Education, and Welfare in the National Air Pollution Control Administration. Their work is not necessarily always closely coordinated with the work of the Environmental Sciences Service Administration.

Mr. EVINS. The Federal Water Pollution Control Administration in the Department of the Interior makes grants to the States and they, in turn, make grants to industry and to municipalities.

Mr. TRAIN. With regard to antipollution, among the Federal facilities the major contributor to pollution in local areas is probably the Department of Defense through its various installations, including Army camps, airbase, and so forth.

Mr. EVINS. They are polluting the atmosphere, but what are they doing to prevent it? What action are they taking?

Mr. TRAIN. Department of Defense has reprogrammed funds in 1970 and I believe have a fairly substantial budget item in 1971 for the abatement of pollution at its own facilities. We could supply for the record the actual dollar amounts.

Mr. EVINS. Supply not so much the dollar amounts as what they are doing. What are the action programs? The same thing about the Department of Health, Education, and Welfare, the Department of Housing and Urban Development, the Department of Transportation, and the Department of State. Tell us what they are doing. Supply this for the record.

Mr. TRAIN. Of course, Transportation has highway and airport programs, major programs with impact upon the environment; not only in terms of pollution, which is substantial, but also in terms of effect on landscape and effect on the community values.

Mr. EVINS. Has the Department of Transportation, through FAA effected action at this time or will additional legislation be needed to prevent pollution from aircraft in the air? Can they take action at present?

Dr. MACDONALD. Yes, and they have. In addition, they are taking action with regard to the noise levels in the new conventional jets.

Mr. EVINS. The Corps of Engineers has testified that Interior is trying to take them over. Do you advocate that?

Mr. TRAIN. Without addressing myself to the specific question of whether Interior should take over the Corps of Engineers, I think we do feel there should be much better coordination, particularly at the planning and decisionmaking level of the major Federal programs affecting the development and management of water resources. This includes the Corps of Engineers, the Bureau of Reclamation, and the small watershed programs of the Department of Agriculture.

Mr. EVINS. The Corps testifies and they feel they have been doing great work over the years, but at the same time they must admit that the harbors and streams have become polluted. They have not been achieving the high goal that is desirable.

The Federal Power Commission, supply for the record what they are proposing to do, what their studies involve, and what actions have been taken.

Of course, there is a great variety in the Department of the Interior, Fish and Wildlife Service, National Park Service, Bureau of Sports Fisheries; the Bureau of Reclamation; and the Federal Water Pollution Control Administration.

Mr. Chairman, you have a monumental job to coordinate all this.

Mr. TRAIN. Mr. Chairman, may I say, with respect to your request, with which we shall comply quite quickly, we can provide an inventory of all of the Federal programs affecting the environment, I think, quite quickly.

You also asked for evaluation of how good a job they are doing. This may take a little longer.

Mr. EVINS. Tell us of some action that is being taken; some noticeable results that can be documented as to what each are accomplishing in their field for the money which we have been appropriating. If you can supply this at this early stage, it would be helpful.

(The information follows:)

FEDERAL DEPARTMENTS AND AGENCIES HAVING SIGNIFICANT ENVIRONMENTAL PROGRAMS

Listed herein are the Federal Executive Departments and Agencies having significant environmental programs with a brief description of their activities. Most of the accomplishments and results from the various programs are of the continuing or long-term variety rather than the one-time nature.

DEPARTMENT OF AGRICULTURE

Farmers Home Administration.—Provides financial and management assistance to rural groups to develop recreational facilities and community water supply and waste disposal systems, carryout soil conservation measures, and shift land use to grasslands and forestry; to local organizations to help finance watershed protection and flood prevention projects; to public agencies or private nonprofit organizations in rural areas to develop, conserve, and utilize natural resources.

Forest Service.—Promotes conservation and best use of the Nation's forest lands, improves these lands, protects them from fire, insects, and disease, and manages their resources for orderly and continuous service.

Soil Conservation Service.—Develops and carries out a national soil and water conservation program including soil erosion control, flood prevention, sediment reduction, land-use planning, recreation, beautification, and water development for agriculture, recreation, wildlife, municipal, and industrial use. Technical assistance is provided to more than 3,000 soil conservation districts covering almost 2 billion acres in all the States, Puerto Rico, and the Virgin Islands.

Agricultural Research Service.—Studies effects of pesticides on the composition and nutritive value of agricultural products, investigates processing wastes and their effect on environmental pollution; investigates pesticide residues in farm products and their effects on the quality of the environment; and studies soil, water, and air pollution in farm areas and develops methods to alleviate this pollution.

DEPARTMENT OF COMMERCE

Environmental Science Services Administration.—Activities include conducting comprehensive programs in meteorology, climatology, hydrology, surveying, cartography, oceanography, and telecommunications. These activities relate to observations, processing, dissemination of forecasts, warnings about the state of the oceans and inland waters, the upper and lower atmosphere, the space environment, and the earth.

DEPARTMENT OF ARMY

Corps of Engineers.—Carries out the civil works activities of the Department of the Army including planning, design, construction, operation, and maintenance of works of navigation, beach erosion control, recreation, fish and wildlife preservation, hydroelectric power, and related purposes authorized by law.

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

Environmental Control Administration.—Preserves and improves the physical environment so as to promote the health and welfare of people through programs designed to reduce levels of exposure to the hazards of improper housing and use of space, noise, rodent and insect vectors, waterborne disease, radiation, and waste accumulation.

Bureau of Solid Waste Management.—Plans, conducts, and promotes research, investigations, demonstrations, and studies for the development and application of new and improved methods of solid waste storage, collection, and disposal.

National Air Pollution Control Administration.—Conducts programs for the prevention and control of air pollution through establishment of Federal regula-

tory controls, conduct of research and development, provision of technical and financial assistance, and development of air pollution manpower resources.

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

Community Resources Development Administration.—Responsible for guarantees for financing new communities and related supplementary grants; advances for public works planning; grants for basic water and sewer facilities; advance acquisition of land; acquisition and development of open space land; acquisition, restoration, and improvement of historic sites or structures for public use or benefit; coordination of flood plain management programs with flood insurance requirements; and assistance to the Federal Insurance Administration through studies and investigations of flood plain zoning and land-use control.

DEPARTMENT OF THE INTERIOR

Fish and Wildlife, Parks, and Marine Resources.—Concerned with the development, conservation, and utilization of the fish, wildlife, marine, and national park resources of the Nation.

Mineral Resources.—Concerned with the appraisal, conservation, development, and use of the Nation's mineral resources. This includes geologic, hydrologic, and topographic mapping and research; water data acquisition and coordination; marine geology, hydrology, and minerals technology; and health safety activities in the minerals industries.

Public Land Management.—Concerned with activities pertaining to outdoor recreation, land utilization and management, territorial affairs and Indian affairs.

Water Quality and Research.—Concerned with the control, prevention, and abatement of water pollution; the development of potable water from saline sources; and water resources research.

Water and Power Development.—Concerned with the development of water resources and power.

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration.—Concerned with developing and testing improved aircraft, engines, propellers, appliances, etc., in the interest of safety and abatement of air pollution and noise.

Federal Highway Administration.—Administers the Federal aid highway program, and attempts in its activities to preserve along highways the natural beauty of the countryside, public parks and recreation lands, wildlife and waterfowl refuges, and historic sites.

ATOMIC ENERGY COMMISSION

Regulates the control and use of source, byproduct, and special nuclear materials so as to protect the health and safety of the public.

FEDERAL POWER COMMISSION

Assures an abundant supply of electric energy with the greatest possible economy and proper utilization and conservation of natural resources.

EXECUTIVE ORDER 11514

Mr. EVINS. Does Executive Order 11514 give any additional duties to your office?

Mr. TRAIN. It simply spells out in greater detail the duties set out in the statute. It does refer to certain additional powers such as the right to hold public hearings if we see fit. That, itself, is not referred to specifically in the statute. There are some additional things in the Executive order of that nature.

Mr. EVINS. What do you propose to do in the international area?

Mr. TRAIN. The field of data collection, I think, is an important one requiring international cooperation. I do not think, as we all recognize, that the quality of the atmosphere, and the quality of the ocean,

are things that stop with a political boundary. If there is to be any effective measurement of quality of these portions of the environment, it is going to require the collection of data in various parts of the world and this certainly will require international cooperation. In other areas, such things as tanker oil spills, a matter of international concern probably cannot be dealt with on simply a unilateral basis.

Mr. EVINS. One press report implies you are functioning as broad as the imagination of man. Do you consider that to be accurate?

Mr. TRAIN. We certainly have a very broad charter, but I would hope we could spell it out as we go along in somewhat more concrete form.

Plainly that is one of the aspects of the work of the Council to which it must give a great deal of attention.

COAST GUARD STUDY

Mr. JONAS. A year or two ago in another committee we talked with the Coast Guard about the dangers involved in oil seepage, or escaping oil out of tankers that were sunk in the Atlantic Ocean off the eastern seaboard. The Coast Guard had a position about it. I forget exactly what they did say but we discussed that in the Transportation Subcommittee. Do you have any knowledge on the effort that is being made to control that submerged oil, to keep it from escaping and washing up on the shore?

Mr. ALM. I am aware of the Coast Guard study which I believe indicated in most cases the oil was all gone, the oil from World War II. This is under study in terms of a broader study of the oil pollution problem right now and the administration will probably have recommendations in the broader aspects of the problem very shortly.

Mr. JONAS. I think this interest developed because of the suspicion that oil washing into New England came from submerged tankers.

I don't know how long that oil can be expected to remain in these sunken tankers, or barrels, or whatever it is in, but with the passage of time I would doubt if it would stay locked up in those vessels permanently.

Mr. ALM. That is correct, sir.

Dr. MACDONALD. I suspect that the contribution from the sunken tankers is now a very small fraction of the oil that we are getting on to the beaches. Estimates run as high as 1 million barrels of oil which are spilled one way or another each year, worldwide.

DEPARTMENTAL STUDIES

Mr. EVINS. Mr. Chairman, do you have at this time an analysis of the studies of the various departments by way of summary of some of their achievements, some of their accomplishments, some of the things they have been able to accomplish?

Mr. TRAIN. I don't know that we have anything in a form we would be ready to submit. We would have to prepare it.

Mr. EVINS. Dr. MacDonald, you made an analysis at one time, did you not, of the broad scope of the work of the various agencies?

Dr. MACDONALD. Yes, and that is sumarized in the National Academy Report.

ARTICLES ON ENVIRONMENTAL MANAGEMENT, AND ENVIRONMENT AND GOVERNMENT

Mr. EVINS. We will place the articles on Environmental Management and Environment and Government from the February 1970 issue of *News Report* in the record.

(The articles follow:)

AN UNUSUAL STUDY POINTS TO INSTITUTIONAL COMPLEXITIES IN ENVIRONMENT MANAGEMENT

On the assumption that individuals equipped with scientific rigor but not necessarily with experience in environmental matters might make a fresh contribution to environmental protection, the Environmental Studies Board of the National Academy of Sciences and National Academy of Engineering brought together physicists, lawyers, public administrators, conservationists, and bioscientists last summer for a look at institutional aspects of environmental problems. The outcome is a call to perceive and cope with frequently ignored complexities of environmental management.

In a report to the Environmental Studies Board, the Environmental Study Group urges that an expression of concern about the environment or the creation of an agency whose responsibility is the environment not be taken to be a solution to environmental problems. The study group cautions:

"The large number of interested segments of the society, the number of involved governmental agencies . . . , the scope of the technological, sociological political and economic aspects of environmental problems, all point to the need for a variety of responsive institutional innovations; no single one can do the job. Indeed, there is a danger that a single step, such as formation of a higher-level Board of Environmental Advisors or a new analytical institution, will be interpreted as a sufficient reaction to the entire range of our concerns."

The report, Institutions for Effective Management of the Environment (see "New Publications," p. 12), is Part I of a two-part study that is unusual in the field of environmental studies both for its findings and for its approach.

The study was suggested by physical scientists, including National Academy of Sciences members Murray Gell-Mann, Marvin L. Goldberger, and Gordon J. F. MacDonald, vice chairman of the Environmental Studies Board and co-chairman, with Goldberger, of the Environmental Study Group. Outgoing Environmental Studies Board Chairman Harold Gershinowitz explains in a foreword to the report:

"[T]hese documents are intended to serve as 'background papers' and to bring fresh views of people in a variety of academic disciplines, public-policy positions, and related areas of concern bearing upon the non-scientific aspects of environmental affairs. They will, we believe, provide a basis on which the Board will make recommendations for effective approaches and institutional mechanisms for dealing with environmental problems."

It is common for assessments of environmental problems to begin with the study of a major effect—e.g., destruction or pollution of a resource—and progress first to estimates of ultimate consequences and then to recommendations that the cause in question be eliminated. The study group chose to do a case study to see what factors are or ought to be considered in decisions affecting the environment.

The study—of the extent to which significant factors were considered and of the complexity of intergovernmental relations and responsibilities in connection with proposed construction of a jetport north of the Everglades—is soon to be published as part II of the group's report. In looking at a real situation and in studying whether and how consequences are weighed, the study group found a broad range of considerations that should enter into environmental decisions.

Resolution of the Florida jetport question with least environmental cost, the study group found, required consideration of population growth and location, protection of water supplies, proper allocation of resources for agriculture, sound development of public transportation, insurance of attractive living conditions, and "protection of . . . unique national resources." The diversity of considerations necessarily involves a multiplicity of agencies whose decisions contribute to an environmental effect; this is the governmental lesson drawn from the case study and addressed in the report.

The summer study was an attempt also to see whether the case-study approach to environmental problems works. The study group concluded that it does, and includes in its recommendations the proposal that machinery be established for similar studies on a regular basis and for longer range work as well.

The report cites "a need to obtain critical data in environmental problem areas on a short-term scale," "a need to bring together available information in a cogent and timely fashion for decisionmakers at various levels of government," "a need to develop new ways of analyzing and evaluating environmental quality so that the budgetary process at various levels of government can be guided by environmental as well as economic considerations," and a need "to develop a system by which possible environmental disasters as well as positive developments for the improvement of environmental quality can be predicted." The latter function, the group reports, "involves a continuing and systematic examination of national developments that relate to environmental change, projected land uses, and applications of technology to avoid or mitigate possible adverse effects on the environment."—G.S.S.

MAC DONALD APPOINTED

Gordon J. F. MacDonald, who served as co-chairman of the environmental study group, has been appointed by President Nixon to a full-time post as a member of the three-man Council on Environmental Quality. Also appointed to the new Council were Under Secretary of the Interior Russell Train and Christian Science Monitor writer Robert Cahn. MacDonald was Environmental Studies Board chairman and National Research Council Division of Earth Sciences chairman at the time of his Council appointment.

ENVIRONMENT AND GOVERNMENT

(In its background report on environmental management, the Environmental Study Group considers organizational aspects of Federal environmental protection in light of the diversity of Federal programs and agencies that may not be characterized typically as environmental agencies but that affect environmental quality directly and substantially. The following excerpts from the report illustrate the group's reasons for concern.)

Our Government has encouraged the development of a productive technology and the exploitation of natural resources for economic benefit. Extraordinary success in these undertakings has led to the world's highest standard of living. In the course of reaching this high level of economic prosperity, we have precipitated undersirable changes in the environment. The Federal Government has responded to these changes by creating special agencies to deal with specific problems. The erosion and exhaustion of the soil led to the establishment of the Soil Conservation Service, now within the Department of Agriculture. The destruction of forests resulted in the Forest Service, also within the Department of Agriculture. The careless slaughter of wildlife led to the Fish and Wildlife Service, within the Department of the Interior. The recognition of the great problems in maintaining water quality resulted in the establishment of the Federal Water Pollution Control Administration, recently transferred from Health, Education, and Welfare to Interior.

In the future the number of environmental problems will multiply at an increasing rate. If they continue to be dealt with in piecemeal fashion, an increasing number of specialized agencies will be needed. The result will be organizational chaos. More importantly, the unity of the environment and the interdependence of its parts will not be the responsibility of any of the competing units, each with partially overlapping and possibly conflicting responsibilities. Such fragmentation will prevent the development and implementation of a national policy for the environment.

In this section we review recent administrative and legislative actions and proposals that affect the management of environmental affairs. In addition we analyze the difficulties involved in creating a Department of the Environment. Finally, we propose a new Board of Environmental Affairs, which would be charged with the responsibility of evaluating the effect of Federal programs on the environment, and a Select Joint Committee of the Congress to provide a public forum for the discussion of environmental affairs.

Both the executive and legislative branches of Government have foreseen the perils of a continuation of past practices.

At present, responsibility for managing parts of the environment is spread over a great variety of Government agencies, including the Departments of Agriculture, Commerce, Defense, Health, Education, and Welfare, Housing and Urban Development, Interior, Transportation, and even the Department of State. In addition, the Atomic Energy Commission, the Federal Power Commission, the General Services Administration, and the Tennessee Valley Authority are all involved in environmental affairs. Quite clearly a matter of highest priority is a regrouping of agency functions in some more rational way relative to the environment. Such a regrouping, however, should come about only after sophisticated management analysis, coupled with a realistic assessment of executive-congressional relationships. In the following discussion we explore in a preliminary way some of the problems that may be encountered in any reorganization scheme.

Not all the major environmental entities within the Federal executive branch report to the same committees of the Congress. For example, most of the Department of the Interior agencies dealing with parks, wildlife, and water—Bureau of Sport Fisheries and Wildlife, National Park Service, Bureau of Commercial Fisheries, Bureau of Outdoor Recreation, Bureau of Reclamation—report to the Committee on Interior and Insular Affairs. The Federal Water Pollution Control Administration, however, reports to Public Works, which also considers solid-waste-disposal and air-pollution activities of the Department of Health, Education, and Welfare. The same pattern is not repeated in the House, however. FWPCA does report to Public Works, but this committee does not also consider solid-waste or air-pollution problems. Most fisheries questions are considered by the Merchant Marine and Fisheries Committee. The Army Corps of Engineers of the Department of Defense, a major water-project constructor, also reports to Public Works in both Houses of Congress. Appropriation Committee subcommittee organization in each House of the Congress generally follows the subject-matter committee structure. These congressional organization patterns present certain obstacles to organization in the environmental field.

The creation of a Federal department on the environment cannot be considered or decided upon as exclusively a question concerning the organization of the executive branch, but involves the committee structure in Congress as well.

Even more than the creation of a new department of the executive branch, a reorganization of several existing departments creates a variety of bureaucratic problems. Existing agencies have an interest in maintaining responsibilities. There is usually no existing power base for a new agency.

Even a casual examination of a table of organization of the Department of the Interior reveals that a majority of those units charged with protection of the environment are physically or organizationally located there, and therefore Interior should become the nucleus of a department on the environment. A closer examination reveals some juxtapositions that pose real problems. The Bonneville Power Administration has exhausted the potential of hydroelectric power generation in the Nortwest and must now turn to other sources, with nuclear power appearing most feasible. Its objective, an increase in power production at lower cost, is not necessarily compatible with that of the FWPCA in terms of water temperatures, or with that of the Bureau of Commercial Fisheries in terms of increased populations of salmon. The Bureau of Mines is charged with increasing the uses of coal to enhance the economies of mining; control of acid-mine drainage is an added cost that impairs activity directed toward what the Bureau regards as its primary objective. The production of oil from shale, promoted by the Bureau, will be inhibited if the cost is increased by required installation of expensive water-pollution-control equipment. The Bureau of Reclamation is not necessarily diposed to having the impact of irrigation-return flows on water quality for downstream uses introduced as a factor in consideration of its irrigation projects; nor is it happy when use of simultaneous hydroelectric power production in its projects which reduces the cost of water supply, is attacked as reducing downstream oxygen levels in violation of water-quality standards established by the Federal Water Pollution Control Administration.

If a new Department on the Environment were to be established, it might well prove to be desirable to transfer many of the functions now existing in other executive departments to the new department. Some obvious functions are those relating to air and water pollution, solid waste, and waste treatment. Others, which are not so clear, but should be considered, are: recreational and land-management activities, construction of water supply, dredging, flood-control projects, and nuclear plant siting.

The list is a long one, and again, while we do not suggest that all these should be in an environmental agency, they should be consciously included or excluded with reason. The jurisdictional difficulties of disengaging them where they are and re-establishing them where they are to be placed should be weighed, and this evalution should be a factor in the final decision. Recognition of congressional organization and liaison should also be a part of the deliberation.

We do not in this paper advocate a major reorganization of government to deal with environmental matters but only point out its importance and recommend that management studies be carried out so as to provide for a realinement of agency responsibilities. With the great variety of agencies and functions it is necessary in the interim and perhaps even on the longer terms to have a strong and inventive agency at the President's level.

The activities of the executive branch in establishing environmental policies, evaluating and overseeing their implementation, and in general managing environmental affairs should. we believe, relate to a congressional organization appropriate to the task. At present several committees of both Houses of the Congress have jurisdictions that relate to environmental matters. And, while we would not presume, of course, to suggest a reorganization of congressional committees, we do recommend formation of a joint committee of the Congress, comprised of the chairmen and ranking minority members of the relevant committees of both Houses, which would provide a much-needed focal point for the informed discussion of environmental affairs.

Such a joint committee would provide an open forum for annual hearings relating to the President's report, in which the important issues would be discussed and debated in public. This would, of course, in no way impinge on existing jurisdictions relating to appropriations or other congressional activities.

Hearings will not adequately serve this purpose if they continue to be held piecemeal, as they are at present, by the several committees having jurisdiction over special-purpose programs relating to the environment. There will, however, be an on-going need within the standing legislative committees to continue to deal with specific legislative proposals within their jurisdictions. It seems to us highly desirable that there be, in addition, regular annual public forums in Congress directed to broad consideration of the President's report.

FUNDING REQUIREMENTS

Mr. EVINS. You have had authorizing legislation since the beginning of the year; haven't you?

Mr. TRAIN. January 1 of this year, the legislation was received. We were sworn in on February 9.

Mr. EVINS. The fiscal year will be up in June. How much money do you need for the rest of this year?

Mr. TRAIN. Under the legislation, Public Law 91–190, we believe we need the full amount which is being requested by the President in the amount of $300,000.

SIZE OF STAFF

Mr. EVINS. How many of your staff do you have onboard at the present time?

Mr. TRAIN. At the time I think it is about 10.

Mr. EVINS. How big do you envision the Council to become?

Mr. TRAIN. Under the authorization and, hopefully, an appropriation of $300,000, we would expect to have a staff by the end of this fiscal year of approximately 20 and would expect in fiscal 1971, on the basis of the full amount of $700,000, which is included in the President's budget, to build that up to approximately 26 permanent positions.

Dr. MACDONALD. We have 14 onboard now.

Mr. EVINS. And you hope to go up to 20 by July 1?

Mr. TRAIN. That is right.

Mr. EVINS. And next year, 26?

Mr. TRAIN. That is correct.

Mr. JONAS. How much of the $200,000 have you spent through March in that period of 2 months?

Mr. SAVAGE. Approximately $120,00.

Mr. JONAS. What do your obligations run a month—$60,000?

Mr. SAVAGE. No, sir.

I should give you an analysis of that $120,000. There are one-time obligations. It started low in February and built up substantially in March, of course.

Mr. JONAS. I am trying to give you an opportunity to prove to our satisfaction that you need this $300,000 between now and June 30.

Mr. TRAIN. It is my understanding that that $300,000 will be substantially all spent by the end of this fiscal year.

REPAYMENT OF PRESIDENT'S EMERGENCY FUND

Mr. JONAS. You are going to repay $200,000 that you got from the President's emergency fund?

Mr. SAVAGE. Yes, sir.

Mr. JONAS. And you have $80,000 of that unspent as of the 1st of April. That only leaves you 3 months. We don't want to see you go out here and obligate money just because it is available. We want to be told why you need that much money to get started. We will talk later about 1971. We are talking now about this supplemental.

Mr. SAVAGE. Two items have not been obligated and would not be until we receive our appropriation, for basically the office equipment and such that will be needed for the Council. At the moment we are using loaned equipment.

Mr. EVINS. Borrowed from whom?

Mr. SAVAGE. From GSA.

Mr. EVINS. How long will they let you have it without charge?

Mr. SAVAGE. A very short time because we are in a temporary building that we are occupying and this is slated for additional commissions, councils, and such.

Mr. TRAIN. We will be on Jackson Place in the row of townhouses on the central portion of Jackson Place; 718, 722 and 726 Jackson Place.

Mr. JONAS. How much do you expect to spend for the space?

Mr. TRAIN. Approximately $50,000 for the full staff.

Those buildings, as you probably know, are just being completed. They are not ready for occupancy yet and we have to pay for all the partitioning inside which is running quite high for us. They are large rooms that occupy an entire floor at the present time so we are having to have them partitioned into offices.

Mr. SAVAGE. The estimated cost for that is $35,000 which has not been obligated.

Mr. EVINS. The President's emergency fund advanced you $200,000. Is there an obligation that you repay this fund?

Mr. TRAIN. We are required to repay that amount.

Mr. EVINS. Mr. Boland, have you any questions?

PRESENT DECISIONS

Mr. BOLAND. Will you detail some of the firm decisions that can be made now without further study?

Mr. TRAIN. That was a generalization in my prepared statement. My statement referred to a good many long-range concerns, public attitudes and values, and I did not want to leave the impression with the committee that we were going to be dealing purely with philosophical types of questions. I gave one example of action in the field of pollution by Federal facilities themselves and pointed out that the President had by Executive order been able to move ahead very effectively in that field, making some funds available and setting up procedures which, hopefully, will result in substantial improvement in that area. That is one field.

In the field of tanker oil spills, we have been having a group meeting over the last 2 weeks or so and we are hopeful we will be able to develop recommendation in that area very quickly. Nothing can be done without some study and some discussions and I wouldn't want to leave the impression we are ready to shoot from the hip on any of these really very important questions.

Mr. BOLAND. I think that is a good position to take. This act was passed overwhelmingly by the Congress. The Congress is terribly interested, as is everyone else. It is, as you have indicated, a very responsible council, one that is going to have some extremely broad powers and can make some very devastating recommendations that could affect the economic health of this Nation. I think if there is one area in which there can be some serious and dangerous decisions made, it is in the field of environment. I hope the Council recognizes this, of course, and I am sure that you do.

Everyone now is an expert on the ecology and the environment. You start with an extremely magnificent atmosphere and climate.

There are some dangers, however, that really concern the viability and economic health of the Nation itself.

Mr. TRAIN. We are very aware of that.

Mr. BOLAND. There are some people who would have us go back almost to a pastoral society. I am sure the Council doesn't recommend this. Some of the areas in which you will deal are areas that have made this country a significantly strong nation economically and have been able to provide jobs for people.

You set out the study areas in your justifications on page 3. One of them is phosphates. Frankly, as a layman, my knowledge is really abysmal on whether or not phosphates actually contribute to pollution. I don't know whether or not there has been any sound decision made on whether this is so. I would hope your Council would be able to determine precisely whether or not these things do actually damage the ecology.

Is this a decision you will be making?

Mr. TRAIN. Yes.

Mr. BOLAND. It is about time we had this kind of focus on the area where a Council such as yours can make these decisions. It is difficult to rely on statements made by so many people in this area all over this Nation.

I think you have a tremendously important responsibility. I am delighted that you have been designated as the chairman of this Council and I am sure this responsibility has been placed in the hands of people who are concerned, as all of us are, about it.

HIGH GRADE POSITIONS

I do note, with respect to your job positions that your GS levels are high. From GS–11 and up, you have 11 positions.

What kind of personnel are you going to use? For instance, you have a GS–17 and a GS–18; $33,495. Who are these two? Are they appointed?

Mr. TRAIN. No, sir; not as yet.

Mr. BOLAND. What kind of people will you put here?

Mr. TRAIN. In one of the GS–18 positions we expect to use, as a chief legal officer, a general counsel. I am not sure of his title.

We have in the Council a tremendous flow of legislative and regulatory work sent us by other departments and the Bureau of the Budget for comment. We must work with the executive orders of other departments. All of this requires, really, substantial legal expertise.

Mr. BOLAND. What about the other positions in the grades that pay anywhere from $15,000 up?

Mr. TRAIN. We are expecting to have a senior scientist as part of our staff who will probably be a GS–18. We have not hired him yet. I think it is exceedingly important that our Council have a strong scientific capability and credibility. Although we do not expect, necessarily, to have a scientific staff as such, we expect some scientific competence. We see that possibly as a GS–18.

Mr. BOLAND. I would think this would be an absolute essential.

Mr. TRAIN. As we move forward with the development of our annual report capability, I anticipate this will place an enormous burden upon our scientific counsel.

I would expect with respect to the Council of Economic Advisers. and the annual Economic Report, that substantially all of that staff is involved with the development and preparation of the annual Economic Report.

I think with the scope, breadth, and reliability of our group it will never be possible for us to make that kind of concentrated commitment of personnel to the annual report but it will be an exceedingly important element in our work and, hopefully, will be very influential and I can see that in time we will need a GS–18 in addition.

SECRETARY TO THE COUNCIL

Mr. JONAS. Tell us why you need a GS–17 as Secretary to the Council. This is no reflection on Mr. Gibbons. What will be his responsibility? I think you are using probably the wrong title. He must have responsibilities other than secretarial.

Mr. TRAIN. The function, as we see it, is not secretarial in the sense of doing stenographic work, certainly, but to provide the primary staff support to our Council, as a counsel. To see to it that our meetings are set up, to see that agendas are prepared in advance, to see

to it that minutes and official records of the Council are kept, to see to it that there is an adequate flow of information amongst the different members of the Council, to be the primary transmittal point for communication with various Government agencies, to keep on top of all of the various requests that come in to us for action on a very wide variety of subjects, and to see to it that we have a work schedule with respect to those items and to prepare the various reports and transmit the various reports that we are required to submit.

He is also expected to be the primary contact point within the Council for persons on the outside, both of a private nature and public nature. I find that otherwise everything tends to come to the Chairman and the Chairman simply doesn't have time, physically, to deal with all of the demands. This is true with respect to requests from congressional committees, the press, inquiries from the White House and other agencies.

In some respects I consider the secretary as being the buffer, in a way, between the Council and the outside, but overall providing exceedingly important services both to the Chairman and to the Council as a whole.

If I may add one other thing, he will also be the Chairman's assistant with respect to the affairs of the Cabinet Committee on Environment.

As you will notice in the Executive order, the Chairman of the Council is to assist the President in directing the affairs of the Cabinet Committee on the Environment. We have to set those meetings up, prepare the agendas, notify the members, keep the minutes, prepare reports for the President of the Cabinet Committee meetings, and all of this also will be Mr. Gibbons' duties.

Mr. MARSH. It is a pleasure to see you gentlemen here this morning. With respect to the Council, do you intend, once you identify the various areas where you seek to assert an interest, to assert that interest yourself by having on board the people to do the necessary studies and come up with recommendations as to how to address the problem in your own agency. Secondly, once you have identified the areas in which you want to move, do you intend to go outside of Government and have them come up with suggestions and recommendations as to how to address the problem. Third, are you going into the various agencies of Government—for example, the National Science Foundation—and request that they allocate some of their funds for studies in this area; are you going into Interior and ask them to do it or to the Office of Water Research and ask them to do it, or go to Transportation and ask them to do it, or into NASA and ask them to do it?

In what manner do you intend to function in that regard?

Mr. TRAIN. I think in all fairness we probably will be utilizing all of those methods. I think it is important for our Council to develop some central basic competence in some of the major fields such as environmental pollution, for example.

I don't think that we should be in the position of being totally dependent upon particularly Government agencies for help as we are being expected to stand a bit outside of the agencies, to be in a position to objectively evaluate their programs and if we become en-

tirely dependent upon what they provide us, then it is difficult for us to have that kind of independent objective analysis.

At the same time, given the tremendous scope of the subject matter with which we are going to have to deal, and the chairman has referred to many of those this morning, it would be manifestly impossible and certainly impractical for us to try to staff up in all of those areas.

We simply cannot have a competence in each area with which we will be dealing. So we will have to depend from time to time upon outside advisory groups, consultants, and upon the Federal agencies themselves.

We are doing that at the present time. As you have seen, we are already involved in quite a wide variety of activities, and yet we have a staff now of only 14, of whom a number are clerical.

Some of these have only come on board very recently. We are obviously utilizing the services of other agencies to a great extent. Our Executive order empowers us to request such information and other reports from all of the Federal agencies as we require in carrying out our responsibilities. So we are exercising that authority.

Mr. MARSH. In that regard, there is a tremendous amount of duplication and research in many areas of science. As you have acknowledged in your statement this morning, some areas have been studied to death. One of these, I think has been water research. There is a tremendous overlap and duplication in the field of water research. There has not been the effort necessary to pull it all together to be certain we are combining all of our efforts to address ourselves to the real problems of water resource control and development.

ENFORCEMENT AUTHORITY

Will your Council, for example, have the authority to implement its findings or its decisions? For example, let us say that you might reach a conclusion that a pesticide's damage to environmental health is so great that it should not be used in the application to crops. The Department of Agriculture may have a finding that you can apply pesticides in certain quantities on crops. At what point can you phase in and take over that and say this pesticide based on your studies is of damage to environmental health, and its crop control, or its crop development capabilities do not override its environmental health?

Mr. EVINS. The gentleman wants to know whether you are going to be an advisory agency or a policeman with the necessary authority.

Mr. TRAIN. We are really not the policeman. We are not under our status given line authority. The President presumably could delegate certain things to us, and Congress could further legislate to give us line responsibility as in the case of pesticides, the one you mentioned. But under the arrangements which we presently have, we are basically members of the Executive Office of the President, and we are directed to advise and assist the President in carrying out his responsibilities in the field of environment.

In the case you give, I would suppose that when we made up our mind that a given pesticide should not be used for a specific purpose, we would endeavor to persuade the Department of Agriculture of the correctness of our decision.

If they did not become persuaded and if we remain in our opinion, we would go to the President for a decision. This might require legislation in the final analysis or perhaps an Executive order. But that would be the procedure which would be expected.

Mr. EVINS. Mr. Pryor?

Mr. PRYOR. I have no questions.

Mr. EVINS. Mr. Jonas.

TRAVEL EXPENSES

Mr. JONAS. This would go to Mr. Savage. I don't know. We will not do much traveling. Who will spend $63,000 next year on travel? That is a lot of money for a small Council to be spending on travel.

Mr. TRAIN. I personally do not have too much experience with a budget item of that sort. I believe this is based upon experience of equivalent agencies insofar as we can determine them. I will ask Mr. Savage to give such justification as we have.

Dr. MACDONALD. Excuse me, one point that should be made is that the travel is not solely for the Council or for the Council and the staff. Actually, a small part of it is that. What we intend to do is to have a series of regular meetings with outside groups in order to consult with them, obtain their viewpoints, as the Chairman has indicated.

We certainly don't have the expertise within our own organization to deal with many of these problems. So the travel contains that item.

Mr. JONAS. This travel will include the expenses of bringing consultants in.'

Mr. TRAIN. Yes.

PRINTING COSTS

Mr. JONAS. The question I wanted to direct to you was this item of printing which seems exorbitant to me—$30,000 for printing. What are you going to do?

Mr. TRAIN. We will be printing the annual report.

Mr. JONAS. I know, but $30,000 will pay for a lot of printing, won't it?

Mr. SAVAGE. Sir, we scaled this down considerably using as our best example the Council on Economic Advisers annual report for publishing 10,000 copies of that. Their estimate was in the neighborhood of $55,000. If we print 10,000 copies of ours, I would guess it would run us about $20,000. I think we can do it for that price.

Mr. JONAS. Aren't you going to sell this report or are you going to give it away?

Mr. SAVAGE. I imagine the great majority.

Mr. JONAS. Most of them are sold through the GPO.

Mr. SAVAGE. In fact, I think they gave away something close to 7,000 copies of the 10,000.

Mr. JONAS. They didn't give me many. They told me to buy the ones I wanted at the GPO. I had a lot of people calling for it. I can see why they could sell their report easier than you can yours. Yours lends itself mostly to giving away.

(Discussion off the record.)

LOCAL AND STATE RESPONSIBILITY

Mr. EVINS. There is one further observation, Mr. Chairman. You referred to the local and State action. What does the Council propose to do with respect to State and local action on matters? You drive along the highway and you see beer cans and litter. What are you going to tell the States and localities to do in this area?

Mr. TRAIN. We, of course, cannot intrude ourselves into the soverign affairs of the States and tell them what to do. We are required as part of the annual report—I don't know that I have the language in front of me—to report on activities of State and local governments in the environmental field. One of the jobs we are undertaking at the moment relates to State activity. I think as most of you will be aware the States, individually mostly are moving quite aggressively in the whole field of environment. Many are setting up councils on environmental quality or something like that. Some are setting up departments of environment. We are trying at the present time through discussions with the Conference of Governors and various State officials' associations to develop a body of information as to what is going on at the State level in this field, and to provide probably a clearinghouse of information on this subject.

Mr. EVINS. You have a great task of coordination and dissemination of information and making recommendations to the President. We hope you will be able to come forward a year from now and give us some concrete positive achievements. There are a lot of studies and we hope we can get some results. We thank you very much.

JUSTIFICATION MATERIAL

Gentlemen, we will place in the record your budget schedules and your justifications.

(The information follows:)

SALARIES AND EXPENSES

Program and Financing (in thousands of dollars)

Identification code 03-33-1453-0-1-903	1969 actual	1970 est.	1971 est.
Program by activities:			
10 Environmental policy development and program evaluation (costs—obligations)			700
Financing:			
40 **Budget authority**			700
Relation of obligations to outlays:			
71 Obligations incurred, net			700
72 Obligated balance, start of year			
74 Obligated balance, end of year			−100
90 Outlays			600

Object Classification (in thousands of dollars)

Identification code 03-33-1453-0-1-903	1969 actual	1970 est.	1971 est.
Personnel compensation:			
11.1 Permanent positions			400
11.3 Positions other than permanent			60
11.5 Other personnel compensation			10
Total personnel compensation			470
12.1 Personnel benefits: Civilian employees			32
21.0 Travel and transportation of persons			60
22.0 Transportation of things			3
23.0 Rent, communications, and utilities			40
24.0 Printing and reproduction			30
25.0 Other services			40
26.0 Supplies and materials			10
31.0 Equipment			15
99.0 Total obligations			700

Personnel Summary

Total number of permanent positions			26
Full-time equivalent of other positions			5
Average number of all employees			22
Average GS grade			12.5
Average GS salary			$18,625

The National Environmental Policy Act of 1969 (Public Law 91-190, approved January 1, 1970), states that "The Congress, recognizing the profound impact of man's activity on the interrelations of all components of the natural environment, particularly the profound influences of population growth, high-density urbanization, industrial expansion, resource exploitation, and new and expanding technological advances and recognizing further the critical importance of restoring and maintaining environmental quality to the overall welfare and development of man, declares that it is the continuing policy of the Federal Government, in cooperation with State and Local governments, and other concerned public and private organizations, to use all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans".

Section 202, Title II, of the Act creates in the Executive Office of the President a Council on Environmental Quality. The Council is composed of three members who shall be appointed by the President to serve at his pleasure, by and with the advice and consent of the Senate. The Council is authorized to employ such officers and employees as may be necessary to carry out its functions under the Act and, in addition, to employ and fix the compensation of such experts and consultants as may be necessary for the carrying out of its functions under this Act. Duties and functions of the Council are:

(a) assist and advise the President in the preparation of the Environmental Quality Report required by section 201 of the Act.

(b) to gather timely and authoritative information concerning the conditions and trends in the quality of the environment both current and prospective, to analyze and interpret such information for the purpose of determining whether such conditions and trends are interfering, or are likely to interfere, with the achievement of the policy set forth in title I of the Act, and to compile and submit to the President studies relating to such conditions and trends.

(c) to review and appraise the various programs and activities of the Federal Government in the light of the policy set forth in title I of the Act for the purpose of determining the extent to which such programs and activities are contributing to the achievement of such policy, and to make recommendations to the President with respect thereto.

(d) to develop and recommend to the President national policies to foster and promote the improvement of environmental quality to meet the conservation, social, economic, health and other requirements and goals of the Nation.

(e) to conduct investigations, studies, surveys, research, and analyses relating to ecological systems and environmental quality.

(f) to document and define changes in the natural environment, including the plant and animal systems, and to accumulate necessary data and other information for a continuing analysis of these changes or trends and an interpretation of their underlying causes.

(g) to report at least once each year to the President on the state and condition of the environment, and

(h) to make and furnish such studies, reports thereon, and recommendations with respect to matters of policy and legislation as the President may request.

Attached are copies of the Object Classification and Permanent Personnel Schedules and a Council Organization Chart. An explanation of the fund requirements by object classification follows:

11.1 Permanent Positions. These estimates cover the salary costs for 20 permanent positions authorized for FY 70 together with 6 additional permanent positions authorized for FY 71, a total of 26. As of March 31, 1970, 14 positions were filled; 3 were committed and the employees will enter on duty during the next two weeks; applicants for the other three positions are being evaluated and it is expected that selections will be made during April. For FY 71, the $410,000 covers the annualized costs for the 20 positions and 9 months each for the 6 new positions.

11.3 Positions Other Than Permanent. These estimates cover the cost of consultants, experts or task forces working on specific problem areas together with temporary personnel hired during peak periods.

12.1 Civilian Personnel Benefits. These estimates cover the retirement, life insurance and health benefit contributions.

21.0 Travel and Transportation of Persons. These estimates cover the costs of staff travel in connection with Council activities together with the travel costs of consultants, experts, etc., for attendance at meetings and conferences regarding Council activities.

23.0 Rent, Communications, and Utilities. These estimates cover the cost of leased office space, postage, telephones, etc.

24.0 Printing and Reproduction. These estimates cover the cost of day to day printing requirements together with the publication cost of the annual report.

25.0 Other Services. These estimates primarily cover the cost of the support services provided by GSA, i.e., finance and accounting, personnel administration, payroll, etc., together with reimbursable service of other Federal Agencies.

26.0 Supplies and Materials. These estimates cover the cost of the day to day operating supplies and materials.

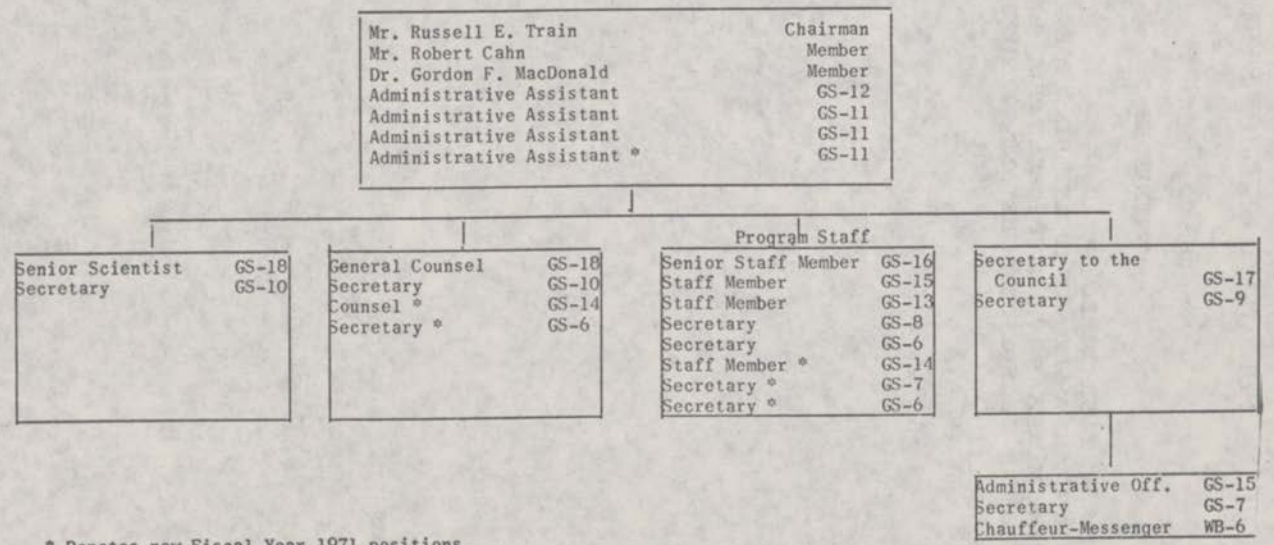
31.0 Equipment. These estimates cover the costs of the office furniture and equipment necessary to establish a new office. These are basically nonrecurring costs and subsequent estimates would be for replacement only.

As regards specific activities of the Council, primary emphasis has been on selecting and assembling a staff and laying out the Council work plan. Following are study areas in which the Council is now or will be engaged:

1. Agricultural Pollution
2. Unconventional Vehicles
3. Re-use and Recycling of Solid Waste
4. Auto Bounty
5. Noise
6. Ocean Dumping
7. Detergents
8. Pesticides
9. Oil Spills
10. Combined Sewer Overflows
11. Economic Study of Costs of Pollution
12. Preparation of Annual Report

Additionally, the Council will be actively engaged in the evaluation of existing and proposed policies of the various Federal Agencies to assure that their activities are carried on in full consideration of environmental values, and will review Agency statements concerning all proposals for major legislation and other actions which significantly affect the environment.

COUNCIL ON ENVIRONMENTAL QUALITY
ORGANIZATION CHART



* Denotes new Fiscal Year 1971 positions.

TUESDAY, APRIL 7, 1970.

SELECTIVE SERVICE SYSTEM

SALARIES AND EXPENSES

WITNESSES

CURTIS W. TARR, DIRECTOR
EDWIN CASH, ASSISTANT TO THE DIRECTOR
JESSE T. McMAHAN IV, CHIEF FISCAL PROCUREMENT OFFICER
BERNARD T. FRANCK III, ASSISTANT TO THE DIRECTOR

Program and Financing (in thousands of dollars)

Identification code 32-40-0400-0-1-059		1969 actual	1970 est.	1971 est.
	Program by activities:			
	1. National administration, planning, training, and records management	3,273	4,149	4,423
	2. State administration, planning, training, and records servicing	10,896	12,604	12,805
	3. Registration, classification, and induction	51,025	56,528	58,615
	4. National advisory committee on the selection of physicians, dentists, and allied specialists	27	102	75
	5. National Selective Service Appeal Board	72	82	82
	Total program costs, funded [1]	65,293	73,465	76,000
	Change in selected resources [2]	−46	−1	
10	Total obligations	65,247	73,464	76,000
	Financing:			
14	Receipts and reimbursements from: Non-Federal sources (40 U.S.C. 481(c))	−3		
25	Unobligated balance lapsing	984		
	Budget authority	66,228	73,464	76,000
	Budget authority:			
40	Appropriation	66,418	68,348	76,000
41	Transferred to other accounts	−190	−165	
43	**Appropriation (adjusted)**	66,228	68,183	76,000
44.20	**Proposed supplemental for civilian pay act increases**		4,595	
44.30	**Proposed supplemental for military pay act increases**		686	
	Relation of obligations to outlays:			
71	Obligations incurred, net	65,244	73,464	76,000
72	Obligated balance, start of year	9,853	10,185	11,401
74	Obligated balance, end of year	−10,185	−11,401	−12,001
77	Adjustments in expired accounts	−111		
90	Outlays, excluding pay increase supplemental	64,801	67,355	75,012
91.20	Outlays from civilian pay act supplemental		4,379	216
91.30	Outlays from military pay act supplemental		514	172

[1] Includes capital outlay as follows: 1969, $606 thousand; 1970, $330 thousand; 1971, $315 thousand.

[2] Selected resources as of June 30 are as follows:

	1968	*1969*	*1970*	*1971*
Stores	405	386	386	386
Unpaid undelivered orders	80	53	52	52
Total selected resources	485	439	438	438

Object Classification (in thousands of dollars)

Identification code 32-40-0400-0-1-059		1969 actual	1970 est.	1971 est.
	Personnel compensation:			
11.1	Permanent positions	39,903	45,681	44,253
11.3	Positions other than permanent	5,630	5,807	7,138
11.5	Other personnel compensation	123	44	44
11.8	Special personal service payments	5,196	6,127	6,159
	Total personnel compensation	50,852	57,659	57,594
12.1	Personnel benefits: Civilian employees	3,711	4,017	4,171
21.0	Travel and transportation of persons	6,215	7,418	9,148
22.0	Transportation of things	207	213	226
23.0	Rent, communications, and utilities	2,490	2,549	2,928
24.0	Printing and reproduction	506	661	647
25.0	Other services	335	281	621
26.0	Supplies and materials	372	337	350
31.0	Equipment	605	330	315
	Total costs, funded	65,293	73,465	76,000
94.0	Change in selected resources	−46	−1	
99.0	Total obligations	65,247	73,464	76,000
	Total number of permanent positions	7,509	7,699	7,227
	Full-time equivalent of other positions	1,086	1,006	1,213
	Average number of all employees	7,772	8,046	7,916
	Average GS Grade	7.3	7.3	7.3
	Average GS Salary	$9,159	$10,066	$10,183
	Average salary of ungraded positions	$5,741	$6,333	$6,395

Mr. EVINS. The committee will come to order.

This afternoon we will consider the budget justifications for the Selective Service System.

We have with us the new Director, Curtis W. Tarr, Director of Selective Service; Edwin Cash, Assistant to the Director; Jesse T. McMcMahan IV, the chief fiscal procurement officer; and Bernard T. Franck III, Assistant to the Director. This is a very distinguished group.

Dr. Tarr, we welcome you to this committee. We have waited to hear you until your confirmation in the other body. We will confirm you here now.

BIOGRAPHY OF DIRECTOR

Mr. Reporter, place Dr. Tarr's biography in the record.

(The biography follows:)

BIOGRAPHY DR. CURTIS W. TARR, DIRECTOR SELECTIVE SERVICE SYSTEM

Dr. Curtis W. Tarr became the Director of Selective Service on March 20, 1970. Prior to his appointment as head of Selective Service, he had served as Assistant Secretary of the Air Force (manpower and reserve affairs) to which position he was named on June 18, 1969. Dr. Tarr was president of Lawrence University in Appleton, Wis., from 1963 until his appointment as Assistant Secretary.

Dr. Tarr was born in Stockton, Calif., on September 18, 1924. During World War II, he served as an enlisted man in the U. S. Army; he earned three battle stars in the European theater of operations. He was granted a bachelor of arts degree in economics from Stanford University in 1948, a master in business administration degree from Harvard University in 1950, and his doctorate in American history from Stanford University in 1962. He received honorary degrees of doctor of humane letters from Ripon College, Wis., in 1965, and from Grinnell College, Iowa, in 1969.

Dr. Tarr was a research assistant and instructor at Harvard Graduate School of Business from 1950 to 1952, and was vice president of the Sierra Tractor and Equipment Co., Chico, Calif., from 1952 to 1958. During 1954–1955, he was a staff member on the second Hoover Commission. In 1958 he was a Republican candidate for Congress in the Second District of California.

From 1961 to 1963 Dr. Tarr was associated with Stanford University—first, as the assistant director and then as director of the summer session, and thereafter as assistant dean in the school of humanities and sciences. He also served as lecturer in the school of business during that period. He was appointed as president of Lawrence College in 1963 (became Lawrence University in 1964).

Dr. Tarr was a trustee of the Institute of Paper Chemistry, an affiliated graduate school of Lawrence University, in Appleton, Wis., from 1963 to 1969. He has served as chairman of the task force on local government finance and organization for the State of Wisconsin. He has worked on a number of civic, church, and educational activities in California, Wisconsin, and Virginia. He is a Methodist, Republican, and Rotarian.

Dr. Tarr is married to the former Elizabeth May Myers. They have two daughters, Pamela E. and Cynthia L.

Mr. EVINS. Yours is a very distinguished career—Stanford, Harvard, and president of Lawrence College in Wisconsin.

Mr. Director, the committee will be pleased to hear you. You may proceed as you wish.

Mr. TARR. Mr. Chairman, to begin, I wonder if I might make a special introduction of Colonel McMahan because his service with the Selective Service System has been impressive through the years. He is soon to leave Selective Service to accept a career opportunity in private enterprise and so in a way this is his swan song and we are happy to have him here with all of you gentlemen here today.

Mr. EVINS. We will miss Colonel McMahan but wish him well in his new endeavor.

Mr. TARR. We will miss him too, Mr. Chairman.

I hope Mr. Cash will be here with me many more times in addition to today. Perhaps you know more about him than I do. I have been briefed before that you might. I really don't know what to say about his background except that he promises to be the right arm of the Director in the area that relates to budget, dollars, orderly procedure in the offices and all the rest. He still feels his ties very strongly in Arkansas and I am sure his service with the headquarters of Selective Service will be distinguished.

GENERAL STATEMENT

Mr. Chairman and members of the committee, this is my first appearance before a committee of the Congress since I became the Director of Selective Service. Although I have spent a considerable amount of time in the Selective Service Office, I was not actually sworn in until yesterday. Consequently, my preparation for these hearings is modest both in an understanding of the problems we face and the means available to carry out our mission. Yet, my study of this budget request for $76 million for the operation of the agency in fiscal year 1971 convinces me that this is a reasonable requirement to finance a minimum expectation of what must be accomplished by Selective Service.

Operations of Selective Service for fiscal year 1970 will require $75,781,000 by the end of the fiscal year. The 1971 request exceeds actual cost for the current fiscal year by only $219,000. These requirements for 1970 include, of course, our supplemental request in the amount of $7,433,000 which the committee also has under consideration today.

As the Administration progresses toward reductions in the strength of our armed services, looking to the possibility of all-volunteer forces, lower draft calls are expected. Consequently you may wonder why the Selective Service System needs to spend dollars at a continuing rather than a reduced rate.

A reduction in the strength of the Armed Forces was taken into account in formulating this budget request, for in fiscal year 1971 we estimate only 200,000 inductions. If we had not anticipated lower force levels, we would have based our request on an estimate of more than 260,000 inductions, the number required to replace those leaving service who were inducted in fiscal year 1969, assuming that enlistment rates did not change.

The volume of the System's required work—registration, classification, delivery for examination and induction—remains high. We must register a growing number of young men who turn 18 each year; more examinations now are required to fill calls than ever before. The personnel of the System, in addition, continue to bear the burden of an extra workload occasioned by legal delays and illegal harassment, both of which emanate partly from opposition to the Nation's policies. For example, executive secretaries and their clerical assistants in fiscal year 1970 gave more than 1,000 man-years, or $6.3 million dollars' worth, of uncompensated serivce. This overload results in part from

badgering of local board personnel, time required to restore destroyed records, the increasing inclination of young men to appeal their classifications, response to larger numbers of telephone and personal calls, and time consumed on legal work for appearances in court, taking depositions and other required actions. The cost of processing appeals has more than doubled in the last 3 years. During February of this year, in just one State, local board personnel worked 92 days on court cases. The out-of-pocket and the hidden costs of sabotage, robbery, vandalism, bomb threats and the like in our offices are soaring.

Personnel compensation and selectee travel continue to constitute more than 90 percent of the System's expenditures. Gentlemen, I know it is familiar to you, but I am immensely impressed by the fact that the System's work is accomplished largely by dedicated citizens serving without pay. They outnumber compensated people more than five to one. This budget request is, in my judgment, necessary to provide these unpaid operators of the System with the support needed to retain their full enthusiasm and to carry out the functions to which they contribute so much.

The details of the agency's budget are set out in the justifications. I will be pleased either to answer your questions or to furnish the answers for you.

Because this is my first appearance as Director before a committee of the Congress, I wish to offer some ideas I have about Selective Service.

I recognize that the mission of the Selective Service System is one which gravely affects nearly every family in the Nation through its impact on the plans and careers of the fathers, sons, and brothers who are liable for military service. Also it seems apparent to me that the maintenance of adequate Armed Forces continues to depend upon the successful performance of this agency.

Because of these factors, you, the Members of the Congress, are intensely interested in Selective Service. I intend to do all that I can to assist you in your concern to provide appropriate legislation to carry out this mission.

I have no reservations about the principle that all of us share the privilege and obligation to serve in the Armed Forces if we are needed. When only a few of those available and qualified are required, the selection must be as equitable and as impartial as can be devised. The system now in use, where the order of selection is based on an impartial drawing of birthdates, is a reasonable one.

However, equity is enhanced to the extent that more of those liable for service are subjected to possible selection at the same age. To attain this improvement, we should limit to the minimum the grounds for deferment.

I recognize that deferments required by law or provided for by Presidential order long have been designed in the Nation's interests. These deferments reflect judgments arrived at after great deliberation on the manpower requirements of the Nation—both in the civilian sector and the Armed Forces. But there is a real question now, given the numbers of men to be inducted and the much greater pool of those available for service, if this channeling should continue. Public discussions during recent years have questioned the need for continuing student, occupational, agricultural, and paternity deferments. Per-

sonally, I believe we should discontinue granting deferments in these areas as soon as possible.

There is, of course, the necessity to insure that the Armed Forces have adequate means of officer procurement. Deferments for ROTC and other officer programs should continue.

Hardship deferments must be retained. So should those for conscientious objection. We must maintain deferments for those participating in our reserve forces. But the bulk of the present deferment structure can hardly be defended under contemporary circumstances. On the question of deferment policy generally, the President should always have the authority to modify policies in the event that the national interest requires doing so.

The present community-based organization and operation of Selective Service, described in the law, has proven its worth. There will always be decisions in any military manpower procurement program which best can be made by the people in the community: hardship deferment decisions provide a good example of these. The administrative challenge of such a system is to encourage local decisions that are consistent with a national policy; insuring that consistency will continue to require a maximum cooperation among the many components of the System.

Involuntary induction for military service has been used in this Nation only in those periods when the Government—and the people—have been persuaded of its need to assume adequate armed strength. Currently the need for induction authority is under discussion. I am impressed by the study made by the President's Commission on an All-Volunteer Armed Force. I believe we should explore the recommendations fully and work toward the objective of voluntary service. The critical question to me is one of timing—of how soon this objective may be achieved and induction calls suspended. We should provide the financial incentives for enlistment, and we must do all that we can to make the Armed Forces an inviting place in which young men can serve, either for a limited term or a full career. I am not certain how soon the services, giving their best efforts, can operate without the draft and draft-induced enlistments.

In the meantime, the Nation requires an effective Selective Service System. I intend to do all that is required to maintain that System, to alter it where wisdom recommends doing so, to insure justice in selection, and to importune you when new laws seem required for improvement.

Mr. Chairman, thank you for this opportunity to speak on these matters crucial to harmony in the Nation and to our security against foreign peril.

VOLUNTEER ARMY

Mr. EVINS. Thank you, Dr. Tarr, for a very interesting statement. Do you feel we should move toward developing a volunteer army?

Mr. TARR. Mr. Chairman, I think it is important for us to move ahead on providing the incentives, particularly the financial incentives that will make enlistment more popular among young men. I

think, however, that it is a dangerous tendency for us to suggest doing away with the machinery of selective service until we make certain that these incentives for enlistment in fact produce the manpower that we need.

Mr. EVINS. I have had reservations about whether you could ever make a volunteer army work. If they have a patriotic cause to fight for, they will fight for the defense of this country. We had the mercenaries of the British in the Revolutionary War; we had mercenaries in the Civil War and they have not been too good.

VIEWS ON DEFERMENT

Do you favor legislation to do away with all types of deferment except for hardship? Hardship deferments must be retained.

Mr. TARR. And conscientious objectors and deferments for people who are in officer training programs; people who are in our Reserve forces, but the bulk of them I think we should do away with.

Mr. EVINS. I noticed in the public statement of Dr. Tarr, that he felt one should not be inducted for reasons of punishment. Some demonstrators might have been inducted in the past. That might have been the reason why they demonstrated against the Selective Service System and have threatened to throw bombs and steal their records. I hope you have a successful administration of the selective service program.

Mr. TARR. Sir, I wouldn't be averse to putting people into jail if they do the wrong thing.

RANDOM SELECTION

Mr. EVINS. Tell us about the volunteer army. Tell us how this will work. Tell us how the birthdays will affect the youth. Tell us how the lottery system of selection will work, or how it is working. It became effective in January of this year, did it not?

Mr. TARR. The transition from the previous policy of inducting the oldest first in the 19 through 26-year age bracket, to the youngest first on the random number, has been a difficult adjustment. I think we are at the place now where it is working more smoothly but the difficulty came from reversing the filing system in the local boards so that the youngest rather than the oldest would be selected. For sending that man on for his preinduction physical and so, by reversing the process, in each of these local boards it has been a difficult problem.

EFFECT OF HARASSMENT

I hope we are beginning to get on top of this. The reports that I have read from our people who go around through local boards in the field have been encouraging, but they emphasize the size of the job.

I do think that part of our difficulty in the past few months has been not only the change in this system of selection but it has also been

the result of turmoil, agitation, open attack against some of our State headquarters and local boards, which has caused a tremendous amount of confusion in some of these places.

So it is difficult to say how well random selection is working under these circumstances that also are difficult, but we are hopeful.

TIMING OF LOTTERY

Mr. EVINS. You have had one national lottery. The youth of what age groups were included in this lottery?

Mr. TARR. My understanding is that youth in the entire exposure period, 19 to 26, were involved in the first lottery. In the next lottery would take a 1-year group rather than this 7-year span.

Mr. TALCOTT. When will the next lottery be?

Mr. TARR. I think we need an Executive order to determine precisely when it will be, but the hope is that the lottery can be held substantially in advance of the time when the first people involved have been inducted. Part of our difficult transition to the lottery is that you hold a lottery one month and begin to operate it the next and it doesn't give you enough leadtime to get these people down for preinduction physicals. So some people have talked about a desirable 6 months stand between lottery and first inductions.

Mr. TALCOTT. That would be July 4th of this year.

Mr. TARR. If that were so, it would be some time in July. I know there is some work being done on an Executive order, but I think that is the tentative plan.

NEED FOR PERSONNEL

Mr. EVINS. Are there any questions?

Mr. TALCOTT. I am wondering if there are enough people on board to handle all the harassment that is going on and that is likely to continue? What are your ideas? Dr. Tarr, will the harassment continue?

Mr. TARR. I, like you, don't see that it will abate particularly. I am hopeful that we might get some stiffening on the part of people in local communities against this. Ultimately the real protection against lawlessness on the part of the people in communities is to demand better enforcement and demand more retribution against people who take the law into their own hands.

LOCAL BOARD MEMBER TURNOVER

Mr. JONAS. What was your turnover of local board members in the last year compared with the previous 6 or 8 years? Has it been greater?

Mr. CASH. I don't have the feeling that it has.

Mr. JONAS. What is the rate running now per year?

Mr. CASH. The turnover, sir?

Mr. JONAS. Yes.

Mr. CASH. I don't know. We have it.

Mr. JONAS. I think it would be interesting to supply for the record a statement showing your turnover in calendar year 1969 and the rate thereof in comparison with the previous 5 years.

(The information follows:)

TURNOVER OF LOCAL BOARD MEMBERS

Fiscal year	Onboard July 1	Losses July 1 to June 30	Percentage of loss
1970	18,654	[1] 2,458	13.2
1969	17,509	2,034	11.6
1968	17,062	3,182	18.6
1967	16,712	1,676	10.0
1966	16,403	1,432	8.7
1965	16,275	1,025	6.3

[1] Actual July through February, estimated March through June 1970.

Mr. JONAS. I have difficulty seeing how you keep the local board members at work.

RETENTION OF MEMBERS

Mr. TARR. That is precisely the point. Even though our figures up to this point, if they don't show a lot of turnover, we can't anticipate that to be true in the future.

Mr. JONAS. I think you would be making a mistake to anticipate that it won't increase. You have board members who have served some 15 or 20 years, but I imagine many of them are becoming increasingly restive, and that is natural because you can't win at this game. It is not a place to make friends.

Mr. TALCOTT. These people have to be just about the most dedicated people we have to do this for nothing and assume the terrible responsibility that they have.

DATA PROCESSING

I am concerned about your use of data processing equipment. Here is one agency of the Government that involves many people, with as little data processing involvement as any. I notice, from your justification, you are using computers some for payroll and supplies and this sort of thing, but are there any data processing applications used for the inductees, or the possible draftees?

One of the complaints I have of the system is that kids go to colleges from all over the country, but they have different applications from different draft boards, even though they all have the same number. Is there enough coordination between the draft boards so there is some fairness in the callup between the numbers? What I am saying is, in one community the number 60 will be called up and in another community it will be 180. That doesn't seem fair for people all in one college who come from many parts of the country.

Mr. TARR. We have been working hard on this one. Whether we can accomplish what you have set forth as a desirable end, I am not certain—with respect, you know, to the rate at which people are called.

SECURITY OF RECORDS

Coming back to the point of harassment and data processing, we have talked as recently as this morning about this problem. It may be that if these people in the local boards are subject to attack because people know that in the local board are the only records by which

they might be inducted, we could thwart a lot of this kind of irresponsible action if we did centralize recordkeeping in a secure environment. We certainly are going to look very carefully at this.

FAIRNESS IN SELECTION

Mr. TALCOTT. There are two ends to be accomplished in something like this: safeguarding the records, but also a little coordination so there is more justice in callup. After you eliminate all the deferments, then you may not have the problem.

Mr. TARR. This is true.

JUSTIFICATION

Mr. EVINS. Place in the record pages 2 through 6 of the justification material.

(The pages follow:)

SELECTIVE SERVICE SYSTEM

FISCAL YEAR 1971—GENERAL STATEMENT

There is presented herewith justification for the request of $76 million with which to operate the Selective Service System, the National Advisory Committee on the Selection of Physicians, Dentists and Allied Specialists and the National Selective Service Appeal Board during fiscal year 1971.

The Selective Service System is organized to carry out the primary functions of registration, classification, selection, and presentation for induction in the Armed Forces of the men necessary for maintenance of the national health, safety, or interest. It also determines the availability of men for selective call-up from the Standby Reserve. The collateral functions of administration, planning, training, and records management are also performed by this Agency.

NEED ADEQUATE HELP

The use of the Selective Service System of the services of over 48,000 uncompensated officials is unique in Government. These patriotic citizens will become less enthusiastic in their giving of service unless adequate clerical personnel is provided. The request for fiscal year 1971 includes the provision for such services in project 30, except for 15-percent uncompensated clerical time.

The Selective Service System, which is decentralized, is organized on a pyramidal structure, the broad base of which is the local and appeal board element where the contact is maintained with over 40 million registrants by the uncompensated members of the System and the local and appeal board personnel who staff the 4,094 local boards and the 102 appeal boards. The next largest group is composed of the 56 State headquarters; the relatively small group which comprises the national headquarters is the apex.

The strength of the Selective Service System lies in the fact that classification is the responsibility of those uncompensated civilians living in the communities with the registrants. They have no pecuniary interest in their position but perform their tasks as a patriotic service.

NUMBER OF INDUCTEES

The size of the calls or the number of inductions in any given period directly affects only one cost factor—namely selectee travel. It is estimated that 200,000 to 280,000 registrants will be inducted during fiscal year 1971.

In appropriate places, there is shown as a one line entry the amount included for the supplemental for the pay raise effective in fiscal year 1970. Also included is a supplemental request to cover some 40 percent more preinduction physical examinations to implement the new system of random selection.

Executive Order No. 11415 reestablished the National Advisory Committee on the Selection of Physicians, Dentists and Allied Specialists. Pursuant to this order, the Selective Service System is required to furnish funds for its share of the committee's operation and provision is included herein.

NATIONAL APPEAL BOARD

Executive Order No. 9988 created the National Selective Service Appeal Board. The Selective Service System is required to pay the members of the board and "to furnish suitable office space and other necessary facilities and service." This requires personnel in national headquarters to the extent necessary to meet this requirement.

The increase in 1971 over 1970 is a reflection of including the additional requirements. These are due to (1) increased examination workload, (2) the increase in workload due to organized efforts at harrassment and (3) to adequately compensate local board executive secretaries and assistants for the work that needs to be done. In addition, the following new programs are being initiated:

1. Data processing unit for fiscal and personnel control.
2. State headquarters manpower officers orientation program.
3. Youth advisory committees.
4. Joint fiscal, procurement and personnel training conferences.

For narrative justification of the new programs see pages 20 thru 24.

15-YEAR EXPERIENCE

The following 15-year table shows the experience and projection of the number of new registrations in future years:

Fiscal year	Age 18 year of birth	Census estimate in thousands	Selective Service registration
1962	1944	1,402	[1] 1,512,980
1963	1945	1,397	[1] 1,506,857
1964	1946	1,414	[1] 1,491,907
1965	1947	1,955	[1] 1,972,638
1966	1948	1,811	[1] 1,999,981
1967	1949	1,813	[1] 1,929,722
1968	1950	1,857	[1] 1,936,021
1969	1951	1,902	[1] 1,980,379
1970	1952	1,867	[2] 1,979,000
1971	1953	1,850	[2] 1,961,000
1972	1954	1,917	[2] 2,032,000
1973	1955	2,128	[2] 2,256,000
1974	1956	2,162	[2] 2,292,000
1975	1957	2,197	[2] 2,329,000
1976	1958	2,124	[2] 2,251,000

[1] Actual.
[2] Estimated.

One of the workload factors in the Selective Service System which has been unpredictable on a long-range basis is the number required for induction by the Armed Forces. We are estimating inductions at 200,000 to 280,000 in 1971, and a range of approximately the same magnitude for each of the next 4 years. This assumes that the rates of acceptance of those presented by the Selective Service System will remain at about present levels.

REGISTRATION WORKLOAD

The other changing workload factor is the number to be registered. As shown in the previous table, this reached a peak in 1966, a reduction was realized in 1967 with an increase for 1968 and 1969, with 1970 and 1971 again reducing but thereafter increasing each year until 1976.

Taking these two workload factors, together with an indicated need for a substantial increase in preinduction physical examinations to fill calls under the new random sequence method of selection, each of which will affect numbers of different actions, we forecast the following in thousands of dollars:

1972	$75,600	1974	$76,798
1973	74,918	1975	76,124

These figures do not include any general pay raise but are based on existing legislation.

MOTOR VEHICLE NEED

A request is included for the replacement of motor vehicles. In fiscal year 1970, 13 vehicles will be replaced and in 1971, 13 are also being replaced at a cost of $21,750. These are (1) eight automobiles for replacement and (2) five station wagons for replacement. These all meet the requirements for replacement.

Our fleet consists of 32 automobiles, 21 station wagons and seven trucks, 1 ton or less. The equipment is in areas where there are no General Services motor pools available. They are principally used by State directors and the officials of State headquarters for contact with local boards within their respective states. The station wagons are also used to deliver light equipment and supplies to local boards. Also, we lease one medium sedan for the Director from the manufacturer and, of course, other vehicles from the GSA motor pools where available.

Where the breakdown of the 3 years is made on objective classification, we have followed the normal display with a 1970 revised estimate column to include the supplemental where appropriate.

NEW PROGRAMS

Mr. EVINS. The following new program is being initiated:

"Data processing for fiscal and personnel control." Is this a record-keeping of all inductees, all the records of all the boards?

Mr. TARR. No, this relates to people who work for the System.

Mr. EVINS. The personnel payroll?

Mr. TARR. Right.

Mr. EVINS. You have another new program, "State headquarters manpower officers orientation program." What is the nature of this program?

Mr. TARR. This is an attempt to do some of what Congressman Talcott was talking about to bring people from the field to a central point to indicate to them what appropriate policies are so that better coordination might be established between these decentralized units in the system.

ORIENTATION PROGRAM

Mr. JONAS. This isn't in the new program; is it?

Mr. TARR. It is my understanding that the rate at which it is planned to undertake this is new.

Mr. JONAS. Do you mean local board clerks or members?

Mr. CASH. Previously we have just talked to the State directors. This program, the $26,000 item, intends to orient State headquarters' staffs below the level of the State director.

Mr. JONAS. To my personnal knowledge you have been doing that for 25 years.

Mr. CASH. Not lately, sir. There was a time.

STATE PAYROLLS

Mr. EVINS. The State directors inform the local boards. A large part of the money goes to the State directors. Do the State directors make payment to the executive secretaries or clerks of the local board or the headquarters?

Mr. CASH. Yes, sir; the State headquarters.

Mr. EVINS. The State headquarters is in contact with the local boards and the State headquarters makes the payment.

You want to spend more money for the State headquarters to call the offices of the local boards?

Mr. CASH. No, sir. If I may speak to that, Congressman Jonas, this program was prompted by the recommendations made during congressional hearings of 1967 that we do more coordinating among our staffs. We now bring the State director in for conferences. He generally does not bring in his deputy or manpower officer. This program contemplates bringing officers on the State staffs other than the State director for orientation; bringing them to the national headquarters, perhaps on an exchange basis.

Mr. JONAS. Previously, you sent somebody from national headquarters out to the field.

Mr. CASH. In World War II people went out.

NUMBERS IN PROGRAM

Mr. EVINS. You now propose to bring into national headquarters staff members below the State director?

Mr. CASH. That is correct.

Mr. EVINS. And have orientation courses?

Mr. CASH. Yes, sir.

Mr. EVINS. How many do you plan to have in the year and how many do you expect to attend each meeting?

Mr. TARR. There are 100 people each year to come to the national headquarters for 7 days each.

Mr. EVINS. You are going to pay all of the travel expenses, per diem and other expenses? How much will this cost?

Mr. TARR. $26,000.

Mr. EVINS. How many meetings are you going to have in a year? One or more?

Mr. CASH. There will be a hundred—it will be a continuing program.

YOUTH ADVISORY COMMITTEES

Mr. EVINS. Tell us about your youth advisory committees. How many will you set up and what are they going to do?

Mr. TARR. There will soon be such a committee in each State. There will be meetings of youth advisory committees in the States. There are to be how many regional meetings of youth advisory people?

Mr. MCMAHAN. 400 State meetings each year.

Mr. TARR. That is about four meetings in each State per year and one regional meeting.

Mr. EVINS. Who will head up these youth advisory committees? Are they already organized or do you propose to organize them in the future?

Mr. TARR. For the most part they are organized now.

Mr. EVINS. Do the youth themselves meet and organize into a committee at the insistence of Selective Service?

Mr. TARR. That is true.

FUNCTION OF COMMITTEES

Mr. CASH. They are advisory committees to the State directors.

Mr. EVINS. They advise the State Directors. Do they advise the local boards? What is the nature of the advice?

Mr. TARR. Recently there was a regional meeting on the west coast and one here on the east coast at which point these young people were asked their recommendations with respect to deferment; how the matter of phase-out of deferments might be handled. I read the report of the people who met in California. I thought their recommendations were very wise. It brought up some factors that some of us in a different generation might not think about. I have received a flood of correspondence from young people who served on youth advisory committees. I would say these are fine young people who have some good ideas about how the system might be changed.

Mr. EVINS. How many of these committees are there?

Mr. CASH. There are 54 of them.

Mr. EVINS. You have at least one in every State?

Mr. CASH. That is the assumption, yes, sir.

COST OF MEETINGS

Mr. EVINS. The youth meet from time to time, give the recommendations to the state headquarters when you ask for them?

Mr. CASH. That is correct, sir.

Mr. EVINS. Who pays for these meetings? How much does it cost to sponsor youth advisory committees?

Mr. CASH. They are appointed advisors to the State directors of selective service. This enables us to pay them per diem and travel and that is all.

Mr. EVINS. The State director names them as advisors to him. Once the committee is formed, then he names them as his advisors?

Mr. CASH. That is correct, sir.

Mr. EVINS. He pays them per diem and mileage when they come to see him?

Mr. CASH. For example in Georgia, they come to Atlanta for 1 day and they get 1 day's per diem or the portion of it to which they are entitled, plus mileage from and to home; no salary.

Mr. TALCOTT. This is a total of $250,000?

Mr. CASH. No sir, $200,000 in the aggregate. It is travel which includes per diem.

ATTITUDES OF YOUTHS

Mr. EVINS. Have you had any instances where these youth advisory groups demonstrated, protested or marched? Were they peaceful? Was there any violence?

Mr. CASH. Many of them are veterans, sir. It might interest you to know that the Youth Advisory Committee, let's say in the state of Georgia—that is one I happen to know a little about—is headed by a Negro lad who left one arm up to about his elbow in Vietnam. There is an effort to get a cross-section of people, a college person, a high school person, a female, a minority group representative, a veterans group representative. Apprentice and trades are also represented.

Mr. SHIPLEY. By whom is the selection made?

Mr. CASH. The State director. He generally seeks help through colleges, through high schools, labor groups.

Mr. EVINS. My question is, after these groups have been formed, have they turned out to be paid demonstrating groups?

Mr. CASH. No, sir.

Mr. EVINS. A lot of times we give a grant to somebody and they use the money to organize a group and demonstrate. None of this money has been used to finance protests and demonstrations?

Mr. CASH. No, sir.

RECOMMENDATIONS OF COMMITTEES

Mr. SHIPLEY. You mentioned that some of the ideas they may have about what might be done—have you gotten any ideas so far from these groups that you have?

Mr. TARR. I only have this one example to give you and that is the comment we got from these two regional meetings held about a month ago. I would say that the comments have been helpful. For instance, these young people—you know, it is a split vote, but they voted against the continuation of undergraduate student deferment. Well, if we get into a position where we come to the Congress and ask for a change in the law as it relates to undergraduate student deferment, I would say it helps substantially for us to know that young people feel that perhaps undergraduate student deferments in this kind of environment are not really helpful.

REGIONAL MEETINGS

Mr. SHIPLEY. Is this one advisory group that you are talking about or was this the action of the combined advisory groups?

Mr. TARR. There are these state advisory groups. When we have regional meetings, the state group may designate up to four people to go to a regional meeting so that a regional meeting would have representation from every State within the region.

Mr. SHIPLEY. The action you are talking about was regional?

Mr. TARR. It was a regional meeting.

Mr. SHIPLEY. How many States were involved in that particular region?

Mr. TARR. I think there were 12.

Mr. CASH. If it is the one I am thinking about it was, minus Arkansas and Louisiana, everything west of the Mississippi, sir.

Mr. TARR. But I don't think they all came.

Mr. SHIPLEY. That is good.

Mr. TARR. The attempt was to have one west of the Mississippi and one east of the Mississippi or something thereabouts.

DEFERRMENT TECHNICALITIES

There are a lot of technicalities with respect to deferment. For instance, the degree to which we continue to protect people under 2–A deferments who are really students but are not enrolled in program leading to a baccalaureate degree. For instance, in junior colleges. Their attitude on what represents normal progress toward a degree; their attitude on the degree to which young people should be

deferred for apprentice programs. Their general feeling for instance was that people in apprentice programs should be treated as people in baccalaureate programs.

I thought they had a good idea on paternity deferment. They say when you are dealing with 19-year-old young people you shouldn't look at the paternity deferment as you do when you are dealing with 26-year-old people.

Now, a lot of these things, sure, you can anticipate yourself and you do, but I think it is helpful to have these people give you their thoughts in addition to your own before decisions that affect this generation are made.

YOUTH COMMITTEE BENEFITS

Mr. SHIPLEY. You are incorporating young people here to act as counsels and advisors, on a State basis and eventually on a regional and national basis. Do you think this is going to help overcome some of the problems we have, the troubles we have had with bombings, burnings and this type of thing?

Mr. TARR. The young people who are involved in the advisory committees think it will.

Mr. SHIPLEY. This is what I wanted to know. I would think that it should if the advisory group is made up of responsible youth of America. It should help.

Mr. TARR. I have gotten quite a few letters since I was named the President's appointee for this job and I would say many of these letters come from people who are not yet aware that we have youth advisory committees, and these people have said, "What you really need in selective service is to get young people involved."

Mr. SHIPLEY. It is a good point.

Mr. TARR. Surely. I don't think anybody suggests they should take over the system. I am sure there are people somewhere who would suggest that, but no one has suggested that to me. On the other hand, there is a real—so far as I can measure—a real interest on the part of people of all generations to get young people involved in the system.

I would be hopeful that ultimately out of these kinds of groups could come the people who can continue to help this system on a volunteer basis in years to come.

Mr. SHIPLEY. I think it is good. I am like the Chairman. I can foresee sometime in the future the thing getting away, but I am sure they will be selective as to who they appoint to the advisory councils. It could really help us, I think, in the long run. I am glad to see you are doing it.

Mr. TARR. It depends on the leadership you give to it.

NEW PROGRAM

Mr. EVINS. Another new program is joint fiscal procurement and personnel training conferences.

We will place in the record pages 20 through 24, the narrative of all the new programs.

(The pages follow:)

NARRATIVE JUSTIFICATION OF NEW PROGRAMS

1. Data processing unit for fiscal and personnel control.—In 1968 the Selective Service System implemented a nationwide salary and local board staffing plan for some 8,000 unclassified employees. This, aside from beneficial morale factors, opened up possibilities to improve monitoring of payroll and personnel actions for control, compliance with standards, and reduction of pay errors. It was also apparent that with the right kind of equipment better planning could be done with faster and more precise estimates of present and future fund requirements.

DATA BANK

Efforts were made to achieve some goals toward that objective by absorbing the monitoring aspects with existing capabilities. Simultaneously, a data bank of information on punch cards concerning local board employees was being manufactured. This included by individual, rate of pay, man years worked, location, and date next pay increase due. By local board, information includes registration, personnel allowance, location, and number of hours open to the public a week.

Initially four people were diverted to sequence, collate and monitor pay changes and personnel actions. By refining this system the number has been reduced to two and there will be a continuing need for that number. This is an economically sound operation in that the salaries are compensated by the pay errors avoided.

FIRST ADP USE

While this is the first application for Automatic Data Processing, it is apparent that some benefits could accrue to other sections of the Fiscal and Procurement Division. For example, the transportation, property, accounting, and budget sections.

There will be a continuing need for IBM machine rental amounting to about $12,000 per year; for supplies amounting to $4,000 per year; and for salaries of five employees, two of which are solely related to machine processing. The salaries for the two amount to $14,800 yearly. During fiscal year 1971 the amount of $7,000 is required for the purchase of auxiliary and miscellaneous equipment.

2. State headquarters manpower officers orientation program.—A program of bringing State headquarters manpower officers to national headquarters for short tours within the Manpower Division is needed for the intensive exchange of information on selected manpower matters between the manpower elements of the State and national levels of the Selective Service System. Areas of exchange are to include: manpower policies and their application by the State; manpower situations within the State which are problem areas or relatively unique compared to other States; ways to maximize the achievement of a proper degree of uniformity among the various States in manpower matters; indoctrination and training of certain manpower officers; and, the overall effectiveness of manpower procurement policies and procedures within the State. This program is needed by the Selective Service System to assist in achieving the System's primary objective of continuous effective manpower utilization. In addition, further movement toward a proper degree of uniformity resulting from the program will minimize unfavorable comment on the subject of uniformity.

7-DAY TOURS

Tours at national headquarters under this program will be seven calendar days in length and 100 such tours are expected annually for at least the first 2 years under the program. Although there are 56 State headquarters, slightly less than this number will participate in this program due to the extremely small size of some of the State systems. Large State systems will require more than one manpower officer tour under the program. However, participation and the timing of the individual tours will be based upon giving priority to those States having the greatest need for the program and size of the State system is not the sole index of this need.

The fiscal year 1971 cost of this new program is estimated at $26,000, chargeable to the travel account, Project 20—State headquarters. The amount required to continue this program in fiscal year 1972 is estimated at $28,000.

3. Youth advisory committees.—State directors of selective service are establishing, pursuant to the instructions of the Director of Selective Service, Youth Advisory Committees to provide information and advice concerning the views and

attitudes of youthful members of society toward selective service laws and their administration. The initial start in forming the committees commenced during the fourth quarter of fiscal year 1969.

Since the committees will advise in the area of registration, classification, and induction, the travel costs of the members shall be charged to the Local Board activity, project 30 funds.

650 YOUNG PEOPLE INVOLVED

There are approximately 40 committees now formed and working. All 56 State directors plan to have a committee selected and functioning prior to the end of fiscal year year 1970. When all committees are formed and at full strength, there will be a total of approximately 650 young people (men and women) participating in advising on Selective Service matters vital to the overall youth of the United States.

Plans call for approximately 400 State meetings each year. The plan includes one regional meeting each year with four members from each State attending. One national meeting per year with two members from each State in attendance is also contemplated.

COST OF ADMINISTRATION

To assist in the administration of the committees travel, funds in the amount of $1,000 will be required by national headquarters, project 10 funds, for each of the fiscal years 1970 and 1971. A like amount will be required to continue the program in 1972. In addition, since this program requires national administration, there will be personnel compensation cost of approximately $36,000 for 1971 and $37,000 for 1972, which will be absorbed by current personnel at the national level.

The amount of $87,000 has been included for personnel compensation in the administration of this program at State headquarters level, project 20 funds, and will also be required for 1972. Travel funds in the amount of $12,000 will be required for State headquarters, project 20 funds, for each of the years 1970 and 1971. This amount will be required to continue the program for 1972.

Travel funds in the amount of $100,000 will be required for local boards, project 30 funds, for the committee travel during 1970 and $100,000 for 1971. To continue the program we will need $100,000 for 1972.

4. Joint fiscal, procurement and personnel training conferences.—Joint fiscal, procurement, and personnel Training conferences are being programed for fiscal year 1971 and subsequent years. The training of State headquarters personnel is urgently needed. Many employees with years of experience in this area of work have retired during the past 2 years and their loss is felt throughout the Agency. A higher degree of efficiency must be obtained by replacement personnel.

Eight area conferences are planned each year with an average of 3.5 employees attending one training conference from each State headquarters within the area and approximately five employees from national headquarters. Travel funds in the amount of $8,000 will be required for 1971 for national headquarters, project 10 funds, and a like amount will be required to continue the program for 1972. Travel funds in the amount of $26,000 will be required for 1971 for State headquarters, project 20 funds, and a like amount will be required to continue the program for 1972.

Mr. EVINS. Tell us in a few words what you propose. Procurement and personnel training conferences. What are you going to do that you haven't been doing in the past?

Mr. CASH. Mr. Chairman, this too is a thing we formerly did, but haven't done for the last 10 years maybe.

SEEK BETTER MANAGEMENT

In general, we aim for just a little better management, a little tighter control. We get together persons involved in personnel and fiscal matters in State headquarters in regional meetings—we propose to have eight with an average of three and a half employees attending each. As I say, it is a thing we one time did; we thought it was good. Sometime about 1957 or 1958, when funds came a little hard, this is one of the things we abandoned. We would like very much to go back to it.

Mr. EVINS. Refer to page 5 and the table contained on that page. This shows the increase in new registrations. We can see readily from 1962 where registrations were 1.5 million, it will go up to 2,251,00 in 1976.

How many registrants do you have to register now to get one drafted as against what you did 10 years ago?

Mr. CASH. There is involved registration and necessary examinations to get one inducted now.

EXAMINATION INDUCTION RATIO

Mr. EVINS. How many registrations do you have to make to get one induction?

NUMBERS REGISTERED

Mr. TARR. We have to register everyone who falls in the age category.

Mr. EVINS. You have 2.25 million registered. How many inductees do you get out of that?

Mr. TARR. That depends on the call that comes from the Army. I think that what you are concerned about are figures of the number of people who actually are called and then who actually are inducted.

Mr. JONAS. What he is getting at is the relationship between the number of people you consider—that would involve how many are deferred and how many are put in 1–A, that would be the first breakdown—what percentage of your total registrants, upon consideration, go into class 1–A and how many go into other classes, and then out of that group of 1–A, what percentage do you examine and what percentage of those examined are accepted?

Mr. TARR. I think it might be well, Mr. Chairman, for us to prepare some figures on what it is now and what it was 10 years ago.

Mr. TALCOTT. It would be good to have the whole series of years. The number in 1–A and how they have changed; the number of physical deferments.

Mr. EVINS. Supply that for the record.

(The information follows:)

Fiscal Year	Total Living Registrants Only, as of June 30	Total Registered During Year*	Total Number in Class I-A as of June 30	Total Number Examinations**	Total Number Inducted
1960	22,829,879	1,349,510	2,315,992	369,514	90,549
1961	24,332,138	1,502,259	2,373,790	407,755	61,070
1962	25,808,555	1,512,980	2,236,857	950,958	157,465
1963	27,278,763	1,506,857	2,034,653	426,941	71,744
1964	28,735,389	1,491,907	1,979,733	1,382,919	150,805
1965	30,676,300	1,972,638	1,965,398	1,226,476	103,328
1966	32,638,305	1,999,981	1,112,014	2,288,803	343,481
1967	34,523,236	1,929,722	1,417,629	1,561,741	298,559
1968	36,410,077	1,936,021	1,283,147	1,733,590	341,404
1969	38,340,721	1,980,379	1,373,869	1,492,730	262,646

*Includes all cancelled and deceased as well as living registrants, beginning with 1962.

**Includes local board, preinduction and induction.

ESTIMATES FOR FISCAL YEAR 1971

Mr. EVINS. Refer to page 10. This is the 1971 estimate, $76 million. This shows where the money goes.

Local boards, $58,615,000, which is 77.12 percent.

The second item is State headquarters, $12.8 million; selectee travel is $7.6 million; you have the medical advisory committee, $75,000; and National Appeal Board, $82,000; National headquarters, $4.4 million.

How does this chart compare with the ones in the preceding years?

Mr. TARR. Except for small changes in percentage, they are consistent with the last 2 years.

LOCAL BOARD ESTIMATE DOWN

Mr. EVINS. The projection for next year is that both local board and selectee travel is decreased, but the State and National headquarters increase.

Why can't you run this on a more economically efficient basis, Mr. Director, under your new administration?

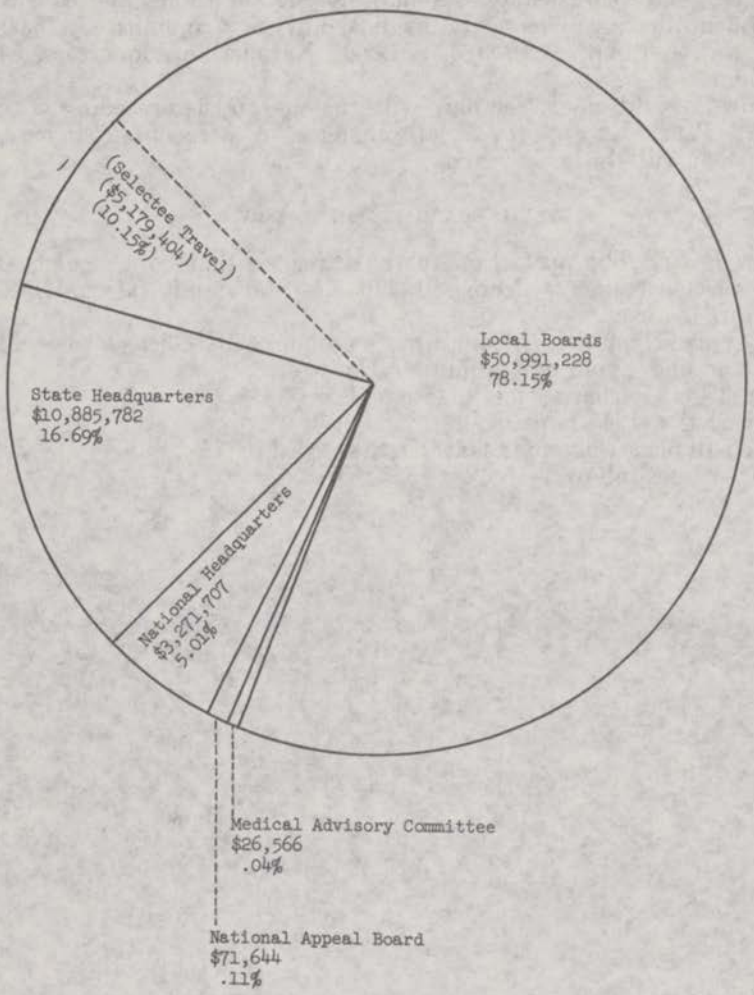
Mr. TARR. Perhaps sometime we will, sir.

Mr. EVINS. Let's hope so.

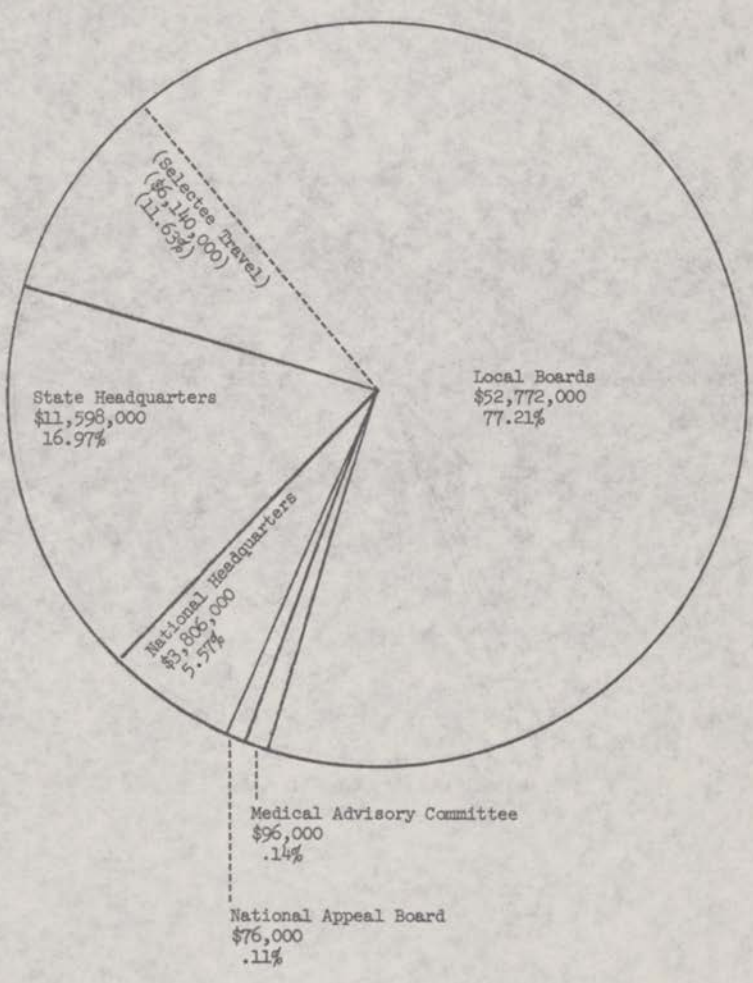
We will place these four charts in the record.

(The pages follow:)

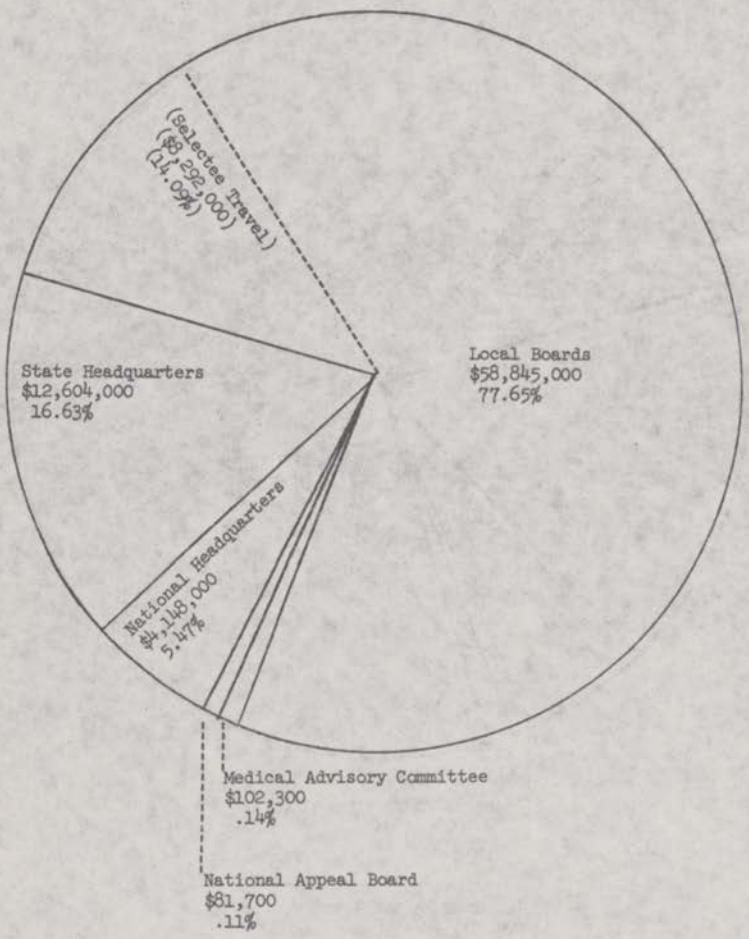
FISCAL YEAR 1969 ACTUAL
$65,246,927



FISCAL YEAR 1970 APPROPRIATED
$68,348,000

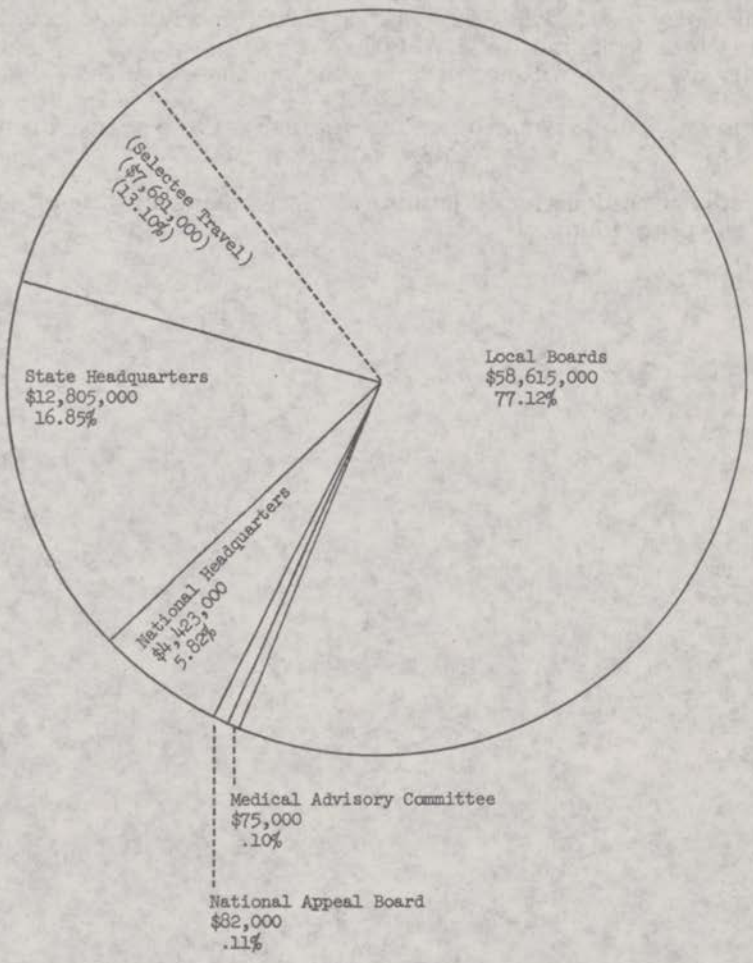


FISCAL YEAR 1970 REVISED ESTIMATE
$75,781,000



This 1970 revised estimate includes $5,281,000 for increased pay cost and $2,152,000 for increased physical examinations (Selectee Travel).

FISCAL YEAR 1971 ESTIMATE
$76,000,000



Mr. EVINS. Consolidated summary of objective classification is shown on page 11.

Mr. TALCOTT. Does the 1970 estimate include the supplemental?

Mr. CASH. Yes.

SUPPLEMENTAL REQUEST

Mr. EVINS. On page 12 we see that the full supplemental for increased pay costs, $5,281,000, plus $2,152,000 for additional examinations which brings it up to $75,781,000.

Mr. EVINS. We will now look at your various activities.

NATIONAL ADMINISTRATION PLANNING, TRAINING AND RECORDS MANAGEMENT

National headquarters. Place in the record pages 42 through 44.

(The pages follow:)

SELECTIVE SERVICE SYSTEM
SUMMARY OF OBJECTIVE CLASSIFICATION
PROJECT 10

	1969 Actual	1970 Estimate	1971 Estimate
11. Personnel compensation:			
Permanent positions	1,517,525	1,889,000	1,906,000
Positions other than permanent	22,174	28,000	28,000
Other personnel compensation	10,125	17,000	17,000
Special personal service payments	1,235,372	1,577,000	1,599,000
Total personnel compensation	2,785,196	3,511,000	3,550,000
12. Personnel benefits:			
Civil service retirement	96,432	123,000	123,000
Group life insurance	7,493	7,900	9,600
FICA taxes	400	1,100	600
Health benefits	10,018	15,000	12,800
Cash awards	900	---	---
Cost of living allowances	---	---	---
Accident compensation	---	---	---
21. Travel and transportation of persons:			
Administrative travel	75,704	145,000	125,000
Travel of selectees	---	---	---
Rental of passenger vehicles	5,261	8,000	8,000
22. Transportation of things:			
Freight, express and drayage	979	2,000	2,000
Rental of trucks	222	1,000	1,000
Parcel post (penalty indicia)	3,000	3,000	3,000
23. Rent, communications and utilities:			
Communication services	47,578	50,000	55,000
Rents and utilities	52,893	91,000	17,000
Penalty mail	60,000	60,000	60,000
24. Printing and reproduction	3,490	10,000	10,000
25. Other services	58,218	40,000	360,000
26. Supplies and materials	19,023	30,000	34,000
31. Equipment	44,900	50,000	52,000
42. Insurance claims and indemnities	---	---	---
Subtotal obligations	3,271,707	4,148,000	4,423,000
Proposed supplemental for increased pay cost	---	-342,000	---
Total obligations	3,271,707	3,806,000	4,423,000

SELECTIVE SERVICE SYSTEM
SUMMARY OF OBJECTIVE CLASSIFICATION
PROJECT 10

	1969 Actual	1970 Appropriated	1970 Revised Estimate	1971 Estimate
11. Personnel compensation:				
Permanent positions	1,517,525	1,889,000	1,889,000	1,906,000
Positions other than permanent	22,174	28,000	28,000	28,000
Other personnel compensation	10,125	17,000	17,000	17,000
Special personal service payments	1,235,372	1,577,000	1,577,000	1,599,000
Total personnel compensation	2,785,196	3,511,000	3,511,000	3,550,000
12. Personnel benefits:				
Civil service retirement	96,432	123,000	123,000	123,000
Group life insurance	7,493	7,900	7,900	9,600
FICA taxes	400	1,100	1,100	600
Health benefits	10,018	15,000	15,000	12,800
Cash awards	900	---	---	---
Cost of living allowances	---	---	---	---
Accident compensation	---	---	---	---
21. Travel and transportation of persons:				
Administrative travel	75,704	145,000	145,000	125,000
Travel of selectees	---	---	---	---
Rental of passenger vehicles	5,261	8,000	8,000	8,000
22. Transportation of things:				
Freight, express and drayage	979	2,000	2,000	2,000
Rental of trucks	222	1,000	1,000	1,000
Parcel post (penalty indicia)	3,000	3,000	3,000	3,000
23. Rent, communications and utilities:				
Communication services	47,578	50,000	50,000	55,000
Rents and utilities	52,893	91,000	91,000	17,000
Penalty mail	60,000	60,000	60,000	60,000
24. Printing and reproduction	3,490	10,000	10,000	10,000
25. Other services	58,218	40,000	40,000	360,000
26. Supplies and materials	19,023	30,000	30,000	34,000
31. Equipment	44,900	50,000	50,000	52,000
42. Insurance claims and indemnities	---	---	---	---
Subtotal obligations	3,271,707	4,148,000	4,148,000	4,423,000
Proposed supplemental for increased pay cost	---	-342,000	---	---
Total obligations	3,271,707	3,806,000	4,148,000	4,423,000

SELECTIVE SERVICE SYSTEM

FISCAL YEAR 1971

NATIONAL ADMINISTRATION, PLANNING, TRAINING AND RECORDS MANAGEMENT

Project 10

The National Headquarters is charged with the overall administration of the Act, with preparation of plans for future emergencies, with the designing and putting into effect of a training program and with the management of records required to be kept. To perform these functions, the National Headquarters has been organized into offices and divisions, each subdivision being charged with certain responsibilities. Included in the following is the cost of the six Regional Field Offices, four Field Auditors operating in the field, and for Field Attorneys' Offices.

11 Personnel Compensation

1969 Actual	1970 Estimate	1971 Estimate
$2,785,196	$3,511,000	$3,550,000

The 1970 figure includes $331,000 for the statutory pay increase effective July 13, 1969.

PAY RAISE COSTS

Mr. EVINS. Personnel compensation is increased. I suppose some of this is due to the Pay Act increases.

Are there any questions?

Mr. JONAS. Why would you have positions other than permanent in national headquarters? I can see why you would have some in local boards. Why do you have temporary employees in national headquarters? I can see why you would have some in local boards. Why do you have temporary employees in National headquarters?

Mr. CASH. Those are part-time people, sir.

Mr. JONAS. Why do you need any part-time people in national headquarters? That is the question. Who are they and what do you use them for?

PART-TIME EMPLOYEES

Mr. MCMAHAN. Mr. Chairman, this part-time figure which is a comparatively small figure of $28,000, covers for example, in my division, the fiscal and procurement division we have two, if I recall, young girls who are going to college and they are working for us half time. They are really productive people but they cannot work full time because of their college courses and the time required. There are also a few part-time people used, not technically as consultants, but in this category.

Mr. EVINS. You have Federal aid to education in there?

Mr. MCMAHAN. This would include our summer people.

INCREASE COMMUNICATIONS COSTS

Mr. EVINS. The communications go up from $47 million to $50 million to $55 million. Why this increased cost in communication?

Mr. TARR. $47,000 to $55,000 in 2 years. We have about 90 percent of our total communication cost in telephone and this represents the rate at which the telephone costs are going up.

Mr. EVINS. Take object 25, "Other services." You go up from $58,000 to $360,000.

Mr. CASH. $300,000 of that is the 1 percent sample survey. You are really talking about 58–2 against 60 there.

ONE-PERCENT SAMPLE

Mr. EVINS. What is the 1 percent survey again?

Mr. CASH. We have had it in the past, beginning with 1953, updated in 1959, again in 1964, a 1 percent sample inventory of all the registrants of the Selective Service System. We wish to update that again. Someone asked about automation. This is one area where we use a little automation.

Mr. EVINS. Can you get this information from your local boards? Can you get it from the Census Bureau?

Mr. CASH. No, sir. It comes regularly from the local boards. What we wish to do now is, we haven't had, since 1964, money with which to put the information contained in the transcripts onto punchcards

and ultimately onto tapes. I will say this, Mr. Chairman: In the main, this information, while it is helpful to the System, it is also desired by a number of other agencies around town: DOD, Labor, HEW——

INFORMATION FROM SAMPLE

Mr. EVINS. What does this information tell you? What does it disclose? What facts do you get?

Mr. CASH. I appreciate this is being vague. I wish I had brought some measurements along, but it is a profile. The sample seeks to give a profile of the whole population of registrants.

Mr. EVINS. How many registered?

Mr. CASH. Precisely. The level of education.

Mr. EVINS. The level of education?

Mr. CASH. The age at which inducted, types of employment, and that sort of thing.

Mr. SHIPLEY. Everyone that is registered?

Mr. CASH. It is 1 percent.

Mr. SHIPLEY. You take a 1 percent sample of everyone registered.

Mr. CASH. The last digit of the Selective Service number is thus and so.

USE OF INFORMATION

Mr. SHIPLEY. For what do you use that?

Mr. CASH. The last time it was used I guess was for the big manpower study over in DOD, looking to the future need for Selective Service, for example. More recently, the National Security Council has——

Mr. SHIPLEY. You don't actually use this yourself; you just take it and turn it over to anybody who wants to use it, is that it? What good does it do your agency?

Mr. CASH. It helps us to know more about our constituency. Quite obviously we have gotten along thus far without it, for the last 2 or 3 years in any case.

Mr. SHIPLEY. If you are going to be inducted——

VALUE OF INFORMATION

Mr. TARR. Here is an example: You can tell what a cross-section of the population inducted is like because the Army can run a study. They have the records; they have all the people, but there is no way by which you can compare what the people inducted are like compared with those registered for induction and may have slipped off the hook somewhere down the line. If there is a tendency for us to key our calls for induction to a certain portion of our population of registrants, it can only come out in comparative studies. You can come back and say, "Do you really need to know that" and I am not prepared to say that you do, but I am not prepared to say that you don't.

Mr. EVINS. We were struck by the increase.

Mr. CASH. That is where $300,000 of it is.

Mr. EVINS. It is to get a 1 percent sampling of information.

OTHER AGENCY INTEREST

Mr. CASH. It is to update it. We receive transcripts on a monthly basis from our local boards.

Mr. EVINS. Does Selective Service want this or does the Department of Defense want it? Has the Department of Defense asked you for it recently?

Mr. CASH. Yes, sir.

Mr. TARR. I think the National Security Council has asked for it. The Department of Defense wants it. The Department of Labor has shown some interest in it. HEW.

Mr. EVINS. They expect Selective Service to have all the statistics and all the information and you want to have the answers for them?

Mr. SHIPLEY. And we expect you to do it without spending $300,000 extra.

Mr. TALCOTT. When was the last one taken?

Mr. CASH. I believe DOD promised us a reimbursable amount of about $275,000 in 1964 if we would update. We updated, but I don't believe the reimbursement was ever forthcoming.

Mr. TARR. The last time it was done was in 1964.

Mr. CASH. This is the one area of automation. You see, right now the transcripts come in and are coded, but that is as far as they go. They are not being key punched and put on tapes.

UNFILLED POSITIONS

Mr. EVINS. In 1969 you had 253 jobs and 30 unfilled positions. In 1970 you estimate 248 jobs and 35 unfilled positions. In 1971 you are asking for 270 jobs with 13 unfilled positions. Why these unfilled positions? Are you a little overstaffed? Why the lesser lapse rate in 1971?

Mr. TARR. You will notice the total permanent positions has not changed in the 2-year period and that it is simply the unfilled positions which represent some kind of turnover. Or, a job that has no incumbent, and the hope is that by the end of 1971 these unfilled positions largely can be filled.

Mr. EVINS. Mr. Director, what is your best judgment as to how many people you need in headquarters?

Mr. TARR. Mr. Chairman, I can't say. I don't know about that. I don't know enough about it. Next year I will tell you.

Mr. EVINS. We will have to wait until next year to find the answer.

STAFFING OF HEADQUARTERS

Mr. SHIPLEY. Mr. Chairman, I wonder if they could furnish for the record the vacancies they do have now?

Mr. CASH. Actually, as Mr. Tarr said——

Mr. TARR. This is a guess at where we will be at June 30.

Mr. CASH. It is a guess at where we will be June 30. Positions that result from turnover or that are not filled on a given date——

Mr. EVINS. How many positions on board at the present time in headquarters?

Mr. TARR. I guess we will have to report that to you, Mr. Chairman.

Mr. CASH. 229 as of February 28, sir; on board.

Mr. EVINS. How many in headquarters other than military?

Mr. MCMAHAN. 188 full time and seven part time.

Mr. EVINS. How many military in headquarters?

Mr. MCMAHAN. Fifty-nine in national headquarters with 11 out in our field offices.

Mr. EVINS. Place in the record pages 50 and 55.

(The pages follow:)

NATIONAL ADMINISTRATION, PLANNING, TRAINING AND RECORDS MANAGEMENT
(Continued)

12 Personnel Benefits

	1969 Actual	1970 Estimate	1971 Estimate
Civil Service Retirement Contributions	$96,432	$123,000	$123,000
Group Life Insurance Contributions	7,493	7,900	9,600
Federal Insurance Contribution Act Taxes	400	1,100	600
Health Benefits Contributions	10,018	15,000	12,800
Employee Suggestion Awards	900	---	---
Cost of living allowances	---	---	---
Accident Compensation	---	---	---
	$115,243	$147,000	$146,000

These benefits are largely tied to civilian payrolls. Most items are based on actual payroll costs.

31 Equipment

1969 Actual	1970 Estimate	1971 Estimate
$44,900	$50,000	$52,000

The majority of this request is for replacement items only. There is included for 1971 the amount of $7,000 for the purchase of auxiliary and miscellaneous equipment required for the newly established Data Processing Unit.

STATE ADMINISTRATION, PLANNING, TRAINING AND RECORDS SERVICING

Mr. EVINS. Look at the State headquarters. Here you ask for $12,805,000, which is an increase over $12,604,000 last year. Compensation goes up and other personnel benefits increase.

I might say to the new Director, this committee likes to fund you adequately but we don't look with favor upon supplementals. It is a bad habit submitting supplementals at various times. You ought to make your estimates precise enough to project your needs for the coming year without supplementals. Keep that little suggestion in mind.

LOCAL BOARD UNIFORMITY

Are the laws uniformly interpreted by the local appeals boards in the various State headquarters?

Mr. TARR. Mr. Chairman, the precise answer is, I think, "no."

Mr. JONAS. What are you going to do with this high school boy you drafted down in Georgia who moved from Macon County, N.C., and created a lot of excitement? He is already in the Army and they took him right out of high school. The papers have been full of it. Haven't you heard about that?

Mr. TARR. I haven't heard about it.

Mr. EVINS. Once the man is inducted into the Armed Forces, he is out of the control and regulation of the Selective Service System.

NATIONAL GUARD APPLICANTS

How about the case, Mr. Director, of a selectee who is placed in I–A classification and he wants to get into the local Guard and the Guard says they have a vacancy and welcome him and will take him in. Could he be accepted into the local Guard? What do your rules provide in this respect?

Mr. TARR. You can go into the Guard unless called for induction.

Mr. FRANK. After he has gotten notice of induction, he can't volunteer for any branch of the service.

Mr. EVINS. Up to that time he can go into any service until he receives an induction notice. Once he receives induction notice, he is precluded from going into the other service.

Mr. FRANK. That is right.

ACTIVE DUTY ENLISTMENTS

Mr. JONAS. That may be according to the law, but that isn't the way it works as a practical matter because the Director can cancel an order to report for induction. I remember General Hershey saying several times in this room that he will let them join any branch of the service and take them off the bus on their way to the induction center.

Mr. FRANK. Other than the National Guard.

Mr. CASH. We did for the National Guard and Reserves until DOD requested we cease doing so.

Mr. TALCOTT. There is another situation that comes up once in a while where a person is inducted into the service; he is in and then develops some sort of hardship situation. The Army will refer it back to the Selective Service to give a report and, of course, Selective Service never changes their mind. They just say if he is in the service, he is in and they don't have anything to do with it.

Mr. FRANK. The regulations provide that the Army may discharge a man forthwith if he makes a case. On the other hand, they mak seek the advice of the State director. It is not binding on the Army.

Mr. JONAS. One thing that causes me more trouble than anything else is the case of registrants who claim and have documentary proof from physicians that they are not physically qualified. Once the Selective Service had a doctor associated with every board who screened these people initially. Is that true now?

Mr. FRANK. We do have a doctor but the only cases referred to the doctor is a list of so-called obvious physical defects. Insofar as other things are concerned, he goes to the examining station.

LOCAL BOARD DISQUALIFICATION

Mr. TARR. But there is no reason why this case couldn't apply. In other words, this is the case of a boy who has a letter from a doctor that the kid can't make it because he has a bum back or doesn't have a kidney or something

Mr. JONAS. What jurisdiction has the local board to defer on the basis of local doctor's certificate?

Mr. FRANK. They can do that in accordance with the list.

Mr. JONAS. I speak of an unobvious defect that is supported by a statement.

Mr. CASH. The Board has authority, sir, to disqualify him.

Mr. JONAS. And put him in a classification of 4–H without sending him to induction?

Mr. CASH. Yes, sir.

PROBLEM OF REEXAMINATION

Mr. TARR. In a decentralized system, both as relates to local boards and examining stations, this is the kind of matter where you are bound to get variations in practice. I think it is about a week from now that I go down and visit with the commanding general who has charge of all the examination stations. There are lots of these things we want to get into.

One of the things troubling me is why should boys who pass their induction physical, the first trip, fail it in so many cases on the second trip. The number runs upwards as high as 25 percent. There are a lot of things like this we have to get into.

Mr. JONAS. Speaking as one person, I think it is an area you ought to get into. There is a considerable amount of——

Mr. EVINS. Lack of uniformity.

Mr. JONAS. Not only that, but a feeling on the part of a lot of people that they don't get proper examinations.

Mr. TARR. There is no question about it.

Mr. JONAS. Particularly if they have letters from doctors. That seems to rub the examiner the wrong way.

ORGANIZATION OF SYSTEM

Mr. EVINS. The Selective Service System is set up on a pyramid basis. The decisions are made by the local boards at the local level where they know the people. The inductee can appeal to the State and to the national level.

The various local boards do not operate uniformly and, as you indicated, the States don't operate uniformly, so you will have to do a little better job in your guidelines to try to bring about fairness and uniformity, for that is the complaint; lack of fairness.

Mr. TARR. Sir, we are certainly going to try.

Mr. EVINS. Gentlemen, we have just reviewed here the various functions of the State board. If there are no questions, we will place in the record pages 56 through 61.

(The pages follow:)

SELECTIVE SERVICE SYSTEM
SUMMARY OF OBJECTIVE CLASSIFICATION
PROJECT 20

	1969 Actual	1970 Estimate	1971 Estimate
11. Personnel compensation:			
Permanent positions	5,423,272	6,202,000	6,543,000
Positions other than permanent	150,741	161,000	163,000
Other personnel compensation	10,417	27,000	27,000
Special personal service payments	3,960,579	4,550,000	4,560,000
Total personnel compensation	9,545,009	10,940,000	11,293,000
12. Personnel benefits:			
Civil service retirement	344,073	404,700	418,800
Group life insurance	28,219	25,400	34,300
FICA taxes	5,524	8,400	6,700
Health benefits	41,922	51,000	51,200
Cash awards	7,140	---	---
Cost of living allowances	20,642	26,500	22,000
Accident compensation	8,413	5,000	8,000
21. Travel and transportation of persons:			
Administrative travel	120,069	311,000	213,000
Travel of selectees	---	---	---
Rental of passenger vehicles	31,504	43,000	43,000
22. Transportation of things:			
Freight, express and drayage	17,800	3,000	4,000
Rental of trucks	2,623	4,000	4,000
Parcel post (penalty indicia)	8,000	8,000	9,000
23. Rent, communications and utilities:			
Communication services	186,676	198,000	212,000
Rents and utilities	43,418	161,000	64,000
Penalty mail	150,000	150,000	152,000
24. Printing and reproduction	30,620	50,000	50,000
25. Other services	96,834	80,000	85,000
26. Supplies and materials	74,699	80,000	80,000
31. Equipment	122,489	55,000	55,000
42. Insurance claims and indemnities	108	---	---
Subtotal obligations	10,885,782	12,604,000	12,805,000
Proposed supplemental for increased pay cost	---	-1,006,000	---
Total obligations	10,885,782	11,598,000	12,805,000

SELECTIVE SERVICE SYSTEM
SUMMARY OF OBJECTIVE CLASSIFICATION
PROJECT 20

	1969 Actual	1970 Appropriated	1970 Revised Estimate	1971 Estimate
11. Personnel compensation:				
Permanent positions	5,423,272	6,202,000	6,202,000	6,543,000
Positions other than permanent	150,741	161,000	161,000	163,000
Other personnel compensation	10,417	27,000	27,000	27,000
Special personal service payments	3,960,579	4,550,000	4,550,000	4,560,000
Total personnel compensation	9,545,009	10,940,000	10,940,000	11,293,000
12. Personnel benefits:				
Civil service retirement	344,073	404,700	404,700	418,800
Group life insurance	28,219	25,400	25,400	34,300
FICA taxes	5,524	8,400	8,400	6,700
Health benefits	41,922	51,000	51,000	51,200
Cash awards	7,140	---	---	---
Cost of living allowances	20,642	26,500	26,500	22,000
Accident compensation	8,413	5,000	5,000	8,000
21. Travel and transportation of persons:				
Administrative travel	120,069	311,000	311,000	213,000
Travel of selectees	---	---	---	---
Rental of passenger vehicles	31,504	43,000	43,000	43,000
22. Transportation of things:				
Freight, express and drayage	17,800	3,000	3,000	4,000
Rental of trucks	2,623	4,000	4,000	4,000
Parcel post (penalty indicia)	8,000	8,000	8,000	9,000
23. Rent, communications and utilities:				
Communication services	186,676	198,000	198,000	212,000
Rents and utilities	43,418	161,000	161,000	64,000
Penalty mail	150,000	150,000	150,000	152,000
24. Printing and reproduction	30,620	50,000	50,000	50,000
25. Other services	96,834	80,000	80,000	85,000
26. Supplies and materials	74,699	80,000	80,000	80,000
31. Equipment	122,489	55,000	55,000	55,000
42. Insurance claims and indemnities	108	---	---	---
Subtotal obligations	10,885,782	12,604,000	12,604,000	12,805,000
Proposed supplemental for increased pay cost	---	-1,006,000	---	---
Total obligations	10,885,782	11,598,000	12,604,000	12,805,000

SELECTIVE SERVICE SYSTEM

FISCAL YEAR 1971

STATE ADMINISTRATION, PLANNING, TRAINING AND RECORDS SERVICING

Project 20

The Military Selective Service Act of 1967 in Section 10 (a) (2) requires the establishment of at least one State Headquarters in each state, territory and possession of the United States. There have been established 56 such Headquarters. The function of State Headquarters is to administer the Act within the respective states in compliance with the law, regulations and directives of National Headquarters. In general, the primary administration and responsibilities of each State Headquarters are as follows:

1. To establish and maintain local boards and appeal boards including arranging for office space, office equipment, securing competent personnel, and the selection for recommendation by the Governor of potential local board and appeal board members for either original appointment or as replacements for members lost.

2. To inform and instruct new local and appeal board members and clerks in the existing regulations, policies and administrative procedures; then to continually inform and instruct local and appeal board members and clerks concerning local manpower situations and changes in regulations, policies and administrative procedures.

3. To allocate calls to the local boards within the state on the basis of availability and quotas established from records of manpower available for service and those already in the service. To do this

STATE ADMINISTRATION, PLANNING, TRAINING AND RECORDS SERVICING (continued)

records must be maintained of men available for service, men already delivered for service, men deferred in all classes and credits to the various communities for men in the armed services. Records must also be maintained to insure the deferment of men needed in agriculture, industry and the national health, safety or interest. Such problems vary in the several states. To know the needs of agriculture, industry, etc., it is necessary that close liaison be maintained between the State Headquarters and these various fields of employment.

4. To allocate funds received and operate within the fiscal limitations so established. To pay all liabilities incurred by both State Headquarters and the local boards within the state. To process all personnel appointment papers. To arrange for the most economical method of transportation of registrants and arrange for delivery of men to the examining and entrance stations in numbers not exceeding the daily capacity of the station. This may only be accomplished by the proper coordinating of schedules with the armed forces and the assigning of delivery dates to the various local boards.

5. To act as custodian and servicing agent of records. There are 54 Federal Record Depots in which are housed the remaining records of all registrants of World War II operations. The work of the depot consists of (1) answering requests for information; (2) the servicing of records and (3) the destruction of records when authorized.

6. To receive from the several services the notification of transfers of personnel to the Standby Reserve; to locate the local

STATE ADMINISTRATION, PLANNING, TRAINING AND RECORDS SERVICING (continued)

board of jurisdiction within the state; to assign the reservist to the appropriate local board and to maintain a record of the availability for selective call-up of reservists as established by the local board pursuant to Public Law 305, 84th Congress.

7. To plan for manpower procurement in general conformity with the National program as adapted to the unique problems within the State.

8. To maintain and keep current a plan for the operation of the State Headquarters and local and appeal boards in event of a catastrophe, including cooperative planning with adjoining states. Also to maintain a plan for an all-out emergency expansion. The number and location of the additional local boards, which would be required under such an emergency, have been established, lists of potential local board members are maintained, records of present registrants are so numbered that should expansion become necessary the records to be transferred to any particular local board are readily identifiable.

9. To develop and maintain a fully adequate program of training to provide a reserve of officers and civilians who will be able and willing to fill a position in the System should it become necessary to expand.

STATE ADMINISTRATION, PLANNING, TRAINING AND RECORDS SERVICING (continued)

11 Personnel Compensation

	1969 Actual	1970 Estimate	1971 Estimate
Permanent positions	$ 5,423,272	$6,202,000	$6,543,000
Positions other than permanent	150,741	161,000	163,000
Other personnel compensation	10,417	27,000	27,000
Special personal service payments	3,960,579	4,550,000	4,560,000
	$9,545,009	$10,940,000	$11,293,000

The 1970 total includes $973,000 for the statutory pay increase effective July 13, 1969.

Included in the 1971 estimate is $87,000 for the administration of the Youth Advisory Committee (see New Programs, pages 22 and 23).

Mr. EVINS. Look at your local boards. There is a slight decrease in personal services, but there is an increase from $52.8 million to $58.6 million in overall costs for local boards. Where are these larger increases?

Are these figures developed precisely? In the future are you going to have your staff be more accurate in gathering your figures?

Mr. TARR. Mr. Chairman, except for the possibility of, you know, changes in salaries by the Congress, I would hope that we could operate on the figures that you give us if we have a reasonable chance to prepare the figures as we want.

Mr. EVINS. You have a whole year to prepare them.

Mr. TARR. We are not always able to submit to you the figures that we would like to have.

WORKLOAD OF SYSTEM

Mr. JONAS. Doctor, isn't it true that the workload in Selective Service depends on the calls you receive from the Army. You may make a projection on the basis of 200,000 to be delivered and sometime during the year that may be increased with the result that you are a way off in your figures?

Mr. TARR. That is true, but about 40 to 45 percent of the workload at the local board is devoted to classification and this might be irrespective of the calls that come from the Army, or from the Department of Defense. We hope, if we can move out in the direction I suggested with respect to the deferments, that we can reduce substantially that workload that relates to classification and reclassification.

One of the things, Mr. Chairman, in the figures that you read, you will notice you went from 52.7 to 58.6, but the 52.7 does not include the supplemental for the increase in personnel compensation, so the appropriate figures really were $56.6 million to $58.6 million, a $2 million increase over the year.

Mr. EVINS. Very good. Mr. Director, you said a moment ago that you did not always get all the money you would like to have. Tell us how much money you would like to have for local boards' operation?

FULL NEEDS OF SYSTEM

Mr. TARR. Mr. Chairman, is it possible for me to say that since yesterday, when I was sworn in, I have not had sufficient time to figure it?

Mr. EVINS. How much would you state is needed for the entire operation of the Selective Service System? There is $76 million budgeted. How much was requested of the Bureau of the Budget.

Mr. TARR. We asked for $84 million.

Mr. EVINS. That gives us the answer.

COSTS INCREASE OVER YEARS

Mr. JONAS. It is worthy of note, if the Chairman will yield, that just 5 years ago this operation cost $47 million. Ten years ago it was $32 million. That is a pretty substantial increase in cost from $32 million to $47 million and now to $76 million.

Mr. TARR. We have done a little more than double in 10 years. How much have general schedule salaries gone up in 10 years?

Mr. EVINS. Not that much.

Mr. JONAS. I don't know where most of that increase comes in.

Mr. CASH. Vietnam in 1965.

Mr. JONAS. That was the start of the buildup in Vietnam.

Mr. TARR. I would think that, except for the increased costs that we pay for services and good, the difference between our program now and our program then was that selective service was much more palatable to a younger generation than it is now.

Mr. JONAS. You are delivering far more people to induction now.

ACCEPTANCE OF SYSTEM

Mr. EVINS. Doctor, what are you going to do to make selective service more palatable?

Mr. TARR. Sir, I am not sure I can guarantee to make it more palatable, but I think that some of the things that you have been talking about with respect to justice and fairness are places where we need to begin. I still think that the average American does not mind standing in line if everybody else stands in line too, but he feels very badly about people crowding in in front of him, getting a special kind of dispensation from this quirk of fate, or that particular board, that is not available to everyone else. So I think the fairness of the system is the place where we must start and this is the main reason why I feel so strongly about eliminating deferments.

Mr. JONAS. Will you permit me to offer a little gratuitous advice?

Mr. TARR. I would appreciate it.

COURTESY OF CLERKS

Mr. JONAS. Some of your associates will tell you after this hearing is over that I have had some background in this field. I think you would go a long way toward eliminating this feeling that we all want to eliminate if you could impress—and I would recommend that you make an effort to insist, through your State directors, that the clerks in every local board treat registrants and their families with courtesy, consideration, kindness, and understanding. Even though they can't do anything for them. They can make them go out of that board office feeling, "Well, this is not just an automatic proposition. I have received a fair hearing. I haven't been treated arbitrarily." I think that is the first place to start working on building up a better spirit on the part of draftees and their families.

Mr. SHIPLEY. If the gentleman will yield, I would go further and say if they would do this we wouldn't have all the complaints coming to our office because of the treatment they get. They may not object to actually going in as much as they object to the treatment they have received. I would have to agree with Mr. Jonas.

CONSIDERATION FOR REGISTRANT

Mr. TARR. Mr. Chairman, yesterday I talked with a fellow who runs a Selective Service operation near here and he said something

to me that is so close to what these fellows have said that I thought you might be interested to hear it. He says:

> When a young fellow, a youngster, a registrant, comes in to me and he feels he has a problem, I bring him in and set him down and say, "Look, it is your life. What would you like to do with it? What would work out best for you?"

And he says young people are so gratified that someone will talk in such human terms to them that they have really cut down the difficulties. I think this is right.

We deal with large numbers and we tend to get statistic-case oriented, but to the fellow who is enrolled and registered and classified 1–A, his concern is the only life he has got and I think you are absolutely right.

Mr. JONAS. He is more than a number to himself.

Mr. TARR. That is right. While our interest is passing, so we can get on with the next case, his could not be more fundamentally involved. We started to talk about this this morning and we are hopeful that a kind of new humanism can be involved in this system that takes into account the real feelings involved.

BOARDS ARE DEDICATED

Mr. TALCOTT. The draft boards themselves are dedicated people. Sometimes they are much older than they should be and they make tough decisions when it comes time to make the decisions. I am grateful to them, but the person who runs the office is the clerk Mr. Jonas is talking about. There is where the contact is. They are on salary, they have been there a long time and they may get pretty bureaucratic. There is where you have to make the impression, I think.

CHALLENGE TO DIRECTOR

Mr. TARR. The challenge to me is somehow to make an impression on every one of those clerks in 4,100 local boards.

Mr. EVINS. Executive secretaries.

Mr. TARR. To make that impression on every executive secretary of local boards in a way that they get an honest feeling of concern for each one of these people.

Mr. EVINS. Gentlemen, we note in 1969 there were about 263,000 inductees. Supply us a table of inductees for the past 5 years by numbers.

(The information follows:)

CALLS AND INDUCTIONS BY FISCAL YEAR—FISCAL YEARS 1964-69

	Calls	Deliveries	Inductions
Fiscal year:			
1964	145,000	190,495	150,808
1965	101,300	137,588	103,328
1966	336,530	399,419	343,481
1967	288,900	345,622	298,559
1968	343,300	401,017	341,404
1969	266,900	320,272	262,646

Mr. EVINS. Place in the record pages 70 through 106.

(The pages follow:)

SELECTIVE SERVICE SYSTEM
SUMMARY OF OBJECTIVE CLASSIFICATION
PROJECT 30

	Actual	Estimate	Estimate
11. Personnel compensation:			
Permanent positions	32,884,479	37,502,000	35,719,000
Positions other than permanent	5,451,757	5,561,000	6,919,000
Other personnel compensation	102,250	---	---
Special personal service payments	---	---	---
Total personnel compensation	38,438,486	43,063,000	42,638,000
12. Personnel benefits:			
Civil service retirement	2,376,497	2,521,100	2,660,000
Group life insurance	219,286	184,000	247,000
FICA taxes	67,813	175,500	77,000
Health benefits	345,697	407,000	388,000
Cash awards	23,489	---	---
Cost of living allowances	70,887	34,400	77,000
Accident compensation	33,653	22,000	30,000
21. Travel and transportation of persons:			
Administrative travel	752,809	700,000	1,000,000
Travel of selectees	5,179,404	6,140,000	7,681,000
Rental of passenger vehicles	41,325	43,000	45,000
22. Transportation of things:			
Freight, express and drayage	82,233	100,000	90,000
Rental of trucks	3,751	4,000	5,000
Parcel post (penalty indicia)	88,000	88,000	108,000
23. Rent, communications and utilities:			
Communication services	867,340	820,000	917,000
Rents and utilities	86,226	238,000	364,000
Penalty mail	993,000	943,000	1,084,000
24. Printing and reproduction	471,725	600,000	586,000
25. Other services	179,783	160,000	175,000
26. Supplies and materials	231,649	225,000	235,000
31. Equipment	438,175	225,000	208,000
42. Insurance claims and indemnities	---	---	---
Subtotal obligations	50,991,228	56,693,000	58,615,000
Proposed supplemental for increased pay cost	---	-3,921,000	---
Total obligations	50,991,228	52,772,000	58,615,000

SELECTIVE SERVICE SYSTEM
SUMMARY OF OBJECTIVE CLASSIFICATION
PROJECT 30

	1969 Actual	1970 Appropriated	1970 Revised Estimate	1971 Estimate
11. Personnel compensation:				
Permanent positions	32,884,479	37,502,000	37,502,000	35,719,000
Positions other than permanent	5,451,757	5,561,000	5,561,000	6,919,000
Other personnel compensation	102,250	---	---	---
Special personal service payments	---	---	---	---
Total personnel compensation	38,438,486	43,063,000	43,063,000	42,638,000
12. Personnel benefits:				
Civil service retirement	2,376,497	2,521,100	2,521,100	2,660,000
Group life insurance	219,286	184,000	184,000	247,000
FICA taxes	67,813	175,500	175,500	77,000
Health benefits	345,697	407,000	407,000	388,000
Cash awards	23,489	---	---	---
Cost of living allowances	70,887	34,400	34,400	77,000
Accident compensation	33,653	22,000	22,000	30,000
21. Travel and transportation of persons:				
Administrative travel	752,809	700,000	700,000	1,000,000
Travel of selectees	5,179,404	6,140,000	8,292,000	7,681,000
Rental of passenger vehicles	41,325	43,000	43,000	45,000
22. Transportation of things:				
Freight, express and drayage	82,233	100,000	100,000	90,000
Rental of trucks	3,751	4,000	4,000	5,000
Parcel post (penalty indicia)	88,000	88,000	88,000	108,000
23. Rent, communications and utilities:				
Communication services	867,340	820,000	820,000	917,000
Rents and utilities	86,226	238,000	238,000	364,000
Penalty mail	993,000	943,000	943,000	1,084,000
24. Printing and reproduction	471,725	600,000	600,000	586,000
25. Other services	179,783	160,000	160,000	175,000
26. Supplies and materials	231,649	225,000	225,000	235,000
31. Equipment	438,175	225,000	225,000	208,000
42. Insurance claims and indemnities	---	---	---	---
Subtotal obligations	50,991,228	56,693,000	58,845,000	58,615,000
Proposed supplemental for increased pay cost	---	-3,921,000	---	---
Total obligations	50,991,228	52,772,000	58,845,000	58,615,000

SELECTIVE SERVICE SYSTEM

FISCAL YEAR 1971

REGISTRATION, CLASSIFICATION AND INDUCTION

Project 30

The Selective Service System, operating under the provisions of The Military Selective Service Act, exists for the primary purpose of making possible the most effective utilization of the manpower resources of the United States. The accomplishment of this mission requires varied and sundry functions, the most important of which are registration, classification, selection and delivery for induction of the male citizens of the United States who by age are subject to the requirements contained in the Act.

The above functions are carried on in the local boards which are composed of little groups of neighbors on whom is placed the responsibility to determine who is to serve the Nation in the armed forces and who is to serve in industry, agriculture and other deferred classifications. These members of the local board serve in an uncompensated capacity and are assisted by other uncompensated citizens known as Advisors to Registrants, Government Appeal Agents and Medical Advisors, totaling in all 48,000. The function of classification in certain cases is carried over to the State Appeal Boards whose members are also uncompensated citizens of the communities they represent and at present number nearly 625. To assist these 48,000 uncompensated citizens in the performance of their duties, it is necessary to provide administrative and clerical services, space, supplies, etc., which are the

REGISTRATION, CLASSIFICATION AND INDUCTION (continued)

supporting facts of this portion of the budget estimate.

In studying the fund requirements for Project 30, it is most necessary that full realization be secured of the unique use by the Selective Service System of the services of some 48,000 uncompensated citizens, many of whom, under the law, make the classification and selection of those who are to serve in the armed forces and select those whose military obligation is to be postponed in support of the national health, safety or interest. There are 4,196 local and appeal boards, including appeal board panels, at which these people serve giving the necessary part of their time to serve the Nation with realization of such service being their only reward. To retain that service, it is a fundamental precept that adequate clerical assistance must be furnished.

In May 1969, a carefully supervised work measurement study, developed with the assistance of the Bureau of the Budget staff, was conducted in fifty-four states. Similar studies were made in previous years. The results of these studies serve as a basis for the following estimate of work units, man years required to process them, and the personnel costs for local boards of the entire Selective Service System.

On the basis of this study, it will be seen that in order to meet the workload requirements, it was necessary to secure in 1969 from local board employees, 676 man years of time for which they could not be compensated because the supplemental to cover the increased requirements was not immediately available and the employment restriction imposed by Public Law 90-364 hampered flexibility.

REGISTRATION, CLASSIFICATION AND INDUCTION (continued)

Also, in recent years, there has been a distinct change in the efforts of those people who are attempting to interfere with the raising of the military forces necessary to meet our Nation's commitments.

During fiscal year 1969, efforts were made to disrupt induction proceedings, enlistment efforts and other activities in support of our armed forces and also harassment of other elements of the Selective Service System by attacks on the local boards. Those steps included attacks on the local board offices by arson to destroying property and records in the local board offices; attacking local board members by disabling their means of transportation when they were attending board meetings and by frequent phone calls attempting to intimidate them and otherwise harass them beyond normal endurance. We have seen the results of this campaign of arson and destruction for the past several months and it appears to be growing, certainly in terms of relocation and restoration costs necessitated by such attacks.

Another more insidious effort, which is even more costly to the taxpayer because it is so wide-spread, is the attempt to throttle the local boards by over work. Normally, in due course, most registrants have been handled with a minimum of processing and the exception was the registrant who asked for a personal appearance. Even the appealing registrants were few and far between. But now in many cities and towns, draft counselling services have been set up to encourage registrants to appeal without basis and to ask for personal appearances just to delay action.

REGISTRATION, CLASSIFICATION AND INDUCTION (continued)

Ever since the time within which to file an appeal was extended from 10 to 30 days by Executive Order, it means at least a month's delay and if personal appearances are added to this, a further delay may be accomplished.

Our rate of appeals to classification actions during fiscal year 1968 was 1.405%. However, when we made our study in May of 1969, the appeal rate had increased to 2.055%. The rate used for 1970 is 2.651% and for 1971 is 2.949%. Under APPEALS in the work measurement breakdown, this is shown on page 84.

Two factors have made it impossible to successfully operate without requiring extended work without compensation by our Local Board Executive Secretaries and Assistants. First, much flexibility is lost due to employment ceilings which are lower than the requirement and further the curtailment of personnel funds.

11 Personnel Compensation

	1969 Actual	1970 Estimate	1971 Estimate
Permanent positions	$32,884,479	$37,502,000	$35,719,000
Positions other than permanent	5,451,757	5,561,000	6,919,000
Other personnel compensation	102,250	---	---
Special personal service payments	---	---	---
	$38,438,486	$43,063,000	$42,638,000

On pages 78 through 80 is shown the breakdown of the staffing for this project as included on the green sheets. Page 81 shows the requirements related to the Work Measurement Study.

The positions other than permanent cover part-time and intermittent employees.

Other personnel compensation covers overtime and holiday pay.

In the May 1969 study of fifty-four states, a report was made of the work performed by local board personnel for which they were not compensated. It amounted to 10% of the amount of time for which compensation was paid.

In order to handle the workload for 1969, local board personnel gave 676 man years of uncompensated time. It will be noted that in the Comparative Summary Statement by Function that this was taken into account in arriving at the total amount and in 1971 a total of 7,850 man years will be required of which 1,016 man years will be uncompensated time.

This circumstance has resulted from underfunding and has continued for a number of years even when Congress has appropriated the full amount of our requests. Employment restrictions have also been a contributing factor.

The 1970 figures includes $3,659,000 for the statutory pay increase effective July 13, 1969.

SELECTIVE SERVICE SYSTEM
COMPARATIVE SUMMARY STATEMENT BY FUNCTION

PROJECT 30 - LOCAL BOARD PERSONNEL

	1969 Actual		1970 Authorized		1971 Estimate	
	Man Years	Cost	Man Years	Cost	Man Years	Cost
Registering	945	$ 5,374,749	945	$ 5,842,008	936	$ 5,839,858
Classification	3089	17,560,274	3281	20,287,895	3181	19,845,334
Appeals	162	918,195	210	1,299,240	239	1,489,321
Physical Exam. (L.B.)	39	222,805	58	356,956	56	345,757
Phys. Exam. (A.F.E.E.S.)	488	2,776,062	719	4,446,456	690	4,306,632
Inductions	244	1,387,418	258	1,592,614	152	950,800
Civilian Work Assignments	8	45,245	8	51,940	5	31,007
Delinquents	62	355,271	66	410,456	64	401,533
Init. Proc. Standby Reserve	100	568,499	116	719,190	100	623,560
Categorizing Standby Reserve	156	885,826	165	1,018,708	153	951,258
Removal from Standby Reserve	28	158,217	61	374,796	61	379,376
Answering Inquiries	791	4,495,520	840	5,196,442	815	5,085,352
Administrative Time	1325	7,532,239	1458	9,016,794	1398	8,724,828
Sub-Total	7437	42,280,320	8185	50,613,495	7850	48,974,616
Less Uncompensated Man Years	676	3,841,834	1221	7,550,495	1016	6,336,616
Total	6761	$38,438,486	6964	$43,063,000	6834	$42,638,000

REGISTRATION, CLASSIFICATION AND INDUCTION (continued)

Registering

	1969	1970	1971
Work Units	1,980,379	1,979,000	1,961,000
Man Years	945	945	936
Cost	$5,374,749	$5,842,008	$5,839,858
Unit Cost	$2.714	$2.952	$2.978

All male citizens of the United States (and alien males in the United States) who are over 18 years of age are required by law to register with the Selective Service System for possible military service. The registration is conducted by local board personnel who normally interview each registrant as part of the preparation of several forms, assign Selective Service numbers and prepare necessary file documents. The function also includes issuance of duplicate replacement registration certificates and the work involved in the cancellation of a registration when necessary.

Estimates of work units to be processed are based on census estimates of the number of men who will turn 18. These estimates are adjusted on the basis of actual numbers registered (see page 5 of this Justification).

REGISTRATION, CLASSIFICATION AND INDUCTION (continued)

Classification

	1969	1970	1971
Work Units	8,033,062	8,531,495	8,272,336
Man Years	3,089	3,281	3,181
Cost	$17,560,274	$20,287,895	$19,845,334
Unit Cost	$2.186	$2.378	$2.399

Classification is the act of declaring a registrant either available for military service or not available for service for any of several prescribed reasons, including dependency and employment in vital industry. The procedure is necessary to comply with a provision of the law which requires a selection system which is fair and just and which is consistent with the maintenance of an effective national economy.

Registrants must be reclassified as changes occur in their family, employment, or health status. Classification determinations are made by uncompensated members of the Local Board but substantial clerical work is also involved.

This item covers the work of the local board personnel in preparing and mailing the classification questionnaire and associated documents, reviewing them when they are returned, securing such additional information as may be required, arranging and scheduling personal appearances, attending board meetings and preparing various post-meeting forms. Estimates of the number of classification actions are made by correlation of the new registration figure and the requirements of the random sequence method of selecting registrants for the military service.

REGISTRATION, CLASSIFICATION AND INDUCTION (continued)

Appeals

	1969	1970	1971
Work Units	165,054	214,715	243,951
Man Years	162	210	239
Cost	$918,195	$1,299,240	$1,489,321
Unit Cost	$5.563	$6.051	$6.105

A registrant, his dependent, or any person who has filed a request for his deferment may appeal any classification action. These appeals go first to appeal boards in the states but may, under certain circumstances, ultimately be submitted to the National Selective Service Appeal Board which is located in Washington, D. C.

This item covers the work of the local board personnel and the appeal board clerks in processing these appeals. It includes the making of necessary notations in various records, preparation of necessary forms and notification to interested persons that an appeal has been taken and informing them of the result of the appeal.

Appeals as detailed on page 75 have continued to increase in number. The volume of appeals for 1968 was the actual count and was at the rate of 1.405% of classification actions. In 1969 the rate had increased to 2.055% of classification actions. To reflect this continued upward thrust of appeal board load, the ratio for 1970 is estimated as 2.651% of classification actions and for 1971 is 2.949%.

The rate of increase in 1971 is less than is shown for the previous years reported due to an expectation that the number of appeals will level off with the implementation of the random sequence method and selection from a lower age group.

REGISTRATION, CLASSIFICATION AND INDUCTION (continued)

Physical Examination (Local Board)

	1969	1970	1971
Work Units	127,172	187,280	179,801
Man Years	39	58	56
Cost	$222,805	$356,956	$345,757
Unit Cost	$1.752	$1.906	$1.923

While most physical examinations are conducted by the medical staff at Armed Forces Examining Stations, medical interviews are conducted at the local boards to screen out registrants who may have obvious disqualifying physical or mental conditions. This interview is usually conducted by a medical advisor to the local board who is uncompensated. Its purpose is to save the cost of transportation to an examining station and provide greater certainty to registrants.

The local board personnel arrange a suitable time, prepare notices for registrants to report for medical interview, complete pertinent forms, make necessary notations on records, etc.

The work measurement study shows that the percentage of registrants who are handled in this manner is 12.383% of the total who undergo armed forces physical examinations. On the basis of 1,452,000 to be forwarded for armed forces physical examinations in 1971, it is anticipated that there will be 179,801 local board physical examinations.

Physical Examinations (Examining Stations)

	1969	1970	1971
Work Units	1,027,030	1,512,400	1,452,000
Man Years	488	719	690
Cost	$2,776,062	$4,446,456	$4,306,632
Unit Cost	$2.703	$2.940	$2.966

Most registrants are examined at Armed Forces installations where there is available equipment for X-ray, laboratory tests, etc.

In preparing groups of registrants to be sent to these installations, it is necessary to issue orders to the individual registrants, prepare various documents for each (and file them on return), instruct group leaders, etc.

The 1970 number of examinations has been increased by some 40%. See pages 97 and 98 for justification.

Inductions

	1969	1970	1971
Work Units	320,272	337,991	200,000
Man Years	244	258	152
Cost	$1,387,418	$1,592,614	$950,800
Unit Cost	$4.332	$4.712	$4.754

Registrants in sufficient number are sent to induction stations for induction into the Armed Forces in numbers requested by each service. Registrants are under control of Selective Service until inducted but from that point on they are the responsibility of the appropriate service.

Workload for this item depends entirely on manpower requirements of the Armed Forces.

REGISTRATION, CLASSIFICATION AND INDUCTION (continued)

Civilian Work Assignments

	1969	1970	1971
Work Units	5,749	6,067	3,590
Man Years	8	8	5
Cost	$45,245	$51,940	$31,007
Unit Cost	$7.870	$8.561	$8.637

Registrants who are conscientious objectors to military service are allowed under the law to do certain types of civilian work in lieu of such service. This work must contribute to the maintenance of the national health, safety or interest and must be in the employ of the United States, a state government or a subdivision thereof, or a non-profit organization engaged in an activity benefiting the general public. The registrant must do such work for a period equal to the time he would spend in military service had he been inducted. The local board must approve the employment of each registrant performing civilian work in lieu of military service.

This item covers the work of the local board personnel in locating suitable work for the conscientious objector, ordering him to report for such work, referring to the State Director of Selective Service cases in which the registrant and the local board are unable to agree on suitable work, making arrangements for travel of the registrants, making necessary notations on records, etc.

The number of civilian work assignments made varies with the number forwarded for induction.

REGISTRATION, CLASSIFICATION AND INDUCTION (continued)

Delinquents

	1969	1970	1971
Work Units	62,658	66,546	64,524
Man Years	62	66	64
Cost	$355,271	$410,456	$401,533
Unit Cost	$5.670	$6.168	$6.223

The Military Selective Service Act of 1967 imposes certain duties on registrants. Failure to perform some of these duties subjects them to possible prosecution. For example, a registrant who fails to respond to an Order to Report for Preinduction Examination or Induction may be reported to the United States Attorney for prosecution under applicable statutes. Local Boards make all reasonable efforts to secure compliance of registrants before reporting them to the United States Attorneys.

This item includes the time local board personnel spend in attempting to locate and secure compliance of registrants, correspondence with the United States Attorney, other local boards, and registrants and making necessary notations on appropriate records.

REGISTRATION, CLASSIFICATION AND INDUCTION (continued)

Initial Processing of Standby Reservists

	1969	1970	1971
Work Units	524,446	610,000	524,000
Man Years	100	116	100
Cost	$568,499	$719,190	$623,560
Unit Cost	$1.084	$1.179	$1.190

The Armed Forces Reserve Act of 1952, as amended, provides that a member of the Standby Reserve, to be recalled to active duty, must first be found by the Director of Selective Service to be available. In order to do this, the Selective Service System must maintain records of the membership of the Standby Reserve and determine for each member whether he is available for active duty or not available by reason either of dependency or employment in an essential industry.

This item describes the function of establishing the original records on Standby Reservists. It includes the receipt from State Headquarters of orders transferring men to the Standby Reserve, preparing locator cards and folders, mailing questionnaires, locating reservists whose proper address has not been supplied and, where necessary, transferring them to other local boards in whose jurisdiction they live. Thus, it is much like registering.

Work receipts for this item depend upon the rate at which the Armed Forces screen men to the Standby Reserve. There were 524,446 processed in 1969. In 1970 it is anticipated there will be 610,000 processed and 524,000 in 1971.

REGISTRATION, CLASSIFICATION AND INDUCTION (continued

Categorizing of Standby Reservists

	1969	1970	1971
Work Units	798,041	844,000	781,000
Man Years	156	165	153
Cost	$885,826	$1,018,708	$951,258
Unit Cost	$1.110	$1.207	$1.218

Categorization is similar to classification and is necessary before Selective Service is able to declare a reservist available or not available for recall to active duty. It is somewhat simpler than classification as only four categories are used. These are I-R (available for order to active duty); II-R (not available because of civilian occupation); III-R (not available because of dependency) and IV-R (not found available and not found qualified for II-R or III-R).

Responsibilities of the local board personnel in this process include review of the questionnaire when it is returned, attendance at board meetings, preparation of notices of availability to the Reservists and to the Armed Forces, and maintenance of pertinent forms and records.

This includes the annual contact to secure current information on availability which is made with all Standby Reservists. The statutory requirement for an annual contact by the services is being satisfied by Selective Service furnishing the several components with the result of this annual contact. Reconsideration of status is made as a result of the information received from this contact.

REGISTRATION, CLASSIFICATION AND INDUCTION (continued)

Removal from Standby Reserve

	1969	1970	1971
Work Units	239,722	522,000	524,000
Man Years	28	61	61
Cost	$158,217	$374,796	$379,376
Unit Cost	$0.660	$0.718	$0.724

Reservists may be removed from the Standby Reserve upon completion of their period of military liability and are removed by death, or upon development of a disqualifying physical or mental defect.

In all of these cases it is necessary to post information to records and notify the Armed Forces when required and the registrant (except in case of death).

The number removed is related to intake two years prior.

REGISTRATION, CLASSIFICATION AND INDUCTION (continued)

Answering Inquiries

	1969	1970	1971
Work Units	11,352,323	12,056,709	11,690,465
Man Years	791	840	815
Cost	$4,495,520	$5,196,442	$5,085,352
Unit Cost	$0.396	$0.431	$0.435

Inquiries come to local boards from registrants, employers, the general public, other offices of the Selective Service System and other agencies of Government. These inquiries cover all phases of Selective Service operations and are in both written and oral form.

This item accounts for the time of local board personnel in answering all inquiries except those which are part of another workload item.

The number of work units for inquiries is based on the number of classification actions. Prior to the current harassment of local boards and in low induction years the percentage of inquiries to classification actions ran between 70% to 75%. The number of inquiries has greatly increased and is currently estimated as 141.32% of the number of classification actions.

In addition to answering inquiries, by the statutory changes in the basic law, the Congress requires a greater reliance on the Local Board Executive Secretaries for counselling the registrants, their families and others interested in the operation of The Military Selective Service Act of 1967.

REGISTRATION, CLASSIFICATION AND INDUCTION (continued)

Administrative Time

	1969	1970	1971
Man Years	1,325	1,458	1,398
Cost	$7,532,239	$9,016,794	$8,724,828

Time spent at meetings of local board personnel, with representatives of State or National Headquarters, in training other employees, preparing reports, general reading of informational media, opening and sorting mail, etc. It is not possible to reduce these functions to a unit measure since the costs cannot be related to processing count nor work units. It is, however, shown on the Comparative Summary Statement by Function. Administrative Time is calculated at 17.815% of the time devoted to those functions measured in units.

Maintaining Files

	1969	1970	1971
Man Years	183	201	193
Cost	$1,037,559	$1,242,055	$1,201,837

This item accounts for the time of local board personnel spent in reviewing, purging and rearranging files of their offices. This cost has been allocated in the proportion of other items where unit costs can be secured and is not an additional cost factor in this request.

REGISTRATION, CLASSIFICATION AND INDUCTION (continued)

Non-Productive Time

In addition to the time spent on the various functions performed in local board offices, there are two classes of non-productive time. These are:

1. Paid Leave - This includes sick leave, annual leave and holidays.

2. Staff Time - Selective Service is required by law to maintain at least one local board office in each county in the United States. Many of these offices generate very little business and these are operated on a part-time basis, some being open only one or two days a week. There are nontheless, occasions when an employee is present in an office but has no work to do. Time so represented is reported in this item.

Time spent on the above item is spread across the productive functions of local boards on a percentage basis. The leave item is figured at 13.93% which was arrived at by a survey of leave taken by local board personnel last year. It is reported below for information purposes only and is not intended as an additional cost factor in this budget request:

	1969	1970	1971
Paid Leave			
Man Years	942	970	952
Cost	$5,354,481	$5,998,676	$5,939,473
Staff Time			
Man Years	131	135	132
Cost	$744,938	$834,561	$826,324

REGISTRATION, CLASSIFICATION AND INDUCTION (continued)

12 Personnel Benefits

	1969 Actual	1970 Estimate	1971 Estimate
Civil Service Retirement Contributions	$2,376,497	$2,521,100	$2,660,000
Group Life Insurance Contributions	219,286	184,000	247,000
Federal Insurance Contribution Act Taxes	67,813	175,500	77,000
Health Benefit Contributions	345,697	407,000	388,000
Employee Suggestion Awards	23,489	---	---
Cost of Living Allowances	70,887	34,400	77,000
Accident Compensation	33,653	22,000	30,000
	$3,137,322	$3,344,000	$3,479,000

These items, except Employee Suggestion Awards, Health Benefit Contributions, Cost of Living Allowances, and Accident Compensation, vary with the payroll amounts. Health Benefit Contributions have continued to rise with wider and greater participation. Accident Compensation is based on experience and is paid to the Department of Labor on their billing.

REGISTRATION, CLASSIFICATION AND INDUCTION (continued)

21 Travel and Transportation of Persons

	1969 Actual	1970 Estimate	1971 Estimate
Administrative Travel	$ 752,809	$ 700,000	$1,000,000
Travel of Selectees	5,179,404	8,292,000	7,681,000
Rental of Passenger Motor Vehicles	41,325	43,000	45,000
	$5,973,538	$9,035,000	$8,726,000

Administrative Travel covers the travel of local and appeal board members (which travel is exempt from the limitation but is increasing with greater acitivty), the travel of local board auditors and the travel of local board personnel when serving more than one board or when attending group meetings. They also occasionally are required to answer a subpoena in cases of court trials involving delinquents being prosecuted for violation of the Selective Service Law. An additional amount of $100,000 for 1970 and $100,000 for 1971 has been included which will be required to support the travel of the Youth Advisory Committee (see New Programs, pages 22 and 23).

The travel of selectees is directly affected by the number inducted into the Armed Forces. Calls to be filled by induction are placed on Selective Service by the Department of Defense. Selective Service does not participate in the determination of the size of the call. In 1969 263,000 were inducted. The estimate for 1970 is based on calls for 283,000 and also includes the supplemental estimate of $2,152,000 to cover some 40% more pre-induction examinations. It was necessary during the

REGISTRATION, CLASSIFICATION AND INDUCTION (continued)

first half of fiscal year 1970 to examine at a higher rate than stated in the budget to replenish the pool of examined and qualified registrants which was sorely depleted. During the second half of the year it will be necessary to examine at even a higher rate to make certain the new system of random selection for military service is properly implemented.

Rental of Passenger Motor Vehicles is from G. S. A. Motor Pools.

SELECTEE TRAVEL - 1971

	Number Forwarded	Unit Cost	Total Cost
For Armed Forces Examination	1,452,000	$4.98*	$7,230,960
For Induction	200,000	$2.25	450,000
Total Selectee Travel Cost			$7,680,960

* Two one-way trips at $2.25 plus 48¢ for meals and lodging.

Our plan is to forward for Armed Forces examination at about the rate of 121,000 per month in preparation for filling calls under the random sequence method of selecting registrants for the military service. This is further necessitated by a potential requirement to assure a physical examination to any registrant on demand. Funding for 1,452,000 examinations during the year will be required.

REGISTRATION, CLASSIFICATION AND INDUCTION (continued)

22 Transportation of Things

	1969 Actual	1970 Estimate	1971 Estimate
Freight, Express and Drayage	$ 82,233	$100,000	$ 90,000
Rental of Trucks	3,751	4,000	5,000
Parcel Post (penalty indicia)	88,000	88,000	108,000
	$173,984	$192,000	$203,000

This object covers the charges for distribution of supplies, materials and equipment to local boards and appeal boards.

Truck rental from G.S.A. is used when it is determined to be more economical than other means of transportation.

The amount appropriated for Parcel Post (penalty indicia) is paid to the Post Office Department and in 1971 is an increase over prior years due to increased workload.

REGISTRATION, CLASSIFICATION AND INDUCTION (continued)

23 Rent, Communications and Utilities

	1969 Actual	1970 Estimate	1971 Estimate
Communication Services	$ 867,340	$ 820,000	$ 917,000
Rents and Utilities	86,226	238,000	364,000
Penalty Mail	993,000	943,000	1,084,000
	$1,946,566	$2,001,000	$2,365,000

Telephone costs are approximately 98% of the Communication Services expense. The increases reflect the rising cost of telephones. The request for 1971 includes $254,000 for FTS services which is an increase of $49,000 over 1970.

The principal item of Rents and Utilities expense is for picking up two years rent on new space. The 1971 request includes:

1. Amount to cover the appropriation transfer to GSA for space and services which will be added to local boards during FY 1970 - $186,000.

2. Cost of relocating or expanding approximately 150 local boards which represents only 3.66% of the 4,094 local boards. It is anticipated that 97 rent-free spaces will be moved to leased space. This will require the actual acquisition of about 28,000 additional square feet at a cost of $119,000. Local boards which are moved into space of comparable size to space currently held will normally require additional funding due to higher rental rates. Local boards which are relocated to a larger space usually require additional funding due to increased rental rates for the new space as well as the added cost for the additional space. It is

REGISTRATION, CLASSIFICATION AND INDUCTION (continued)

estimated that such moves will require approximately 67,000 square feet of replacement space for relocations at an estimated additional rental cost of an average of $.66 per square foot or $44,220. Grand total - $163,220.

3. Requests have been made to add air conditioning or other services in approximately 20 Local Board locations at an estimated average cost of $500 per location per year - $10,000.

The remaining is to pay for local board expense in Guam as well as charges for garage rental wherever used and charges for utilities in rent-free space.

Penalty mail is to reimburse the Post Office Department for use of penalty indicia. The amounts are arrived at as a result of a survey. The increase for 1971 is due to the additional workload.

24 Printing and Reproduction

1969 Actual	1970 Estimate	1971 Estimate
$471,725	$600,000	$586,000

This object provides for contractual printing and reproduction by the Government Printing Office and by commercial printers.

The principal requirements are for forms for local board use; the most costly of which are the Questionnaire (SSS Form 100), which is an eight page document and is a part of the record of every registrant, and the Cover Sheet (SSS Form 101) which is heavy file folder stock and on which is placed pertinent data covering the status of the registrant. It is used as a file folder and is part of the permanent record of each registrant. Between 2 to 2 ½ million are required annually.

REGISTRATION, CLASSIFICATION AND INDUCTION (continued)

25 Other Services

1969 Actual	1970 Estimate	1971 Estimate
$179,783	$160,000	$175,000

This item includes the cost of repairing and painting local board offices where G.S.A. does not furnish the service and repairs of office equipment, principally typewriters.

26 Supplies and Materials

1969 Actual	1970 Estimate	1971 Estimate
$231,649	$225,000	$235,000

This object class provides for all commodities which are ordinarily consumed or expended within a comparatively short period of time. The supplies consist of paper, envelopes and other miscellaneous office material required to carry out day-to-day operations. It also includes purchased forms, other than Selective Service forms.

REGISTRATION, CLASSIFICATION AND INDUCTION (continued)

31 Equipment

1969 Actual	1970 Estimate	1971 Estimate
$438,175	$225,000	$208,000

Under the simplified obligation report approved by the Bureau of the Budget several years ago, no records of cost are maintained on the principal items of equipment. The estimates are based on centrally adjusted estimates of requirements submitted by the several State Headquarters.

The principal items for 1971 are: 4 or 5 drawer file cabinets ($15,000); other filing equipment ($6,000); typewriters ($103,000); shelving (for files in transfer cases) ($29,000); office tables, chairs, cabinets, etc. ($22,000); office equipment (adding machines 15 - calculators 5) ($7,000) and miscellaneous ($26,000).

These items are for replacement, to provide for expanding file needs or to furnish new local board offices where boards have been so large that they are unwieldy. The new registrants account for most of the file cabinets. The use of uncompensated board members requires that the workload on them must be maintained at a reasonable level. As boards divide, it is an opportunity to get a board office closer to its registrants, thus requiring a new board set-up.

Due to the moratorium on the purchase of file cabinets in recent years, we have transferred to Local Board Records Centers the files of many older registrants not currently liable and to which file reference is not often made. By using transfer cases and steel shelving, we have

REGISTRATION, CLASSIFICATION AND INDUCTION (continued)

31 Equipment (continued)

been able to release file cases to take care of new records. At the present rate of registration, it requires about 2,000 file cases per year to take care of the annual expansion. We have combed the System and have gotten by for the present but the file cases requested are vitally needed to perform efficiently.

In addition to the office furniture and equipment, the request for 5 station wagons and 8 sedans at a cost of $21,750 is included in the miscellaneous figure.

Mr. EVINS. Your medical advisory committees are next.

Why are the positions other than permanent showing a wide fluctuation?

MEDICAL ADVISORY COMMITTEE

Mr. CASH. In 1969 the committee was dormant—out of business. Then they came back into business and we didn't know frankly just how to estimate how frequently they would meet, but assuming they would have some meetings, we budgeted for a little more money. I might say in all candor, the 1970 estimate might be a little over.

Mr. EVINS. You found it was over in 1970 and reduced it in 1971. You are being honest and fair with the committee.

Mr. CASH. That is correct, sir. In other words, they were out of business. They were two committees. They reorganized.

Mr. EVINS. You think about $75,000 is about the right level? That is about three times what you had in 1969.

Mr. CASH. I can tell you what they have been spending in just a half a moment, sir.

Through February, sir, of this year, in the current fiscal year, they had already obligated almost $32,000, so you see, perhaps—well, $96,000; that might be a bit over. They are functioning now as against not functioning in the previous year.

Mr. EVINS. Your total obligations are down from $96,000 to $75,000. We won't quarrel with you too much on that.

Place in the record pages 107 through 110.

(The pages follows:)

SELECTIVE SERVICE SYSTEM
SUMMARY OF OBJECTIVE CLASSIFICATION
PROJECT 40

	1969 Actual	1970 Estimate	1971 Estimate
11. Personnel compensation:			
Permanent positions	15,197	18,300	19,000
Positions other than permanent	6,048	57,000	28,000
Other personnel compensation	12	---	---
Special personal service payments	---	---	---
Total personnel compensation	21,257	75,300	47,000
12. Personnel benefits:			
Civil service retirement	1,030	2,600	1,400
Group life insurance	83	200	200
FICA taxes	266	1,300	1,400
Health benefits	81	200	200
Cash awards	---	---	---
Cost of living allowances	---	---	---
Accident compensation	---	---	---
21. Travel and transportation of persons:			
Administrative travel	2,155	20,000	22,000
Travel of selectees	---	---	---
Rental of passenger vehicles	---	---	---
22. Transportation of things:			
Freight, express and drayage	---	---	---
Rental of trucks	---	---	---
Parcel post (penalty indicia)	---	---	---
23. Rent, communications and utilities:			
Communication services	746	900	900
Rents and utilities	---	---	---
Penalty mail	300	300	300
24. Printing and reproduction	567	500	600
25. Other services	---	700	700
26. Supplies and materials	81	300	300
31. Equipment	---	---	---
42. Insurance claims and indemnities	---	---	---
Subtotal obligations	26,566	102,300	75,000
Proposed supplemental for increased pay cost	---	-6,300	---
Total obligations	26,566	96,000	75,000

SELECTIVE SERVICE SYSTEM
SUMMARY OF OBJECTIVE CLASSIFICATION
PROJECT 40

	1969 Actual	1970 Appropriated	1970 Revised Estimate	1970 Estimate
11. Personnel compensation:				
Permanent positions	15,197	18,300	18,300	19,000
Positions other than permanent	6,048	57,000	57,000	28,000
Other personnel compensation	12	---	---	---
Special personal service payments	---	---	---	---
Total personnel compensation	21,257	75,300	75,300	47,000
12. Personnel benefits:				
Civil service retirement	1,030	2,600	2,600	1,400
Group life insurance	83	200	200	200
FICA taxes	266	1,300	1,300	1,400
Health benefits	81	200	200	200
Cash awards	---	---	---	---
Cost of living allowances	---	---	---	---
Accident compensation	---	---	---	---
21. Travel and transportation of persons:				
Administrative travel	2,155	20,000	20,000	22,000
Travel of selectees	---	---	---	---
Rental of passenger vehicles	---	---	--	---
22. Transportation of things:				
Freight, express and drayage	---	---	---	---
Rental of trucks	---	---	---	---
Parcel post (penalty indicia)	---	---	---	---
23. Rent, communications and utilities:				
Communication services	746	900	900	900
Rents and utilities	---	---	---	---
Penalty mail	300	300	300	300
24. Printing and reproduction	567	500	500	600
25. Other services	---	700	700	700
26. Supplies and materials	81	300	300	300
31. Equipment	---	---	---	---
42. Insurance claims and indemnities	---	---	---	---
Subtotal obligations	26,566	102,300	102,300	75,000
Proposed supplemental for increased pay cost	---	-6,300	---	---
Total obligations	26,566	96,000	102,300	75,000

SELECTIVE SERVICE SYSTEM

FISCAL YEAR 1971

NATIONAL ADVISORY COMMITTEE ON THE SELECTION OF PHYSICIANS, DENTISTS AND ALLIED SPECIALISTS

Project 40

On June 24, 1968, the President by Executive Order No. 11415 dissolved the National Advisory Committee on the Selection of Physicians, Dentists and Allied Specialists which had been established by Executive Order No. 10166 on October 4, 1950. This Executive Order also dissolved the Health Resources Advisory Committee which was established at the direction of the President on October 5, 1950. The dissolution was accomplished by having all appointments expire.

When first established, these two committees had duplicate memberships. In 1961 by Executive action, the membership of the two committees was changed and each had its own membership.

Under Executive Order No. 11415, the two committees have been reestablished with a common membership of twelve members to be appointed by the President from private life.

The Office of Emergency Planning, which had responsibility for the National Health Resources Advisory Committee and the Selective Service System have jointly agreed on the financing of the reimbursement for the Committee.

The National Advisory Committee on the Selection of Physicians, Dentists and Allied Specialists had used committees set up in the several states. The Resources Committee did not have such a feature nor do they find the need for one. Therefore, Selective Service is assuming any

NATIONAL ADVISORY COMMITTEE ON THE SELECTION OF PHYSICIANS, DENTISTS AND ALLIED SPECIALISTS (continued)

costs incurred by reason of the State Committees which were authorized by Executive Order No. 11415.

The Committee, as presently constituted, reside in:

Galveston, Texas
Morganton, North Carolina
Northfield, Minnesota
Nashville, Tennessee
New York, New York
San Francisco, California
Chapel Hill, North Carolina
College Station, Texas
Atlanta, Georgia
Columbus, Ohio
Philadelphia, Pennsylvania
Long Beach, California

The cost of personnel compensation for 1970, as indicated on the Summary of Objective Classification, includes $6,300 for the statutory pay raise effective July 13, 1969.

Full attendance at each meeting held in Washington involves approximately $2,000 in travel funds.

NATIONAL APPEAL BOARD

Mr. EVINS. National Appeal Board goes up from $76,000 to $82,000. You have more appeals before the National Appeal Board and more days in meetings.

Mr. CASH. We have considerably more appeals, sir. We have both. We had Presidential appeals, 163 of them in 1965. Last year we had 3,084. Nineteen times as many Presidential appeals, sir.

Mr. EVINS. Nineteen times as many Presidential appeals?

Mr. CASH. That is from 1965 to 1969.

Mr. EVINS. What is the projection 1969 to 1971?

Mr. CASH. 1968 is 2,171 and 3,084 in 1969. They are up a good third from 1968 to 1969 and we project an increase. And then there are personnel benefits.

MEMBERS OF APPEAL BOARD

Mr. EVINS. Who are the members of the National Appeal Board? There are three of them selected by the President.

Mr. CASH. That is correct, sir.

Mr. EVINS. Will you name them for the record and what States they are from?

Mr. TARR. Mr. Levi A. Jackson of Michigan is the chairman. Mr. Elmer Gerald Banks of Florida, and Mr. Charles N. Collatos from Massachusetts.

Mr. EVINS. Once these three men make the decision, it is final except for a possible additional decision by the President. Has the President ever taken any action contrary to the Appeal Board?

Mr. CASH. Not to my knowledge, sir.

Mr. EVINS. For all intents and purposes, the Appeal Board is the last authority. The Presidential Appeal Board. It is delegated by the President to act for him.

Are there any questions, gentlemen?

Thank you, Mr. Tarr. You have a very important mission, a very sensitive one, and we wish you good luck and much success.

Mr. TARR. Mr. Chairman, I look forward to next year when I will be better prepared for these hearings.

TUESDAY, MARCH 24, 1970.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

WITNESSES

DR. THOMAS O. PAINE, ADMINISTRATOR
DR. GEORGE M. LOW, DEPUTY ADMINISTRATOR
WILLIS H. SHAPLEY, ASSOCIATE DEPUTY ADMINISTRATOR
DR. WERNHER VON BRAUN, DEPUTY ASSOCIATE ADMINISTRATOR FOR PLANNING
DALE D. MYERS, ASSOCIATE ADMINISTRATOR FOR MANNED SPACE FLIGHT
DR. JOHN E. NAUGLE, ASSOCIATE ADMINISTRATOR FOR SPACE SCIENCE AND APPLICATIONS
ORAN W. NICKS, ACTING ASSOCIATE ADMINISTRATOR FOR ADVANCED RESEARCH AND TECHNOLOGY
GERALD M. TRUSZYNSKI, ASSOCIATE ADMINISTRATOR FOR TRACKING AND DATA ACQUISITION
DR. ROBERT R. GILRUTH, DIRECTOR, MANNED SPACECRAFT CENTER
ROBERT T. ALLNUTT, ASSISTANT ADMINISTRATOR FOR LEGISLATIVE AFFAIRS
WILLIAM E. LILLY, ASSISTANT ADMINISTRATOR FOR ADMINISTRATION
JOSEPH F. MALAGA, DIRECTOR, RESOURCES ANALYSIS DIVISION

Mr. EVINS. The committee will come to order.

We take up this morning the budget justification for the National Aeronautics and Space Administration. We have with us our distinguished friend, Dr. Thomas O. Paine, the Administrator, accompanied by those set forth above.

This is a very distinguished group. We always listen to you with profit.

Mr. Administrator, we will be pleased to hear you. You may proceed as you wish.

GENERAL STATEMENT

Dr. PAINE. Mr. Chairman and members of the subcommittee, since our last appearance before you, Apollo 11 and 12 have demonstrated to all the world that the systems which we built with your support can fly men across a quarter of a million miles of space, land them with precision, and enable them to carry out research and exploration of another heavenly body. The Apollo 11 astronauts met NASA's commitment for the decade of the sixties on time and within budget. Apollo 12 opened the era of scientific lunar exploration, and next month Apollo 13 will build on this beginning.

BUDGET REQUEST DOWN

We appear before you today with these accomplishments behind us, ready to embark on a new course for the next decade in space. The Congress again shares with the administration the responsibility

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for continuing U.S. progress and leadership in space and aeronautics. We ask for your support as NASA goes through a difficult but necessary period of redirection. We are requesting 12 percent less funds than last year, which means that austere budget goals must be met. This is a time of great change and challenge for our management, our staff, and our associates in industry and universities. But I firmly believe that with your support this Nation can and will continue to forge ahead in space exploration, in science, applications, and in aerospace technology. The reduced program which we are laying before you in these hearings, although austere, provides for balanced U.S. progress toward challenging goals for the 1970's and the decades to follow.

SUMMARY OF BUDGET SITUATION

Mr. Chairman, the following table outlines the fiscal year 1971 NASA appropriation request before you. For your convenience it also shows the recently announced actions of the Committee on Science and Astronautics on the fiscal year 1971 authorization. We are, of course, presenting and defending the President's Budget.

BUDGET PLAN

[In millions]

	1969	1970	1971 budget	1971, H.R. 16516
Research and development	3,201.4	3,113.8	2,606.1	2,903.200
Construction of facilities	32.1	53.2	34.6	33.975
Research and program management	648.0	688.4	692.3	693.700
Total	3,881.5	3,855.4	3,333.0	3,630.875

In summary, the fiscal year 1971 budget estimate is $3.333 billion. This is $522 million below the comparable figure for 1970, which is $3.855 billion when the fiscal year 1970 appropriation of $3.697 billion is adjusted, as shown in the budget schedules, for the application of the $118 million withheld in 1969, the supplemental requirements for the Civilian Pay Act increase of $42 million to be provided separately later this year, and a transfer of $500,000 to GSA for rental space. Our estimate of fiscal year 1971 expenditures is $3.4 billion, $489 million below the estimate for the current year, and more than $2.5 billion below the Nation's peak expenditures for space in 1966.

EMPLOYMENT TO DECREASE BY 45,000

As I will explain in more detail, this substantial reduction in the space budget for fiscal year 1971 will require major cutbacks and deferrals in a number of programs, and the closing down of one of NASA's research centers. Our best current estimate is that total nationwide employment on NASA work—once 420,000—will decline from the current level of about 190,000 people by approximately 45,000 to some 145,000 people by the end of fiscal year 1971. The impact of these lost jobs is being felt in many sections of the country. In making up the fiscal year 1971 budget the administration faced the hard fact that these difficult decisions had to be made to achieve a fiscally responsible,

balanced budget in this time of inflation and escalating costs in other parts of the Government. Thus the fiscal year 1971 budget as it comes from the President to the Congress includes this major reduction in the Nation's space program.

LONG-RANGE SPACE PLAN

In the days ahead, we will review with you in considerable detail the specific requests in the President's budget for fiscal year 1971. But this year we are presenting to you more than the program for a single year. With the Apollo lunar landing behind us, we are now in a position to present to you the Nation's aeronautics and space budget in the framework of a sound long-range plan for the Nation's future in space. As a result of the work last year of his space task group, the President has made decisions on the goals and direction this Nation should take in space in the seventies and beyond. He announced these in his statement earlier this month. The President's fiscal year 1971 budget recommendations provide for the progress NASA should make toward these new goals during fiscal year 1971.

HIGHLIGHTS OF PAST YEAR

Before presenting details of our fiscal year 1971 budget and the long-range goals the President has set, I think it will be useful to review for you briefly some highlights of NASA's accomplishments in the past year. The year 1969 will go down in history as the year of Apollo—the year man first left his home planet earth and explored another celestial body. We put to the ultimate test all of the intensive work and planning which you supported in the first decade of space—in the Ranger, Lunar Orbiter and Surveyor programs and in the Mercury, Gemini and precursor Apollo flights. The successful climax came on July 20, 1969, when Neil Armstrong announced to the world from Tranquility Base: "the Eagle has landed," and set foot on the lunar surface with the words: "That's one small step for a man, one giant leap for mankind."

Four months later, on November 19, 1969, the Apollo 12 spacecraft "Intrepid" made a pinpoint landing in the Ocean of Storms alongside a Surveyor spacecraft in an area of prime sceintific interest. Man's initial exploration of the moon is now continuing in over a hundred laboratories on earth where detailed analyses of the lunar material returned on the Apollo 11 and 12 missions are underway, yielding important scientific results. With these samples and the data which are still being received from the scientific experiments emplaced and calibrated on the moon by the astronauts, scientists around the world have entered an exciting new period of lunar research which already gives indications of revolutionizing man's understanding not only of the composition and history of the moon itself, but of the origins and cosmic history of our earth and the solar system as well.

The year 1969 will also be remembered for another significant U.S. scientific achievement: the dramatic close-up studies of Mars by Mariners 6 and 7. These spacecraft returned more than 200 photos of unprecedented clarity which, together with other scientific experiments in the spacecraft showed that Mars is a world unlike either the Earth

or the Moon. Although numerous craters were observed in most areas, including one almost 300 miles in diameter, one vast stretch of over 1,200 miles was observed with almost no craters. Unlike the Moon, Mars has some atmosphere, roughly equivalent in density to that of the earth at 100,000 feet altitude. The only identifiable cloud was a very thin streak hanging 20 to 30 miles off the edge of the planet. Ice cap temperatures were measured to be very similar to that of dry ice, although one experimenter believes there may also be frozen water at the edge of the polar caps.

PROGRESS IN APPLICATIONS OF SATELLITES

Closer to home, 1969 saw continuing steady progress in practical applications of satellites for immediate economic benefits here on earth. The meteorological satellite, Nimbus 3, launched on April 14, 1969, was the first to provide from orbit by electronic means daily measurements of vertical temperature profiles, air pressure, vapor content and wind speeds at numerous points around the world. These data could previously only be obtained at a few specific points by sounding rockets and balloons. This breakthrough, which permits continuous detailed observations of the vertical profile of the atmosphere, has been assessed by meteorologists to be as significant to their field as the launch of the first weather satellite.

NASA also launched operational meteorological and communications satellites on a reimbursable basis for ESSA and Comsat, Skynet-A for the DOD on behalf of the British Ministry of Defense, and a scientific satellite for the European Space and Research Organization. In addition, a Canadian ionospheric research satellite and a German radiation belt satellite were launched in cooperative international projects.

Two Orbiting Solar Observatories, OSO's 5 and 6, were successfully launched in 1969 to continue our study of the sun; and an Interplanetary Monitoring Platform IMP–G and an Orbiting Geophysical Observatory, OGO–6, were launched to study the regions of space from the earth out to more than 100,000 miles. The Orbiting Astronomical Observatory II, launched in 1968, continues to provide significant new knowledge of the universe by observing stars and galaxies at wave lengths which do not penetrate through the atmosphere to telescopes on the surface of the earth.

In aeronautical research, NASA's promising new supercritical wing development moved from conceptual work and ground tests into preparations for full-scale tests at our Flight Research Center. Flight tests on a modified jet aircraft acquired from the Navy will begin in November 1970. Because of its potential for enhancing both the cruise performance and the operating economy of subsonic jet aircraft, this new NASA advance is generating widespread interest within the aircraft industry.

NATION'S FUTURE IN SPACE

With this brief summary of some highlights of aerospace progress in 1969, let me turn now to the future. In previous years we have not been able to lay before you a clear and authoritative program for the Nation's future in space. With the lunar landing accomplished and

the Administration's review of the post-Apollo period completed, we can now present to you a longer range program for the 1970's. Your subcommittee and the Congress can consider our fiscal year 1971 budget request as the first step toward the new goals for the 1970's established in President Nixon's statement. With your permission, Mr. Chairman, I would like to place in the record the full text of the President's statement on the Nation's future in space of March 7, 1970.

Mr. EVINS. It will be inserted following your statement.

SUMMARY OF PRESIDENT'S STATEMENT

Dr. PAINE. I will summarize briefly the principal points made by the President and relate them to our fiscal year 1971 budget request.

First, the President strongly supports a bold but balanced U.S. space program as one of the Nation's continuing high priorities, within the context of other major national programs. He says:

> We must build on the successes of the past, always reaching out for new achievements. But we must also recognize that many critical problems here on this planet make high priority demands on our attention and our resources. By no means should we allow our space program to stagnate. But—with the entire future and the entire universe before us—we should not try to do everything at once. Our approach to space must continue to be bold—but it must also be balanced.

The fiscal year 1971 budget before you meets this concept. It is austere, but it will permit us to build on the successes of the past toward new achievements. It fully recognizes other high priority demands on national attention and resources this year. The NASA budget request has been cut 12 percent from last year to the lowest level in 7 years. But we can and will, after making many major cutbacks, continue a balanced program directed at the objectives the President has designated.

PROGRAM OF SEVENTIES

Second, the President makes it clear that the U.S. space program of the seventies will not be focused on a single major goal—like landing a man on the moon in the sixties—but will be a continuing program directed at achieving important objectives in a flexible manner. He says:

> We must realize that space activities will be a part of our lives for the rest of time. We must think of them as part of a continuing process—one which will go on day in and day out, year in and year out—and not as a series of separate leaps, each requiring a massive concentration of energy and will and accomplished on a crash timetable. Our space program should not be planned in a rigid manner, decade by decade, but on a continuing flexible basis, one which takes into account our changing needs and our expanding knowledge.

The fiscal year 1971 budget we are submitting to you is based on this concept. It does not commit the Nation to a major new objective to be achieved by a certain date. It supports clear working schedules for the projects previously appoved but the pace at which we move toward the major new goals mentioned in the President's statement is—within limits—flexible, and will be reviewed by the President and the Congress each year as we progress.

GENERAL PURPOSES

Third, the President identifies the three general purposes which he believes should guide the U.S. space program as exploration, scientific knowledge, and practical applications. I think what he says about exploration is especially important:

> From time immemorial, man has insisted on venturing into the unknown despite his inability to predict precisely the value of any given exploration. * * * Man has come to feel that such quests are worthwhile in and of themselves—for they represent one way in which he expands his vision and expresses the human spirit. A great Nation must always be an exploring Nation if it wishes to remain great.

This recognizes that exploration is a true end-in-itself of the space program, on a par with scientific knowledge and practical applications—two other purposes that have always guided our efforts. As you will see, our fiscal year 1971 budget is geared to support accomplishments of the three purposes cited by the President in a balanced way, both in the execution of the programs already underway and in the development of new capabilities for the future.

SPECIFIC OBJECTIVES

Fourth, the President has set six specific objectives for the U.S. space program in the years ahead. The fiscal year 1971 budget provides for progress toward each:

1. We will continue to explore the moon. Our present plan is to continue Apollo lunar exploration through 1974, taking advantage of the 15 Saturn V rockets and Apollo systems procured in previous years which are now essentially built and paid for. This permits seven more U.S. lunar expeditions on which astronauts will carry increasingly versatile payloads into new and different lunar areas of special scientific interest. The next mission will be Apollo 13, scheduled for April 11. After Apollo 19 in 1974 our plans now call for discontinuing U.S. lunar exploration for the time being, while decisions on future lunar missions are reviewed on the basis of the results of the Apollo missions and any Soviet missions which have been completed by them. I will discuss our revised Apollo schedule in more detail in a few moments.

2. We will move ahead with bold exploration of the planets and the universe. The fiscal year 1971 budget provides for continuing work on the planetary projects approved by Congress in previous years. These include the 1971 Mariner Mars Orbiter missions, the 1973 Mariner Venus/Mercury Flyby mission, and the Viking mission to land instruments on Mars now scheduled for launch in 1975. Other unmanned spacecraft will continue important scientific exploration of space. The President's statement gave special emphasis to a new objective for the late 1970's: the "Grand Tour" missions to study the mysterious outer planets of the solar system—Jupiter, Saturn, Uranus, Neptune, and Pluto. The alinement of these planets in the solar system in the late seventies gives man a unique opportunity to launch spacecraft on a trajectory that will pass by several planets on a single flight. Preparations for these missions will not begin until 1972, so there are no funds requested for this in the fiscal year 1971 budget.

The President also set forth as a major long range U.S. goal beyond the 1970's, that should nevertheless be borne in mind as we lay out our program for the 1970's, the eventual manned exploration of Mars. There are no funds in the fiscal year 1971 budget for this project and it will be many years before we will be in a position to propose moving ahead. The significance of the President's inclusion of a Mars expedition as a long-range U.S. goal is that it helps focus future engineering plans and decisons on other programs in such a way as to prepare the way for an eventual decision and to minimize the ultimate cost of manned flight to Mars when the decision to proceed is finally made.

3. We will work to reduce substantially the cost of space operation. A major effort in this direction will be the development of the reusable space shuttle rocket plane to take men, equipment and supplies from earth to orbit in a much less costly and complicated way. We have under study a fully reusable two-stage rocket plane with a 50,000 pound payload both to and from orbit which could ultimately replace all of our expendable launch vehicles except the small Scout rocket at one extreme and the large Saturn V at the other. The fiscal year 1971 budget includes funds for a major effort on advanced technology and detailed definition of the space shuttle, but a commitment to proceed with actual development of the shuttle will not be made until the fiscal year 1972 budget.

4. We will seek to extend man's capability to live and work in space. The first major experiments will come with the launching of the Apollo Applications earth orbital space station prototype—now called "Skylab"—in late 1972, with three astronaut revisits. We are far along in this program and look forward to an exciting and productive series of long-duration missions which will give our astronauts the opportunity to live and do research in space for several months under living conditions approaching those on earth. Beyond this, we will continue in 1971 the detailed definition studies begun last year of the next step—a long-lived orbital space station. The space station will consist of modules permanently joined in orbit in which many men will be able to live and work in space in the late 1970's. As in the case of the space shuttle, the fiscal year 1971 funds do not go beyond the definition and advanced technology development phases, and the decision to proceed with actual development will not come before fiscal year 1972.

5. We will continue to hasten and expand the practical applications of space technology. Under the fiscal year 1971 budget we will move ahead with the first two Earth Resources Technology Satellites A & B—which were presented and approved in our budget for the current year. These satellites will be launched in 1972 and 1973 to provide earth resource data acquired systematically and simultaneously from a number of sensors on a single experimental spacecraft. These experiments will permit user scientists in many fields and agencies to learn how best to apply earth resources data from space to problems in farming, forestry, fisheries, oceanography, water resources, mineral resources, air and water pollution, and many other fields. In the long run, this may well prove to be the area of greatest direct benefits from the space program. We are proceeding very carefully in partnership with other agencies so that our experiments will

make the maximum contribution to as many fields as possible at minimum cost. We will also continue in fiscal year 1971 our important work with the Applications Technology Satellites and advanced meteorological satellites. The practical uses of space for immediate economic returns are continuing to receive very high priority in our program.

6. The United States will encourage greater international cooperation in space. We are making a special effort to encourage other nations to participate with us in future major space programs like the space shuttle, and space station. We are proposing true participation—participation in the costs and technological contributions as well as in the benefits—by other nations. At the request of the President I have personally initiated discussions with space authorities of the major nations of Western Europe, Canada, Australia, and Japan. It is too early now to know what the response will be, but I am hopeful that mutually advantageous international arrangements will be worked out.

PROGRESS IN AERONAUTICS

The President's statement addresses itself only to the nation's space program. In addition, of course, NASA has major responsibilities for R. & D. in civil and military aernoautics—a responsibility carried over from the days of NACA which in recent years has had special significance. The "supercritical wing" is a good example of NASA's current technological contribution to the vitality of our aircraft industry. I am sure this subcommittee appreciates the importance of the aerospace industry to the economic strength of the United States. As you know, this industry is a major source of employment and the largest single contributor to the favorable U.S. balance of international payments. Indeed the U.S. aerospace industry alone accounts for more than the total excess of U.S. exports over imports, thus compensating for other less competitive U.S. businesses. This position has been gained through the clear technological superiority of our aircraft—the Boeing 707's, 737's, 727's, and 747's and the McDonnell-Douglas DC–8's and DC–9's, and others that are to be seen at airports around the globe, bearing the insignia of the world's leading airlines. Parenthentically the second largest new technology job provider and export generator is the U.S. computer industry, which has attained a clear position of world leadership with substantial stimulus from NASA programs.

I cannot overemphasize the importance to the United States of maintaining our lead in aeronautical technology. Therefore, within a declining total NASA budget we have slightly increased R. & D. efforts in aeronautical systems. In fiscal year 1971 we will give special emphasis to civil aeronautic system advances of special interest to the Department of Transportation and to continuing our close partnership of long standing with the Department of Defense in advanced military aircraft technology and design.

NEED TO MAINTAIN CAPABILITIES

To attain these important objectives in space and in aeronautics under a declining budget one of our most important needs is to maintain the essential cadre of NASA's technical, operational and man-

agement capabilities. It was these people and these capabilities—at our research centers, development centers, launch centers, and at headquarters—which gave the Nation the successes of thes pace program in the 1960's and on which the future position of the United States in space and aeronautics depends. This is truly a scarce and valuable national resource. For this reason, even though we have been and are continuing to make substantial reductions in our government, contractor, and operating base following our successful first lunar landing, it is absolutely essential that the U.S. maintain the capabilities of the team we need to carry out the programs projected for fiscal year 1971 and subsequent years. Our budget estimate for "Research and program management" is designed to do this, and we particularly ask your support for this essential activity. To make progress under our austere 1971 budget we need flexibility to concentrate our limited resources on the most critical program areas.

RECENT REDUCTIONS AND SUSPENSIONS

The serious problems of the total Federal budget, with which this subcommittee is very familiar, have required a sharp reduction in NASA's fiscal year 1971 budget. In order to preserve a balanced program oriented strongly to the future, within the present constraints, we have had to make hard choices and take prompt actions to reduce both our previously planned programs and our institutional base.

The most significant actions include:

Reducing our broad electronics research program and closing NASA's Electronics Research Center in Cambridge, Mass.

Suspending, for an indefinite period, production of additional Saturn V's after the original 15 vehicles are completed.

Placing the NASA Mississippi test facility in a standby status in 1971 after the final Saturn V test is completed this December, unless alternative uses can be found, and reducing the work force of the Michoud assembly facility in New Orleans to the minimum necessary to support future Saturn flights.

Canceling the Apollo 20 lunar mission and suspending production of lunar and command and service modules related to follow-on Saturn V vehicles.

Delaying the initial Skylab prototype space station flight by about 4 months, to late 1972.

Delaying the Apollo 18 and 19 lunar missions until 1974—after the Skylab missions are completed in 1973.

Rescheduling the Viking Mars missions from the 1973 launch window to the 1975 opportunity.

Slipping the launch of applications technology satellites F and G by about a year.

Canceling the NASA sustaining university program.

In taking these actions, we must plan carefully, and implement precisely, so that we retain the essential skills and programmatic building blocks that will be needed to execute the new U.S. space projects of the coming decades. We believe that the actions we have taken will lease NASA the capability we require to move forward in the 1970's, but we have left no margin whatever, and our resources are spread very thin.

REVISED APOLLO SCHEDULE

I would like now to return to the revised Apollo schedule. When we appeared before you last year, we were carrying out Apollo missions at the rate of five per year, leading up to our first attempted lunar landing. Our plans then called for reducing this rate to three per year once the first successful landing was accomplished, and we requested funding to continue at the rate through Apollo 20 in 1972. Our plans beyond Apollo 20 were still not firm, but we intended to continue production of the Saturn V launch vehicle beyond the fifteen initially purchased which carried us through Apollo 20. Later in 1969 the President's Space Task Group recommended a program which included, after Apollo 20, follow-on manned lunar missions beginning in 1974 at the rate of two per year. The Conference Report on Independent Offices and Department of Housing and Urban Development Appropriations for 1970 requested that further considerations be given to the then recommended lunar exploration program, in the light of total program balance and budgetary constraints. We have carefully reviewed this area as you requested.

Mr. EVINS. Thank you, Dr. Paine, for an overall view of the space program. This is a very comprehensive and excellent statement. I think it has given us a very good picture of your current thinking.

Gentlemen, I think it well at this point for us to have a general discussion on the space program.

Let me say for the record we commend our great space team, and talented men, for their achievements in space.

OFFICIAL REPORTS

We have come from behind and achieved the goal. In 1969 we landed men on the moon and safely returned them, which in the early days caused many of us to be skeptical. I particularly remember Dr. von Braun speaking with great confidence and assurance that this could be achieved and his prediction became a reality.

We have entered a new decade and our committee last year suggested that there be an overall review of the programs for the future. We have had two reports, the President's task force on space and the Vice President's report. One is called "The Next Decade in Space," by Dr. Lee DuBridge, who was before our committee yesterday. It is a more modest, conservative report than the other report called "The Special Task Group Report to the President." This was headed by the Vice President.

As we view it, the Special Task Group gives three options. You can go on a crash program to Mars, you can have a more modest approach, or a very conservative approach.

The task force is for the future and is very, very indefinite, very long-range. The other report, "The Next Decade in Space," calls for about the program that you are recommending in this budget. Is this correct?

COMMENTS ON REPORTS

Dr. PAINE. We are approximately in the middle program outlined in the Space Task Group report.

Mr. EVINS. Any comments on these reports will be appreciated.

Dr. PAINE. This report, "The Next Decade in Space," was published by the Space Science and Technology Panel of the President's Science Advisory Committee. It was one of the inputs which was submitted to the Space Task Group. Although the date on this is March 1970, it was actually submitted last summer and is one of the reports which was considered when the overall Space Task Group report was put together.

I believe the overall program which we are laying before you is consistent in direction with both reports, Mr. Chairman.

Mr. EVINS. Does this report, "The Next Decade in Space," differ in any respect from the program outlined in your 1971 budget?

In the course of establishing the NASA fiscal year 1970 operating plan and the fiscal year 1971 appropriation request, the administration concentrated particular attention on the question of the future pace and content of the Apollo program. The result is the program we are laying before you, which suspends further Saturn V production and lunar trips after Apollo 19. Instead of the eight lunar flights which were planned for 1970, 1971, and 1972, we now propose a series of seven flights at 6-month intervals ending in 1974. Further Saturn V production, and associated lunar spacecraft production, is being suspended. Canceling the orders for lunar spacecraft for Apollo 20 and associated measures have reduced Apollo funding requirements from $1.686 billion in fiscal year 1970 to $956.5 million in the budget before you. We do not plan follow-on U.S. lunar flights in the period immediately following Apollo 19 in 1974, although we expect to resume such flights in the late 1970's or early 1980's when the reusable space shuttle, space station are available with nuclear propulsion to reduce costs.

Thus we have reduced the pace of Apollo flights and limited their number to those flights which can be carried out with available hardware. As the remaining Apollo expeditions explore exciting and vastly different lunar sites, we will accumulate a wealth of new information about the moon, its origin, its history, and its future potential for man. In addition to the scientific and ultimately practical value of this knowledge, we will be adding to our understanding of the ways in which men can best operate in space, and capitalizing on the investment we have made over the past decade.

AUSTERE PROGRAM

Mr. Chairman, as this subcommittee proceeds to consider the NASA fiscal year 1971 budget request in detail, there is one point I would urge that you particularly keep in mind. The program we are laying out, is forward-looking but extremely austere. As an example of the constraints we will be operating under, you will recognize that we have no plans for U.S. astronauts to fly in space between the last Apollo flight in 1974 and the time when the space shuttle becomes operative in the late 1970's. Any substantial further 1971 reduction will further extend this gap in American manned space flight, and reduce other essential programs.

Speaking very frankly, the NASA fiscal year 1971 authorization and appropriation request is lower than the budget that my colleagues and I would prefer to be defending before you. However, we can move ahead in 1971 with a minimal sound program at this level. The

President has coupled his necessarily restrictive budget recommendation for fiscal year 1971 with a strong endorsement of bold long-term goals for the seventies, and we have every confidence that the austere fiscal year 1971 program will lead to substantial achievements in later years. The President's endorsement of our future goals is a vote of confidence in what we have accomplished in space and in what he is sure we can and will achieve in the future. I hope that we can also continue to count on your confidence and support, which has always meant so much to us and to the nation.

Mr. Chairman, this concludes my prepared statement.

FOR IMMEDIATE RELEASE MARCH 7, 1970

Office of the White House Press Secretary
(Key Biscayne, Florida)

THE WHITE HOUSE

STATEMENT BY THE PRESIDENT

Over the last decade, the principal goal of our nation's space program has been the Moon. By the end of that decade men from our planet had traveled to the Moon on four occasions and twice they had walked on its surface. With these unforgettable experiences, we have gained a new perspective of ourselves and our world.

I believe these accomplishments should help us gain a new perspective of our space program as well. Having completed that long stride into the future which has been our objective for the past decade, we must now define new goals which make sense for the Seventies. We must build on the successes of the past, always reaching out for new achievements. But we must also recognize that many critical problems here on this planet make high priority demands on our attention and our resources. By no means should we allow our space program to stagnate. But -- with the entire future and the entire universe before us -- we should not try to do everything at once. Our approach to space must continue to be bold -- but it must also be balanced.

When this Administration came into office, there were no clear, comprehensive plans for our space program after the first Apollo landing. To help remedy this situation, I established in February of 1969 a Space Task Group, headed by the Vice President, to study possibilities for the future of that program. Their report was presented to me in September. After reviewing that report and considering our national priorities, I have reached a number of conclusions concerning the future pace and direction of the nation's space efforts. The budget recommendations which I have sent to the Congress for Fiscal Year 1971 are based on these conclusions.

Three General Purposes

In my judgment, three general purposes should guide our space program.

One purpose is exploration. From time immemorial, man has insisted on venturing into the unknown despite his inability to predict precisely the value of any given exploration. He has been willing to take risks, willing to be surprised, willing to adapt to new experiences. Man has come to feel that such quests are worthwhile in and of themselves -- for they represent one way in which he expands his vision and expresses the human spirit. A great nation must always be an exploring nation if it wishes to remain great.

A second purpose of our space program is scientific knowledge -- a greater systematic understanding about ourselves and our universe. With each of our space ventures, man's total information about nature has been dramatically expanded; the human race was able to learn more about the Moon and Mars in a few hours last summer than had been learned in all the centuries that had gone before. The people who perform this important work are not only those who walk in space-suits while millions watch or those who launch powerful rockets in a burst of flame. Much of our scientific progress comes in laboratories and offices, where dedicated, inquiring men and women decipher new facts and add them to old ones in ways which reveal new truths. The abilities of these scientists constitute one of our most valuable national resources. I believe that our space program should help these people in their work and should be attentive to their suggestions.

(MORE)

A third purpose of the United States space effort is that of practical application -- turning the lessons we learn in space to the early benefit of life on Earth. Examples of such lessons are manifold; they range from new medical insights to new methods of communication, from better weather forecasts to new management techniques and new ways of providing energy. But these lessons will not apply themselves; we must make a concerted effort to see that the results of our space research are used to the maximum advantage of the human community.

A Continuing Process

We must see our space effort, then, not only as an adventure of today but also as an investment in tomorrow. We did not go to the Moon merely for the sport of it. To be sure, those undertakings have provided an exciting adventure for all mankind and we are proud that it was our nation that met this challenge. But the most important thing about man's first footsteps on the Moon is what they promise for the future.

We must realize that space activities will be a part of our lives for the rest of time. We must think of them as part of a continuing process -- one which will go on day in and day out, year in and year out -- and not as a series of separate leaps, each requiring a massive concentration of energy and will and accomplished on a crash timetable. Our space program should not be planned in a rigid manner, decade by decade, but on a continuing flexible basis, one which takes into account our changing needs and our expanding knowledge.

We must also realize that space expenditures must take their proper place within a rigorous system of national priorities. What we do in space from here on in must become a normal and regular part of our national life and must therefore be planned in conjunction with all of the other undertakings which are also important to us. The space budget which I have sent to Congress for Fiscal Year 1971 is lower than the budget for Fiscal Year 1970, a condition which reflects the fiscal constraints under which we presently operate and the competing demands of other programs. I am confident, however, that the funding I have proposed will allow our space program to make steady and impressive progress.

Six Specific Objectives

With these general considerations in mind, I have concluded that our space program should work toward the following specific objectives:

1. We should continue to explore the Moon. Future Apollo manned lunar landings will be spaced so as to maximize our scientific return from each mission, always providing, of course, for the safety of those who undertake these ventures. Our de decisions about manned and unmanned lunar voyages beyond the Apollo program will be based on the results of these missions.

2. We should move ahead with bold exploration of the planets and the universe. In the next few years, scientific satellites of many types will be launched into Earth orbit to bring us new information about the universe, the solar system, and even our own planet. During the next decade, we will also launch unmanned spacecraft to all the planets of our solar system, including an unmanned vehicle which will be sent to land on Mars and to investigate its surface. In the late 1970s, the "Grand Tour" missions will study the mysterious outer planets of the solar system -- Jupiter, Saturn, Uranus, Neptune, and Pluto. The positions of the planets at that time will give us a unique opportunity to launch missions which can visit several of them on a single flight of over three billion miles. Preparations for this program will begin in 1972.

There is one major but longer range goal we should keep in mind as we proceed with our exploration of the planets. As a part of this program we will eventually send men to explore the planet Mars.

3. We should work to reduce substantially the cost of space operations. Our present rocket technology will provide a reliable launch capability for some time. But as we build for the longer-range future, we must devise less costly and less complicated ways of transporting payloads into space. Such a capability -- designed so that it will be suitable for a wide range of scientific, defense and commercial uses -- can help us realize important economies in all aspects of our space program. We are currently examining in greater detail the feasibility of re-usable space shuttles as one way of achieving this objective.

(MORE)

4. We should seek to extend man's capability to live and work in space. The Experimental Space Station (XSS) -- a large orbiting workshop -- will be an important part of this effort. We are now building such a station -- using systems originally developed for the Apollo program -- and plan to begin using it for operational missions in the next few years. We expect that men will be working in space for months at a time during the coming decade.

We have much to learn about what man can and cannot do in space. On the basis of our experience with the XSS, we will decide when and how to develop longer-lived space stations. Flexible, long-lived space station modules could provide a multi-purpose space platform for the longer-range future and ultimately become a building block for manned interplanetary travel.

5. We should hasten and expand the practical applications of space technology. The development of earth resources satellites -- platforms which can help in such varied tasks as surveying crops, locating mineral deposits and measuring water resources -- will enable us to assess our environment and use our resources more effectively. We should continue to pursue other applications of space-related technology in a wide variety of fields, including meteorology, communications, navigation, air traffic control, education and national defense. The very act of reaching into space can help man improve the quality of life on Earth.

6. We should encourage greater international cooperation in space. In my address to the United Nations last September, I indicated that the United States will take positive, concrete steps "toward internationalizing man's epic venture into space -- an adventure that belongs not to one nation but to all mankind." I believe that both the adventures and the applications of space missions should be shared by all peoples. Our progress will be faster and our accomplishments will be greater if nations will join together in this effort, both in contributing the resources and in enjoying the benefits. Unmanned scientific payloads from other nations already make use of our space launch capability on a cost-shared basis; we look forward to the day when these arrangements can be extended to larger applications satellites and astronaut crews. The Administrator of NASA recently met with the space authorities of Western Europe, Canada, Japan and Australia in an effort to find ways in which we can cooperate more effectively in space.

* * *

It is important, I believe, that the space program of the United States meet these six objectives. A program which achieves these goals will be a balanced space program, one which will extend our capabilities and knowledge and one which will put our new learning to work for the immediate benefit of all people.

As we enter a new decade, we are conscious of the fact that man is also entering a new historic era. For the first time, he has reached beyond his planet; for the rest of time, we will think of ourselves as men from the planet Earth. It is my hope that as we go forward with our space program, we can plan and work in a way which makes us proud both of the planet from which we come and of our ability to travel beyond it.

\# \# \#

Dr. PAINE. There are a few differences. By and large the report was taken into account. This report, of course, was made by some of the Nation's scientists. In addition then to that. we have considered the input from the engineers, from the practical application end of the space program. We also considered our interests in aeronautics in putting together our total 1971 budget.

Mr. EVINS. Our program for the future is going to be bold but balanced, as I understand it, and it is going to include not only manned landings on the moon but major applications in space science investigations.

Did the scientists win out in this debate or did the engineers?

COMPROMISE FOR BALANCE

Dr. PAINE. I think the definition of a balanced program would reflect a compromise. We obviously are not doing all the things the scientists would like to do. We are not doing all the things engineers would like to do. We believe we have selected the best programs from each for the money and that the balanced program we have come up with is a sensible compromise, Mr. Chairman.

Mr. EVINS. In a way our country was frightened into the space program by the Soviets' achievement with sputnik, but we came from behind with bigger payloads and more achievements. We have landed men on the moon and the Soviets haven't achieved this as yet. How do we stand today compared with the Soviets?

Dr. PAINE. Mr. Chairman, I believe with the support which this committee and the Congress gave to the space program of the sixties, that we indeed have come from behind and we have now demonstrated to all the world that American technology in space, in American industry and government and universities fully has met the challenge of the Soviets and I believe surpassed them in many areas.

As you know, space programs are programs which are largely conducted on the ground for a number of months while preparations are made, at the end of which time suddenly very spectacular achievements appeared based on all the work that has gone before. We have every reason to believe now, Mr. Chairman, that the Soviets are in the final phases of preparations to unveil more powerful new systems for their program in the 1970's and although I think we do have a good superiority at the moment, I think that we will see some very spectacular output in the Soviet program in the months to come.

FUTURE APOLLO FLIGHTS

Mr. EVINS. The historic and succesful Apollo 11 flight of July 1969 accomplished the national goal and the Apollo 12 flight has even gone further. You have seven more manned space flights planned, two in 1970, two in 1971, one in 1972, and two in 1974.

Dr. PAINE. Yes, Mr. Chairman.

LUNAR ROVER

Mr. EVINS. You have a plan for increased mobility while on the lunar surface that you call Lunar Rover. This will allow man to move

around at great distance from the landing place. Is this within the plans of the 1970 manned lunar landings?

Dr. PAINE. Yes, Mr. Chairman; we plan to carry the first Lunar Rover on our Apollo 16 mission.

Mr. EVINS. Will this be assembled after landing, or is it planned to carry it up already assembled?

Dr. PAINE. It will be assembled but in a somewhat folded-up configuration and the astronauts will move it down from the lunar module, unfold it and it will be ready to go.

Mr. JONAS. What will drive it?

Dr. PAINE. It will be electrically powered. I think a good way to visualize it is that it is rather similar to an electric golf cart. In the one-sixth lunar gravity where everything weighs only a fraction of what it weighs here on earth, we wll get a good deal more battery power for a given weight.

Mr. EVINS. How fast will it go?

Mr. MYERS. About 7 miles an hour.

Mr. JONAS. They will go what distance from the craft?

Mr. MYERS. It has a maximum range of about 80 miles. It will not travel that far away. We are going to go distances that are just far enough that the man can walk back to the LM in case of trouble. We will probably go distances like 5 miles away from the lunar module.

Dr. PAINE. Within that 5 miles, we can make a circle.

ACTIVITIES IN THE 1970'S

Mr. EVINS. Apollo applications program employs a Saturn workshop, and an Apollo telescope mount. Then you refer to the space shuttle and station. These are pretty far-out plans for the future. Do you expect these to be achieved within the next decade?

Dr. PAINE. Yes, Mr. Chairman. As we look to the future and as we take the tremendous amount of American aerospace talent we developed in the sixties for the Apollo program, we are finding that we can indeed make plans that are fairly bold and yet accomplish these with some economy.

The 1972 launch of the prototype space station, which we call the Skylab program, for example, is being built within the empty rocket casing of the third stage of a Saturn V launch vehicle so it is a relatively simple project for us to adapt this to our Saturn V launch vehicle. At the same time, we are getting a great deal of capability built into this program which allows us to carry the solar telescope which you mentioned and to perform what we think are going to be extremely significant experiments for man's long stay times in space. We hope to be able to visit it first with three astronauts and stay for a period of 1 month. We hope after a month in between missions to send up another crew which will be able to stay for as long as 56 days in orbit and then after another delay, a third crew for the same 56-day period, providing we don't encounter any difficulties.

This will go a long way toward teaching us the effect of weightlessness on a man and indeed on living systems for long periods. At the same time, I think it will give us the basic design parameters we need to proceed with the space stations that we will be flying later in the seventies and eighties.

SPACE SHUTTLE

Mr. EVINS. May we understand from your testimony, Dr. Paine, that the space shuttle is not supposed to be funded in the 1971 budget?

Dr. PAINE. In the 1971 budget we have program definition studies of both the engines and the vehicle for the space shuttle system. The space shuttle is as large an advance over the Apollo system as the DC–3 was over the Wright brothers, I believe, Mr. Chairman. It is a way of practically moving men, supplies and equipment back and forth from space to the ground. It is going to require us to do the very ultimate in rocket engines. We are going to have the highest specific impulse you can get with chemical fuels. At the same time, we have to provide this with ultra-light-weight structures, high performance aerodynamics and we have to solve the entry problem in a way that will give us a vehicle that can be used many times.

SPACE STATION FUNDING

Mr. EVINS. Is the space station included in 1971?

Dr. PAINE. It is in the program definition phase, also. There is no decision to go ahead on either project contained in the 1971 budget.

Mr. EVINS. Does that also apply to the telescope mount?

Dr. PAINE. No; the telescope mount is a part of the Skylab program which has previously been approved and this is in the advance hardware stage. This is pretty well along now, and we are preparing for launch in 1972.

Mr. EVINS. I thought the telescope mount went on the station?

Dr. PAINE. No; the telescope mount we are referring to here will be a part of the Apollo applications or Skylab program which is a prototype space station. Perhaps that is why I gave you that impression. This telescope mount is down at Huntsville now under advance test and is very well along.

LUNAR ROVER

Mr. EVINS. Is the Lunar Rover in your 1971 program?

Dr. PAINE. The continuing funds for the Lunar Rover are in the 1971 program; yes, sir.

Mr. EVINS. The Lunar Rover and the telescope mount are in your 1971 program, but the space station and space shuttle are not except for the program management and planning?

Dr. PAINE. Precisely.

Mr. EVINS. Very good.

FUTURE APOLLO MISSIONS

Mr. JONAS. You said you were going to use the Saturn V for a mission different than that originally planned. How many of these 15 Saturn V rockets that you say we have on hand, virtually paid for, are complete, or how many could be converted?

Dr. PAINE. I can give you a complete rundown of where these are, but you will notice that I mentioned we would complete the 15 Saturn V vehicles, but the last mission to the moon will be Apollo 19.

We are pulling out of the line the one we planned to use for Apollo 20 for this reconversion, and that will be the Apollo applications rocket.

Mr. JONAS. The reason I ask this question is that you are going to have to make a pretty good record here to show the necessity of making these seven additional manned landings, because I hear the argument on all sides: Well, we have gone to the moon now twice and made our point and there is not any reason to risk any more lives until we make all of the studies that can possibly be made with unmanned flights.

Somewhere along the line, today or tomorrow, you need to put in your strongest pitch showing the necessity for this.

REASONS FOR ADDITIONAL LUNAR LANDINGS

Dr. PAINE. We have prepared to do that, Mr. Jonas. I think that the value of the flights that we are proposing to make to science is very clear to many experts in the field. In fact, I have a letter from the prestigious American Geological Society making a very strong point that we are learning not only about the moon, but also a great deal about the origins of the earth, carrying out studies which can't be carried out here on earth and we would be very glad to develop this further for you in our testimony.

Mr. JONAS. Last year you defended the idea of continued landings by using the analogy of the United States, that you can't find much out about the United States if you only visit New England. You need to visit California, and Michigan.

Mr. EVINS. And North Carolina and Tennessee as well as Pennsylvania.

Mr. JONAS. And Virginia.

Now, we are going to have to defend this again on the floor and we need you to furnish the ammunition.

Dr. PAINE. Fine. We are going to give you a good deal of testimony on the space flight program and upon the exploration of the moon.

SUCCESSES WITH SATURN V

Mr. EVINS. Supplementing what Mr. Jonas said, there was some thought that you were going to have a misfire and waste a few rockets and this is the reason you over ordered all these big Saturns that Dr. von Braun produced. But you were successful and didn't waste or lose them and now you have a surplus. It would be uneconomical not to utilize the surplus in stock. Just to mothball and put them in storage would be costly, wouldn't it?

Dr. PAINE. It would, but we can fully justify these flights to the moon on the basis of the flights themselves. It is not a scientific WPA project to use up old rockets, although the argument which goes that we did, in our original order of 15 rockets, prove to be somewhat conservative, is correct. Very frankly, we had no idea we would be successful with No. 5.

Mr. EVINS. It proved to be an overpurchase, did it not?

Dr. PAINE. Looking back to where we were before we made the first lunar landing, the purchase of 15 vehicles was a very wise decision. We

have been fortunate in our Saturn performance. It has outperformed many of our previous development systems. The fact we were able to land with Saturn No. 5 is certainly, I think, a great tribute to the people's work.

MEN AND INSTRUMENTS NEEDED

Mr. EVINS. It is your thinking that we need not only manned landings, but scientific applications as well; that we can't get all this information from computers, television cameras, and instrumentation isn't that right?

Dr. PAINE. That is correct, Mr. Chairman.

Mr. EVINS. There was a school of thought that we could prevent hazard to lives and get all this information by instrumentation. Do you deny this?

Dr. PAINE. The program we are carrying out could not be carried out without men on the surface of the moon and although the hazard to lives is an undoubted fact—these are risky missions that we fly—nevertheless, we have taken every possible precaution to make them as safe as modern science and technology can possibly make them. I assure you we will leave no stone unturned to keep the fine safety record we have had.

Mr. JONAS. When you ordered the 15 there was, of course, no certainty as to whether you wouldn't require the use of the 15.

Dr. PAINE. All 15 or even more, Mr. Jonas, yes.

Mr. JONAS. Now that you have succeeded without using all 15, tell us whether you are planning to use even more for manned landings.

Dr. PAINE. Yes.

USE OF SATURN V ROCKETS

Mr. JONAS. That leaves eight. Now, when was the decision made to use the eight for other purposes.

Dr. PAINE. We ordered 15 in the original buy and this decision goes back to about—Wernher, do you remember when that was made? It would be 1963 or 1965?

Dr. VON BRAUN. 1963.

Dr. PAINE. This was long before the program. We had to determine how many to order and we decided to order 15 many years ago. When it came time to test the first of the Saturn V rockets, there was some question in our minds whether we should take parts of these 15 and shoot them up one at a time, testing each part. Instead of doing that, we made the decision that, based on all of the ground testing which had been done in many places around the country, including the State of Tennessee, that we were prepared to test all of these in one major test, which would put all of the rockets into flight at once. And so we did indeed, in our first Saturn V launch, put all of the components together and we were able to get a successful test with only one vehicle of the 15 in an unmanned flight, and able to move much further along than we had thought we would be able to previously when we had ordered the 15 vehicles.

We then launched the second of our Saturn V's in the second unmanned test and in the course of this flight we encountered a number of problems. One of the problems we encountered was a tearing off of parts of the outer skin of the rocket. Another problem we encountered

was a disconnection of a line that carried propellant into the top of an engine and that caused that engine to shut down. We also encountered an additional problem in the adjacent engine due to the wiring such that both engines were shut down. When we got into orbit, despite these two failures—really, I should say three failures—and attempted to re-ignite the third stage of the rocket, we had the same problem of this propellant-line tearing away which prevented refiring, so we were unable to get the kind of test of the third stage we had expected to get.

THIRD SATURN V LAUNCH

That was in our second unmanned launch. At that time there was a serious question in our minds whether on the third launch of the Saturn V we would be prepared to put a man aboard. It was only after a very intensive review in which all of the top talent within the space agency and indeed from the American acrospace community, all of the top talent that could be brought to bear were applied to the problem, that we decided, indeed, on the third Saturn V launch we would be prepared to put men aboard.

Now, in the meantime, in October 1968, we launched one of our smaller Saturn I–B rockets with a command and service module of the kind designed to carry men to the moon, and it was proved out in Wally Schirra's Apollo 7 flight that we were indeed ready insofar as the spacecraft was concerned.

APOLLO 8

We therefore made the decision that at the end of 1968 with the launch of our third Saturn V rocket that we would put Frank Borman and his crew aboard it, that it was safe to fly it manned, that we understood all of the problems we encountered on the second flight and, indeed, we were so confident we understood these problems that we would plan a possible mission to go out into orbit around the moon at Christmas in 1968, providing that all parts of the Saturn V worked in a flawless manner. And, indeed, as you know, this did prove to be the case. We were able to go out around the moon in the Apollo 8 mission at Christmas, 1968, and this was the third time that we had launched a Saturn V rocket. We had no idea earlier in the program when we had ordered these rockets that we would be that far along with only our third launch.

APOLLO 9 AND 10

With our fourth launch, we put into earth orbit for the first time the lunar module together with the command module and for the first time flew men in the lunar module, exercising in earth orbit to prove when we got it out to the moon that it would be able to fly in space as we expected.

That was the fourth Saturn V launch. On the fifth Saturn V launch, we debated whether we were ready for a lunar landing on the surface and decided it was premature, we were not ready but well down the road, so we took with the fifth Saturn V the command module and the

lunar module out to within 60 miles of the surface of the moon, orbited the moon and then detached the lunar module with two men aboard and brought it down within about 15 miles of the surface of the moon, not making the final touchdown, but going through the entire landing operation. That was with our fifth Saturn V rocket.

APOLLO 11

Then with number six we were able to say on the basis of all of these successes to date that we were ready to make the first landing attempt and this, of course, was our Apollo 11 flight in July, last year.

Again, even at the time we made the attempt, we were not certain it would be successful, but the systems performed flawlessly and due to the tremendous amount of dedication on the part of everyone who had worked on these systems—which I think was a very important factor in these successes—that we were able to get down with that vehicle numbered six.

SATURN V DIVERTED

This left then the rest of the 15 available to us. The decision that we are now proceeding with is to pull one of these remaining initial 15 purchased out of line for the launch in 1972 of the Apollo Applications workshop project, using the third stage, refurbished for the actual laboratory and using the first two stages to launch it into orbit. We will use the other seven rockets for the purpose of the final seven trips that we will make to the moon with the Apollo system, pending some future decision.

Mr. EVINS. Which one will you use in April?

Dr. PAINE. Thirteen.

Mr. EVINS. I mean what numbered rocket?

Dr. PAINE. No. 8 of the original purchase of 15.

Mr. JONAS. That will leave you seven.

Mr. SHAPLEY. Six more will be for Apollo and the seventh for the Skylab.

Mr. JONAS. Can you use any of the remaining six in the same way you plan to use the seventh, by remodeling the insides of the carcass?

Mr. SHAPLEY. Yes; this is a possibility and we have alternate plans, Mr. Jonas, in which we are examining that possibility. At this time we don't believe that is the recommendation we would make, but we are studying this very carefully and it is not impossible that at a future time we might propose that.

Mr. JONAS. I understand your recommendation, but I wanted the record to show whether it would be possible.

Dr. PAINE. Yes; this would be feasible.

SATURN V PRODUCTION

Mr. JONAS. How far are you along with these rockets?

Dr. PAINE. They are virtually completed and are going along in final testing.

Mr. JONAS. How about the development of the inside of the rocket?

Dr. PAINE. In connection with our Skylab project, which is our process in NASA, we are preparing some backup equipment in case we have difficulties and lose that one.

RUSSIAN LUNAR FLIGHT

Mr. McDade. On this description you just gave us of the moon flights—I guess at the time of the last one the Russians had a launch at the same time. Can you tell us anything about what the Russian launch at the time was attempting to do?

Dr. Paine. It is very difficult for us to give you an authoritative and definitive statement. We can merely say what we suspect based on the orbit they reported and on the maneuvers which they carried out. Our best guess is that this was an attempt to soft land a package on the surface of the moon, which may have contained scientific instruments which would send signals back to earth, or it might possibly have contained a small rocket to scoop up a sample and send that back to earth. We don't know which of these possibilities is the case and they haven't said.

Mr. McDade. But the mission was apparently a failure?

Dr. Paine. The landing apparently was a crash landing instead of the soft landing which they had hoped to achieve.

Mr. McDade. Now, recently we saw some indications they had launched two vehicles rather closely together and there was some speculation. Can you give me any indication about what you believe the Russians were attempting at that time?

Dr. Paine. I believe the Russians published statements on this which are probably fairly reliable and their statement was that they launched two within 24 hours and then they launched a third one within another 24 hours, which is incidentally a very good feat of launching. They brought the three vehicles very close to each other. Their statement was that these were precursor experiments for the construction in earth orbit of a space station and that the experiments which they carried out with the three spacecraft were successful and represented a step toward this long-stated Soviet objective of a space station.

TRACKING CUTBACKS

Mr. Jonas. Have we lost some of our tracking ability in the vicinity of the Indian Ocean?

Dr. Paine. We have decreased our tracking capabilities in the period after our successful lunar landing for economy reasons. We have laid three of our four tracking ships up. We have reduced the number of our tracking aircraft and we have shut down some of our tracking stations around the world.

In our testimony later Mr. Truszynski will describe to you the current status of our tracking system.

Mr. Jonas. We haven't lost any tracking facilities by Government action?

Dr. Paine. We have lost no tracking facilities through Government action. In fact, the NASA worldwide space tracking network that we have many international agreements on, I believe, represents one of the finest examples of intergovernmental cooperation we have. We have been enthusiastically received and we have had no difficulties.

ASSESSMENT OF SOVIET PROGRESS

Mr. McDade. These Russian missions we were discussing—will you refresh my recollection? How does the present state of the Russian rocket craft compare to ours at the present time?

Dr. Paine. With your permission, perhaps I could refer that question to Dr. von Braun who can speak with great authority on it.

Dr. von Braun. So far there is no evidence that the Russians have launched a vehicle of the payload carrying capability of the Saturn V. However, there seems to be some evidence that the Russians are working very hard on the development of the vehicle that may even exceed the Saturn V payload capability. This vehicle, however, to the best of our knowledge, has not yet flown.

The vehicles actually used in this space station experiment you were referring to were three spacecraft which flew simultaneously and were launched by a rocket approximately of the power of our Saturn I–B. It can carry three men into earth orbit, including enough consumables to sustain these men for many days. I think they spent up to a week in orbit, and it could very well be that the payload even would have sufficed to extend that stay time to several weeks.

I would like to add to what Dr. Paine has just said about the significance of this recent simultaneous flight of three of these men. The Soviets have repeatedly stated that they never intended to dock these vehicles, so any interpretation made in Western newspapers to the effect that the experiment apparently was a failure because they attempted to dock and didn't dock, is something that the Soviets have refuted repeatedly. They said they have demonstrated their capability of docking before and the purpose here was not to dock. They even alluded to the fact that they conducted simultaneous earth-related measurements from these spacecraft that were in close proximity but not mechanically docked together.

USE OF EARTH SENSORS

Mr. McDade. Do you have an individual judgment about what they were trying to do in the last mission and whether or not it was a success or failure?

Dr. von Braun. I can only go by their own statements and they said one of the measurements they conducted referred to measurement on snow accumulation in the Soviet Union. To see if they can measure snow thickness by measurement from orbit.

There is, of course, some doubt whether they were just interested in snow, but it would indicate they were experimenting with earth sensors very much of the kind we are using in our earth resources program.

SOVIET SPACE STATION CAPABILITY

Mr. McDade. Have they the ability to put together a space station with their present rocket capability?

Dr. von Braun. Had they docked these three units together, this would have been a very sizable space station. And having nine men simultaneously in orbit, they have the crew complement there also, and their docking capability, as such, has also been demonstrated;

so I think the answer is yes, they have the capability of building a space station. They have actually demonstrated it. I think in this field they are ahead of us.

Mr. McDade. Thank you, Mr. Chairman.

BIOGRAPHIES

Mr. Evins. Dr. Paine, maybe we should hear from some more of your key personnel in addition to Dr. von Braun. You have George Low, Dale Myers, and Dr. Gilruth here. We would like to hear observations from all of these distinguished gentlemen. I suggest you put in biographical sketches on these new men.

(The information follows:)

BIOGRAPHICAL DATA OF GEORGE M. LOW

George M. Low was born in Vienna, Austria, on June 10, 1926. He came to the United States in 1940 and became a naturalized citizen in 1945. During World War II he served in the U.S. Army from 1944 to 1946.

Dr. Low attended Rensselaer Polytechnic Institute, Troy, N.Y., receiving a bachelor of aeronautical engineering degree in 1948, and a master of science in aeronautical engineering degree in 1950. In 1949 he married the former Mary Ruth McNamara of Troy, N.Y. Dr. and Mrs. Low have five children—Mark, Diane, David, John, and Nancy.

PROFESSIONAL CAREER

Dr. Low's entire professional career has been in Government service. He joined the National Advisory Committee for Aeronautics (NACA) as an aeronautical research scientist in 1949. At the NACA's Lewis Flight Propulsion Laboratory in Cleveland, Ohio (now NASA's Lewis Research Center), he specialized in experimental and theoretical research in the fields of heat transfer, boundary layer flows, and internal aerodynamics; he published many reports in these fields. While at the Lewis facility, he was named head of the Fluid Mechanics Section, and later, Chief of the Special Projects Branch.

In October 1958, when the National Aeronautics and Space Administration was organized, he transferred to its headquarters in Washington as Chief of Manned Space Flight. He was responsible, in headquarters, for the Mercury and Gemini programs and was chairman of the special committee that formulated the original plans for the Apollo manned lunar landing. His last position in Wasington was that of Deputy Associate Administrator for Manned Space Flight. In that position he was responsible to the Associate Administrator for manned space flight in the management of the Gemini and Apollo programs and the field centers directly associated with those programs.

In February 1964 Dr. Low transferred to NASA's Manned Spacecraft Center in Houston, Tex., as Deputy Director. As the Center's general manager, he had overall responsibility for the Gemini, and Apollo spacecraft efforts, as well as future program development, flight operations and flight crew operations. In April 1967 he was named manager of the Apollo spacecraft program. Under his leadership the Apollo spacecraft was made flightworthy after the fire of January 1967. He also played a leading role in planning and executing all of the Apollo missions and originated the plans for Apollo 8, the first manned lunar orbit flight. During the time Dr. Low directed the program, five manned flights were flown, including Apollo 11, the first manned lunar landing in July 1969.

In November 1969 Dr. Low as appointed Deputy Administrator of NASA by President Nixon.

PROFESSIONAL ACTIVITIES, HONORS, AND AWARDS

Dr. Low is a Fellow in the American Institute of Aeronautics and Astronautics and in the American Astronautical Society.

In June 1969 he received the honorary degrees of doctor of engineering from Rensselaer Polytechnic Institute; and doctor of science from the University of Florida.

He also has received the following special honors:

NASA's Outstanding Leadership Medal in 1962 for his contributions to Project Mercury.

Arthur S. Flemming Award (Ten Outstanding Young Men in Government) in 1963.

NASA Distinguished Service Medal, for his contributions to the Apollo 8 manned lunar orbit mission in 1969.

Paul T. Johns Trophy from the Arnold Air Society, April 1969, for his outstanding contributions in aeronautics and astronautics.

1968 American Astronautical Society Space Flight Award in acknowledgement of his contributions to the advancement of space flight and space science.

NASA Distinguished Service Medal for his contributions to the success of the Apollo program, October 1969.

Louis W. Hill Space Transportation Award from the American Institute of Aeronautics and Astronautics for his leadership role in bringing the Apollo program to fulfillment, October 1969.

BIOGRAPHICAL DATA OF DALE D. MYERS

Dale D. Myers is Associate Administrator for Manned Space Flight, National Aeronautics and Space Administration. He assumed direction of NASA's manned space flight program on January 12, 1970. In this capacity he is responsible for the planning, direction, execution, and evaluation of NASA's overall manned space flight program. These functions include management authority over the George C. Marshall Space Flight Center, Manned Spacecraft Center, and John F. Kennedy Space Center.

Myers was born in Kansas City, Mo., on January 8, 1922. He was graduated from the University of Washington, Seattle, Wash., in 1943 with a bachelor of science degree in aeronautical engineering.

He joined North American Aviation in June 1943 as an aeronautical engineer and was project aerodynamicist on the F–82, XSNJ, and XFJ–1 airplanes. He developed the basic methods used by the company for stability and control analyses, including the effects of aeroelasticity on both dynamics and static stability.

In 1946 he joined the aerophysics department of North American, which was engaged in research and development of long-range supersonic guided missiles. He progressed through aerodynamics and flight test to assistant director of the aerophysics department in 1954. In 1956 he was named chief engineer of the newly formed missile division, and in 1957 became program manager for the Air Force Hound Dog missile. He was appointed vice president and program manager of the Hound Dog program in 1960. In April 1964, after a short period of advanced design, he became vice president and program manager of the Apollo command and service modules activities at North American Rockwell Corp., the company's present name.

Myers is a member of the American Institute of Aeronautics and Astronautics and of the American Management Association. In February 1969 he was awarded the NASA Certificate of Appreciation for his contributions to the Apollo 8 Moon-orbiting flight and in September 1969 he received the NASA Public Service Award for his contribution to the success of the Apollo 11 lunar landing mission.

Myers is married to the former Marjorie Williams, of Seattle, and has two daughters.

Dr. PAINE. Fine. Dr. Gilruth, as you know, is the Dean of our Center Directors, the head of the Manned Space Flight Center in Houston. Dr. Gilruth, would you like to comment on any of these questions?

NEXT SOVIET PROJECT

Dr. GILRUTH. I think it is quite interesting to speculate on what the Russian's next big thrust will be in manned space flight. I am sure they are going to make one. If I were they, I would surely go for the very large space station.

I had the opportunity to discuss with Feoktistov some of their thinking over there and they have many of the same kinds of problems that we have. They are wondering whether to go allout, to go to Mars, or whether they should go first with developments in earth orbit like our Skylab.

When they are talking to you, they are trying to get an idea of your thinking as much as anything else. I was interested though in the fact that they are considering a need for artificial gravity in their space station the same way we are. They are concerned about the fact that they have got to make the right decisions because in this game you have pretty well got to be right because you don't get very many chances because of the high cost.

DATA ON MAN IN SPACE

In regard to the question of the purpose of the three Soviet spacecraft that were put up with the many Russian Cosmonauts, one of their major purposes, as relayed to me, was simply to get more data on the behavior of man in space over longer periods of time. I was specifically told that they hadn't intended to dock all of these craft, but to get them up simultaneously and go through the rendezvous techniques, but simply to observe how their navigation equipment they were bringing together worked, and how the astronauts behaved, and how their medical qualities were in this sort of a mass-type flight.

I think that their major effort is going to be one of doing things in earth orbit with very large spacecraft. I think their rocket program tends to support this kind of a mission.

I don't expect to see the Russians go to the moon with men, at least in the next few years.

CONVERSION OF SATURN V'S

Mr. EVINS. Doctor, do you think we should convert more of the Saturn V's into workshops since we have plans in the future for space stations?

Dr. GILRUTH. I think that is a very important question and a very difficult question because at the present time we are learning so much for science from our trips to the moon that there is a great deal of pressure from the scientific community to continue these flights.

The payoff has been so great from the flights that we have made. However, I think it would be a great mistake to stop forevermore the production of Saturn V's because of the very great capability it gives this country. When I think of all of the work and very good work that was done over the past 10 years or so to produce this magnificent rocket for this country, I would hate to see all of the tooling and all of the plans scrapped, so that at the end of the decade in the early eighties we don't have the capability to put the large payloads into orbit that we can do with Saturn V.

I don't think you can just save them. I think you have to keep a capability to make them.

Mr. EVINS. I wasn't thinking so much of that. I was thinking since we are going into the workshop area you would need more than one; that perhaps there could be some further conversions along the lines Mr. Jonas suggested.

Mr. GILRUTH. I think as Dr. Paine said, this is one of the questions that is under very serious thought.

Mr. EVINS. Mr. Low.

12-MAN SPACE STATION

Dr. LOW. I would like to add a word or two about the discussion we just had about the Soviet achievement of the three manned spacecraft launched at 24-hour intervals. As somebody here pointed out, this meant they had nine men in space at the same time, which would represent a very major space station capability if they had perfromed the docking and had joined up with a space station module. This is the kind of capability that we are now studying in the space station effort that Dr. Paine discussed before. We are talking about a 12-man space station, not very large an extension over the number of men they have already had in space.

In our case, this will be only a study with no decision to move ahead until 1972 or later budgets. Insofar as our Apollo program is concerned——

VALUE OF SPACE STATION

Mr. MCDADE. Doctor, before you get there, could I stop you for a very fundamental question? What is the benefit of a space station? What difference does it make to the Nation whether you have one or not?

Dr. LOW. The space station would become the first true laboratory in space where we could perform experiments of all kinds—experiments to look out further into space with telescopes, with other devices to learn more about the universe, about us. We could look down from a space station, look down onto the earth and study better than we have been able to do so far, the earth's weather. We could study our national resources so that over a period of time we could understand how to better manage these resources so that as our population grows here on earth we will be able to get the maximum benefit in terms of agriculture, in terms of forestry, in terms of understanding our environment, our water, our air, all of the things around us.

The space station could be used as a laboratory in space in addition to looking up and looking down in that it would provide an environment which you cannot have here on earth; weightlessness, for example. We could study more about man and how man physically can work and thrive in this environment and perhaps understand more about man in this one gravity of earth by conducting experiments with man in space.

These are just some of the things. I am sure many of the people here could add much to that and perhaps I should pass to Mr. Dale Myers at this point and ask him to make additional observations on the subject.

Mr. EVINS. Mr. Myers, the Committee will be pleased to hear you.

BENEFIT TO THE ECONOMY

Mr. MYERS. Of course, as far as the Skylab is concerned, I am looking forward there to a real opportunity to see in the Skylab the beginning of experiments that really are in the earth resources area and have direct applications to the economy of the country.

We have experiments going in Skylab that are going to be useful in studying the whole spectrum, from the light spectrum, infrared up to the higher frequencies into radar, to give patterns of what is going on on earth's surface and looking at the resources of the country.

We think it would be important in terms of agriculture. We think it will be important in terms of fishing areas, for example. It does give us an opportunity here to use what I consider the most natural vacuum-packed environment we can get as far as experiments are concerned, to get more out of space in terms of both science and applications.

I think, going back to the Apollo program, the Apollo science that we are going to have in these additional flights is really significant. While I was in industry we were all driving very hard for that first lunar landing, but at the same time we were beginning to look forward to the time when we could begin to carry out scientific experiments with the Apollo program.

As you look at the detailed planning going into these additional flights, you will find expanding science outputs as we go on in these flights and we find we have the flexibility to make modifications to the science program as we learn more from these first, early flights to the moon.

DRILLING ON MOON'S SURFACE

For example, in Apollo 13 we are going to do some core drilling down to 10 feet below the surface of the moon. In that area we will be able to get a better idea of more virgin soil on the moon and also be able to implant a temperature measurement device so we can actually get some feeling as to whether there is a hot core to the moon.

With that kind of information, we will get more understanding of the relationship of the moon to the earth. Did the moon really get torn out of the side of the earth in the process of cooling of the earth or is it a conglomerate of material that was just collected in orbit around the earth? And, as we go into the later flights with the Lunar Rover program where we can actually move into much larger areas around the surface of the moon and land at these various different sites, we will be able to implant instruments which will make up a system of instruments on the moon and then the geologists will be able to get triangulation effects and really be able to understand more about the formation of the moon itself. I think that may be important to our understanding of the earth.

We are making studies of the possibility of an additional skylab and, as you point out, if we use the backup skylab as an actual skylab program, we must cancel one of the lunar flights to get the necessary Saturn V hardware.

Those studies are under way. The judgment is going to be a very difficult one because the scientific community is now finding that the output of science is tremendous from these flights, and 12 is just a major step forward from 11 as far as science output is concerned and the scientists are now extremely enthusiastic about the additional things that we have coming up in the Apollo program.

EXAMINATION OF LUNAR MATERIAL

Mr. EVINS. The scientist, at some 200 laboratories around the world, are now examining the lunar dust and rocks.

Dr. PAINE. We might ask Dr. Naugle to say something about the significance of the things we have brought back from the moon.

Dr. NAUGLE. Mr. Chairman, there have been a number of results that have already come out of the first two lunar landings.

Mr. EVINS. Spell it out for the record. Some Senator said we spent over $20 billion and all we got was a few rocks. What are we discovering from the examination of the rocks? What have been the accomplishments?

Dr. NAUGLE. We will certainly do that.

(The information follows:)

At this time in 1969 the success of Apollo 8 had placed us on the threshold of accomplishing the initial objectives of the Apollo program. In 1970 we can talk of the first manned landings on another body in our solar system and of the many important scientific results which are accumulating from these landings. Apollo 11 and Apollo 12 have had a major impact on a great many scientific disciplines and have prompted some scientists to state that we have witnessed the birth of a whole new field of science.

SCIENTIFIC RESULTS FROM APOLLO 11 AND 12

All of the scientific objectives of these two missions were met or exceeded, and the results obtained are considered to be very significant. Although much data are still coming in and detailed sample analysis of the Apollo 12 samples is just commencing, it is clear that the astronauts and the equipment which they carried on these missions performed excellently. One aspect of the missions which has not been generally emphasized in the crush of gathering data is that the astronauts have demonstrated that man can perform without undue difficulty as an efficient scientific explorer in this alien environment. Understanding more about man's capabilities and limitations has always been one of the objectives of our lunar program. Much of the scientific success of these missions is directly attributable to the resourcefulness and intelligence of the astronauts in carrying out tasks which required real-time changes in order to insure their completion. Removing the stuck fuel capsule on Apollo 12 is an example. Our experience on the missions to date bodes well for the increasingly ambitious missions we are planning.

To recap Apollo 11 briefly, the astronauts deployed three experiments, a passive seismometer, laser ranging retroreflector, and solar wind composition collector. In addition, 44 pounds of lunar material were collected and several hundred high quality pictures taken.

The passive seismometer recorded both natural and artificially induced events on the moon for 21 days. Eighty events, upon careful study, are believed to be natural events with the most likely causes being meteoroid impacts, near-surface moonquakes, or landslides in nearby craters. This is a much smaller number than would have been detected on earth during the same length of time with a similar instrument. At this time it is difficult to select a single model of the interior of the moon which best fits the experimental data. In any case, it is quite clear that the lunar interior, to a depth of several tens of miles, is markedly different from the earth.

Another objective of the lunar program is to find uses for the moon as a platform in orbit around the earth. An example of this is the highly successful laser retroreflector experiment. Ranging on the array has been accomplished by three different telescopes at Lick Observatory in California, Cambridge Research Laboratories in Arizona, and the McDonald Observatory in Texas. In addition, French and Russian observatories have made preliminary steps to participate in the experiment and inquiries from several other countries have also been received. This particular experiment is unique in this respect since any observatory in the world with the proper equipment can participate.

As a result of ranging by our observatories the relative earth-moon distance has been determined to an accuracy of about 1 foot—far greater accuracy than had previously been possible. As no degradation in the reflective properties of the array have been noticed after 7 months on the moon, continued ranging is expected to improve the accuracy to the goal of ± 6 inches. With this kind of accuracy it should be possible to measure the rate at which the continents are drifting and to determine subtle variations in the earth's rotation which are of

interest to the world's geodesists and geophysicists. There are recent indications that variations in the wobble of the earth's axis is associated with major earthquakes. It is conceivable that eventually this experiment may contribute to our ability to predict earthquakes. We hope to place two more laser reflectors on the moon in the span of the present Apollo program.

The solar wind composition experiment on Apollo 11 revealed interesting data even with the short exposure time of the foil to the sun's rays. The investigators determined that approximately 36 million atoms of helium are bombarding each square inch of the moon each second. Data obtained during the far longer exposure times of the identical foil on Apollo 12 and the 30-month exposure of the returned Surveyor 3 spacecraft pieces will add greatly to our knowledge and could indicate additional elements present in the solar wind.

In January 1970, over 1,000 scientists and engineers gathered in Houston to discuss the results of 3 months of study of the lunar material returned from Tranquillity Base; 24 other countries were represented. This meeting marked a milestone in the study of the moon with a majority of the world's scientists active in lunar study in attendance. No one who attended could have failed to detect an almost electric sense of excitement.

Perhaps the most important result of these studies has been the determination of the very old ages of the lunar material. Two distinct ages in the moon's history were revealed by the material returned from Tranquillity. What is considered to be a volcanic episode, about 3.7 billion years ago, is well documented in the crystalline rocks. A much older age of 4.6 to 4.7 billion years was found for the fine-grained material or lunar "soil". The interpretation of the older age of the "soil" is not straightforward, since the materials which were analyzed include fragments from unknown locations on the Moon thrown by meteorite impacts. Most of the rocks on the earth range in age from a few million years to about 500 million years. In a very few places, rocks as old as 3.5 billion years have been found, but none older. The lunar rocks are indeed a new experience for the world's scientists. The proposition supported by some scientists prior to Apollo that the Moon would reveal information on the early history of the solar system which we cannot possibly gather on Earth, has now been proven correct.

The chemistry of the lunar rocks is as interesting as their very old ages. They are similar in some respects to the lavas found in the Hawaiian Islands. They are in reality unusual combinations of generally common minerals although four new minerals have been identified. One of the most striking differences is the high titanium content which if found on Earth in the same concentration would be mined as titanium ore. Some elements like barium and zirconium are noticeably enriched in the lunar rocks compared with Earth rocks. More volatile elements, such as potassium, are much less abundant. Another significant observation from the chemical analysis has been evidence that water and oxygen were not abundant on the Moon when the rocks were formed.

Remnant magnetization has been found in the rocks. This leads to inferences that the ancient Moon may have had a magnetic field with a strength of a few percent of the Earth's field. The remnant field associated with the rocks having an age of 3.7 billion years either could have been induced at a time when the Earth and Moon were much closer together, or is the result of processes not yet understood.

In looking for clues to the origin of life, the search for complex carbon compounds, such as amino acids, in the lunar material was carried out with some of the most sensitive analytical techniques ever devised. No unambiguous identification of such compounds was made from the initial material. On Apollo 13 material will be gathered from a depth of 10 feet beneath the surface and subjected to similar analysis.

The Apollo 11 samples were collected from an area on the Moon's surface about the size of a garden plot. Nevertheless, they have given a vast new insight into the processes that have shaped the lunar surface and established some important limiting factors which must be taken into account in the future development of theories on lunar origin and evolution.

The mission of Apollo 12 was also an outstanding success from both an operational and a scientific point of view. In addition to the flawless functioning of the total system after a spine-tingling takeoff, the procedural changes instituted to accomplish a pinpoint landing worked perfectly and Conrad and Bean landed some 600 feet from their target, Surveyor 3. This was an extremely important advance in capability since future missions require accurate landings to maximize the science returns.

Whereas the Apollo 11 astronauts were able to work outside the lunar module (LM) a little more than 2 hours each, the Apollo 12 astronauts carried out two extravehicular activities (EVA's), each of 4-hour duration—an increase of over 200 percent in man-hours on the surface. The first EVA period was used to collect some representative lunar material, and deploy the Apollo lunar surface experiments package (ALSEP). The ALSEP was emplaced and all of the instruments were turned on. Data began flowing immediately and scientists on the ground were able to record the movements of the astronauts on the seismometer and the outgassing of their suits on the atmosphere detector. The lunar magnetometer immediately detected a magnetic field approxiamtely 10 times greater than expected.

Between EVA's, a ground team at the Mission Control Center checked the geological maps prepared for the landing site and recommended a traverse plan for the second period on the surface. This was passed to Conrad and Bean, agreed upon, and followed closely on the second excursion. This was an important step as we demonstrated that a scientific team on earth can work closely with the astronauts during a mission to increase the scientific returns.

The second EVA traverse took the astronauts more than 1,200 feet from the LM, at times out of line-of-sight of the LM, and covered in total of over 1 mile. During the traverse the astronauts encountered several different "soils", sampled and described a diverse variety of rocks and craters and, near the end of the EVA, arrived at the Surveyor 3 which had preceded them by 30 months to the lunar surface.

After extensive photography of and around the Surveyor, Conrad and Bean removed several pieces of aluminum tubing, the television camera, scoop, and a piece of electrical cable. They noted that the imprint of the Surveyor foot pad at its initial point of contact, from which it bounced to its final resting place, was still sharp and clear. The most noticeable change was that the color of the spacecraft had changed from white to light tan.

The return of Surveyor parts had always been considered as a possible bonus, rather than an objective of the Apollo 12 mission. We were delighted that the astronauts were able to accomplish all the tasks planned. The Surveyor parts are now undergoing extensive scientific and engineering analyses to determine the effects of the lunar environment over a precisely known time period. We will gain information in such areas as meteoroid flux, cosmic ray effects, changes to thermal paints, effects on electronic parts, motors, and lenses. These data may effect future designs of all types of long-term spacecraft and future equipment planned for use on the moon.

Distribution of the samples collected during Apollo 12 started on February 10. Extensive analyses will be done by scientific teams in 25 States and in 16 foreign countries (another example of the international flavor of the lunar program).

Preliminary analysis indicates some significant differences between the material from the Sea of Tranquility and that from the Ocean of Storms, even though both were mare regions. There is a much greater variety of rocks than observed in the first samples. Some of them are very coarsely crystalline (crystals larger than 1 inch).

Many of the rocks returned by Apollo 11 were classified as a breccia, a conglomerate of rock pieces stuck together. The Apollo 12 samples contained very few rocks of this variety. Most importantly, preliminary age dating indicates that the rocks from Oceanus Procellarum are about 1 billion years younger than those returned from Tranquility Base. This establishes another date of major lunar activity.

Differences in mineralogical and elemental composition were also noted. As an example, the titanium content of the Apollo 12 samples is generally lower, about half that of the Apollo 11 samples.

There seems to be no doubt that the predictions that the moon would exhibit diverse characteristics at different locations are being borne out. It is evident that the history of the moon as revealed in the memories of its rocks, has been very complex.

The ALSEP experiments being powered by nuclear energy also have been telling us much about the moon. We deliberately impacted the lunar module ascent stage on the surface after the astronauts were finished with it. The resulting signal at the seismometer showed the moon vibrated for almost an hour. Geophysicists have not seen anything comparable on earth and are having difficulty arriving at a model of the interior of the moon that would result in such a prolonged vibration. The discovery of the unexpected magnetic field at the

Apollo 12 landing site has led us to establish plans to carry a hand-held magnetometer on an early mission. Pinpointing the probable cause of such anomalies will be critical if we are to interpret the local and regional histories of the areas we intend to explore.

NEXT MISSIONS

One hears questions raised as to whether or not more Apollo missions are justifiable. Let's place our accomplishments in proper perspective. The moon is an area about the size of North and South America combined. On Apollo 11 we explored an area not a whole lot bigger than a basketball court; on Apollo 12 perhaps an area the size of a football stadium.

The broad strategy for determining the major characteristics of the moon calls for landings at sites that appear to be substantially different to study the different processes, and to determine the chronology of major events.

If we are to understand the spectrum of characteristics of the moon, we need missions to the highlands, the craters, the unexplained riverlike rilles and other unique features.

Apollos 13, 14, and 15 have essentially the same basic exploration capability as Apollo 12 except for the increases inherent in learning from each preceding mission. For these missions we can now confidently target to the most scientifically interesting site.

Respectively, the candidate sites for these missions are: The Fra Mauro formation, north of the Crater Fra Mauro; the Littrow area at the southeastern edge of Mare Serenitatis; and either the northwestern rim of the crater Censorinus, or the Davy crater chain.

The landing site selected for Apollo 13 is in a hilly and undulating upland region. This will be the first Apollo landing to other than a lunar mare. This hilly region has been designated as the Fra Mauro formation, a widespread geological unit covering large portions of the lunar surface around Mare Imbrium. The Fra Mauro formation is interpreted by lunar geologists to be an ejecta blanket of material thrown out by the event which created the massive circular Mare Imbrium basin 600 miles across—a major event in the history of the moon.

This interpretation gives rise to the expectation that material will be sampled from deep within the moon, perhaps from a hundred miles or more below the moon's surface. We hope that it will also be possible to date the Mare Imbrium event, believed to be a major impact. Perhaps it was the in-fall of a smaller moon, which was swept up in the primordial, accretionary evolution of the moon. Based on this theory, rocks from the Fra Mauro formation should predate the rocks returned from either Apollo 11 or Apollo 12 and be close to the original age of the moon. At the Fra Mauro landing site we will deploy another ALSEP. The prime new experiment of this ALSEP complement is a heat-flow experiment to be placed in holes drilled about 10 feet into the surface. The measurement of the heat flow originating from the interior of the moon is a fundamental geophysical measurement which is necessary to interpret the present internal constitution of the moon as well as its history and evolution. Material from the bottom of the hole will be analyzed very carefully for clues to the origin of life.

Another seismometer will be deployed to continue establishment of a seismic network on the moon.

Several other significant scientific operations are also associated with the Apollo 13 mission. For the first time we will purposely attempt to control the S–IVB trajectory after translunar injection to impact on the moon producing an artificial seismic event to be recorded by the seismometer. The S–IVB, anticipated to produce an impact 10 times the energy of the LM ascent stage, will be targeted to a point much further distant from the Apollo 12 seismometer than the ascent stage. The greater energy and the greater distance is expected to reveal new information on the moon's subsurface structure. As on Apollo 12 we also intend to impact the Apollo 13 ascent stage after rendezvous in lunar orbit. This objective is the same as that for the Apollo 12 mission with the added bonus of having two seismometers functioning simultaneously at different distances from the impact point.

Finally, on this mission we intend to carry out extensive orbital photographic tasks. We will photograph future candidate exploration sites where we feel additional photography will help us to plan the scientific aspects of the mission and insure that operationally acceptable landing sites can be reached. We will

also carry out dim-light astronomical photography of the solar corona, zodiacal light, and gegenschein.

Apollos 14 and 15 will be targeted to different types of geological regions on the moon. The candidate landing site for Apollo 14 is on the southeast edge of the Sea of Serenity, about 50 miles west of the crater Littrow. Mare Serenetatis is one of the very perplexing "mascon" basins which should be studied in more detail to understand their origin. These are areas of concentration of high density material in the circular seas, discovered in the tracking of Lunar Orbiter. In addition, the landing site has been selected to sample material which is thought to be about the youngest on the moon and to study a peculiar ridge structure which appears unique to the moon.

Apollo 13 photography will be an important input to the site selected for the Apollo 15 landing. The two candidates are Censorinus and Davy Rille. Censorinus is a small young crater in a region thought to be highlands and thus extremely old. Davy Rille appears to be an explosion crater chain. Earth analogs show that this type crater often exposes rock brought up from deep in the interior. The site is by a highland/mare contact so hopefully samples from the highlands would be returned.

For missions following Apollo 15 we will introduce a block change to the LM and CSM. Modifications to these spacecraft are already underway. Our ability to carry out scientific exploration on these later missions will be significantly improved.

Changes to the CSM will provide it with the capability to support lunar missions of up to 16 days total flight duration versus the present 10.7 days. The CSM will be able to deliver a heavier LM to lunar orbit. Both the payload to the surface and surface staytime will be increased. Additionally, modifications are being made to carry a scientific instrument module (SIM) in one bay of the service module. In the SIM we will be able to install a number of high priority orbital experiments. A total of 22 instruments have been approved thus far, although all may not fly. These experiments will permit us to obtain imagery as well as measurements in the fields of geochemistry, geodesy, geophysics, particles and fields, and atmospherics. We are developing and flying these experiments to obtain broad coverage of the moon, obtainable only with sensors in orbit, and to correlate the orbital data with information coming back from the surface experiments. This method of data gathering has been strongly recommended by several scientific advisory groups.

Modifications to the LM will also be completed by the Apollo 16 mission. Surface staytimes up to 54 hours will be possible. We expect total surface activities periods of 30 hours or more for the astronauts as campared with about 5 on Apollo 11. We anticipate carrying an ALSEP and a small roving vehicle on each flight.

The roving vehicle is now under development with delivery scheduled to support Apollo 16. This vehicle will carry two astronauts and 170 pounds of equipment for a total range of 80 miles. Operationally, we expect to make three sorties of 20 to 25 miles each. During the sorties, geological investigations, sampling, photography, and probably some geophysical measurements will be carried out.

The candidate sites selected for these later missions have been selected with the Rover in mind. They will involve the study of surface features and local problems which we believe can be usefully attacked within a radius of 3 to 6 miles from a designated landing point.

The specific sites for later missions are obviously less firm than those for the missions of the immediate future. Site selection is a continual process involving scientists and engineers both within and outside of NASA. A review is conducted after an assessment of each mission and when any important new information of either a scientific, operational, or engineering nature is received.

Briefly, our prime candidates for the later missions include the following:

1. Marius Hills: An area in which the variety of volcanic features and their similarity to earthlike volcanoes strongly suggests there has been intensive and prolonged volcanic activities. This will represent the westernmost point of our instrument deployment. This site of prime interest to the scientists but has been deferred to a later mission in order to insure that a roving vehicle will be available to carry out long-distance traverses.

2. Copernicus: A major crater in which the landing point would be on the crater floor near the central peaks. The crater is over 12,000 feet deep. The peaks are believed to be made of material brought up from a few miles below the surface.

3. Hadley-Apennines: An area which includes the Hadley Rille—one of the unexplained riverlike features made by some flowing material. With a pinpoint landing mare, highlands and this dry "river" bed can be explored. It is the most northern site presently proposed.

4. Tycho-North Rim: A major (over 50 miles in diameter), fresh impact crater in the highlands with apparent lava lakes and other unique surface appearances. It is the farthest site from the equator (42° S.) which makes it ideal for establishing a network for emplaced science, that is, seismometer and magnetometer, and for survey by the orbital experiments.

During the past year we asked the scientific communtiy to propose experiments to be carried on the later Apollo missions. The strong scientific interest in lunar exploration is indicated by the submission of 99 orbital experiment proposals and 142 surface experiment proposals. This is the largest number of proposals ever received by NASA for a set of missions. The number of good experiments exceeds, by a considerable amount, our ability to carry them. Only the best are being developed.

The program of lunar exploration we have outlined has been carefully distilled from the many recommendations and studies which have been produced during the last several years. A special study of the National Academy of Sciences conducted last summer took into account this past work and augmented it with the latest data available from Apollo 11. Their overall recommendation was to continue lunar exploration into the mid-1970's utilizing the Apollo system modified to provide improved capabilities we have just described. We are implementing almost all of their detailed recommendations.

LUNAR SUPPORTING RESEARCH AND TECHNOLOGY AND DATA ANALYSIS

Less apparent than the operational and scientific accomplishments of the Apollo Program, but nonetheless the cornerstone of the whole lunar science program, has been our program of supporting research and data analysis for lunar exploration.

Progress in science can be achieved only when the raw scientific data are placed in proper context—placed in perspective with the main body of scientific knowledge. Plans for gathering scientific data must be made in this same context. Thus, the data from a sound scientific program, such as we have, must be based upon and incorporated into a well ordered, developing body of scientific knowledge. To provide this body of knowledge and incorporate the new information into it, is the function of our supporting research and technology (S.R. & T.) program for lunar science and our companion program for data analysis. These programs provide balanced support through research effort in several science areas:

Earth-based observations of the moon to gather particular data on selected areas during critical periods (orbit, libration, lighting);

Study of selected earth features to better understand—and plan exploration of—similar type lunar areas (impact craters, lava flows);

Theoretical studies bearing on the origin, development, internal properties, and environment of the moon (thermal history, internal structure);

Laboratory simulation of likely, or potentially important, lunar surface and/or subsurface processes (effects of solar radiation, behavior of dust in a vacuum);

Meteorite and lunar sample analysis techniques and interpretation which bears upon the evolution of terrestrial and other rock bodies (support of meteorite research). (More than 40 Lunar Sample Principal Investigators were supported earlier in meteorite research).

Science experiment concept development, and definition of instruments appropriate for lunar mission applications, either in lunar orbit or on the lunar surface.

Advanced experiment concepts and associated instruments are not spontaneously created but rather evolve through an extended period of research and experimentation. Thus S.R. & T. effort several years in advance of a flight program provides the long lead time for significant flight experiments.

Data analysis is the scientific "payoff" for all our effort. The initial analysis of an investigation is accomplished by those scientists who, as principal investigators supported by flight programs, analyze their data during and soon after flight. However, much more is accomplished by additional analysis later, by these and other scientists drawn from the widespread scientific community,

supported under the data analysis program. One recent, fruitful source of data for such analysis was provided by Apollo 12, which brought back the Surveyor 3 camera and other parts for assessment of radiation effects and other environmental factors.

Analysis of lunar data from several flight programs continues, with attention centering on data from the Surveyor (nearing completion), Lunar Orbiter, and now the Apollo programs. In the analysis of Lunar Orbiter data, initial emphasis was given to photo analysis, bearing on selection of safe Apollo landing sites, and orbit analysis (gravity anomalies) bearing on Apollo landing trajectories. Attention will continue to be given to these analyses but with major effort directed also to scientific problems in these and other areas of the moon. For these studies the Lunar Orbiter data are supplemented by a wealth of new, high resolution Apollo photography, much of it in color, or selected parts of the lunar equatorial zone.

Added significance is given these analyses through their correlation with analyses of lunar samples and geologic exploration of the Apollo landing sites by the astronauts.

Analysis of Apollo scientific data, other than that done initially by principal investigators, will be a significant part of the fiscal year 1971 data analysis program. Such scientific data bear on the lunar surface environment, composition, physical properties, and also subsurface structure and properties. The results will be evaluated in relation to new facets of the earth's history and properties.

SUMMARY

The Apollo 11 mission dramatically demonstrated our ability to reach the moon, perform assigned tasks, and return safely. Apollo 12 made a pinpoint landing and the crew performed a substantially increased number of scientific tasks. The remainder of the Apollo missions are designed to take full advantage of this capability we have developed to broaden and deepen our base of scientific knowledge, to search for potential ways of exploiting the moon, and to gain valuable experience in space operations. To the scientist initial data returned have great significance in the search for knowledge of the origin, evolution, present characteristics, and historical relationship of the moon to the earth and to the solar system. There is evidence that we will learn much about the earth in studying the earth and moon as a system. The moon appears to be very nonhomogeneous. Sites are being carefully selected to provide us with the broadest possible spectrum of its characteristics. The seven remaining missions will exploit the Apollo system to the maximum considered prudent. Increased staytime, mobility, and payload to and from the surface are planned for the later missions.

The broad aim of the Apollo lunar exploration program is to gain as much knowledge about the moon as possible, in a limited number of missions. At some time in the fuutre we will ask whether further exploration or exploitation of the moon is justifiable. We want to provide the data to ensure that the proper decision is reached.

Dr. NAUGLE. I would like to say a word or two right now for your benefit, Mr. Chairman.

DIFFERENCES IN MOON MATERIAL

One of the major discoveries made dealt with the age of the moon. It is apparent that the rocks the astronauts brought back solidified about 4.5 billion years ago, which is about a billion years older than anything we have been able to date on the earth. They have found that the moon varies in composition from place to place. That is, the samples brought back from Apollo's 11 and 12, while they are very similar, it is very clear we are looking at material where there is no possibility of mistaking it for terrestrial rocks or anything of that nature. At the same time the materials from Apollo's 11 and 12 are quite different. The age of materials brought back from these two sites seems to be quite different. This is why we in the scientific com-

munity feel very strongly there should be additional missions to the moon and additional missions to different sites.

We originally felt that the material that would come back from the two sites would be very similar. We found major differences when we go to locations which from the earth look similar and from the orbit pictures look like they would be similar. When we go to sites like the highlands on the moon where we feel there will be significant differences, then we fully expect even more discoveries.

NEW MINERALS DISCOVERED

To continue on some of the discoveries which have been made already, the rocks that are there have been formed by melting and crystalization at very high temperatures on the moon. Water and organic compounds seem to be nearly absent. Several new minerals have been discovered. That is, minerals that don't exist on the earth. We found, surprisingly, a very weak lunar magnetic field, but much stronger than what we had expected on the basis of the orbital information we had.

This means that it is probably local and associated with the particular area where Apollo 12 landed, so we will want to go to other sites to confirm this.

The rocks we have also indicate that the magnetic field of the moon, a billion years ago, was much stronger than it is at the present time. So this could mean either that early in its history the moon had a much stronger magnetic field than it does now or that the moon was closer to the earth than it is at the present time.

"MOONQUAKE" VIBRATIONS

The natural moonquakes, if you will, the earthquakes or tremors on the moon, are very few and very weak. On the other hand, when they crashed the LM ascent stage into the moon, it triggered off oscillations which lasted about 50 minutes, which is about an order of magnitude longer than the effect a similar event would have produced on the surface of the earth. So it is very apparent that the moon's crust transmits vibrations quite differently than the earth.

From a scientific standpoint, one of the things that has come out very clearly is that the lunar material has recorded over 4.5 billion years of the history of the sun's activity and the sun's composition. That is, the particles that the sun ejects come directly to the surface of the moon and are trapped in the rocks. By analyzing the material and seeing where this material from the sun is located, you can tell what has happened over the years on the sun.

We have put devices on the moon which enable us to measure the earth-moon distance to about a 1-foot accuracy which, if you translated into a measurement on the surface of the earth, would mean that you could measure the distance from here to San Francisco to an accuracy of about an eighth of an inch.

AGE OF MOON

Mr. EVINS. You state in your justification that nearly all rocks on the earth fall within the age range of a few million to 500 million

years, with the oldest being about 3.5 billion years. Then you say the lunar dust in Tranquillity Base was estimated at 4.6 billion years. How do you make that determination?

Dr. NAUGLE. Mr. Chairman, we make that determination because of the fact that there are elements that are radioactive. That is, over a period of time they will emit a particle, or emit radiation and, in effect, change into another element. By measuring the ratio of two substances in lunar material, the older the material, the more of the decay product you will see. So by making these measurements you can indeed, if you have something which decays very slowly, over billions of years, you can actually measure it. This is an excellent technique that is used in doing this.

PLANT LIFE GROWN IN LUNAR SOIL

Dr. PAINE. I might just add one piece of information to what Dr. Naugle told you, Mr. Chairman, and that is the very unusual effects we have seen trying to grow plant life here on earth, in the samples of lunar soil we have brought back from the moon, in which it has been very clear that some unknown effects are taking place. Some samples of liver wort that we grow, for example, are about three times higher growing in the lunar soil than they are in the soil here on earth and we have yet to identify the agent or cause for this growth stimulation.

These are the kinds of things emerging from these investigations and we can put a more complete statement in the record.

Mr. EVINS. Mr. Giaimo, have you any general questions?

Mr. GIAIMO. I have one general one, Mr. Chairman.

Mr. EVINS. Go right ahead.

NASA COMMENDED

Mr. GIAIMO. First of all, I certainly want to commend NASA for the great successes which you have had in the past year. I think that after everything else that we do in this nation becomes part of history, all of us who have been privileged to live in this age are going to remember the great accomplishment which NASA and all of you gentlemen and your assistants performed last year. I think it is a great day not only in American history, but in the history of the world.

IMPORTANCE OF SPACE EXPLORATION

As we review the objectives of NASA, those of us who have supported it through all of the years and continue to support it, are being questioned more strongly today as to how we justify continued expenditures of billions of dollars in space exploration.

One only has to pick up any newspaper or read the speeches of many people in public life who are terribly concerned with our domestic problems and the struggle for the Federal dollar, to realize and recognize this.

I believe that this Nation must be in the forefront of exploration and pushing back the borders of human knowledge, and I wish you could spell out for us clearly and succinctly why it is so important that we don't let down our efforts in this area. Why in this particu-

larly difficult period of American history, where there is great concern to resolve many of the problems which face us on earth, why at the same time we must continue in the skies and in space.

I wish you would address yourself to that for just a few moments.

Dr. PAINE. Mr. Giaimo, it seems to me we ought to have an understanding of the difference between the kind of activities in this Nation which generate new wealth and the kind that more fairly distribute the money we already have.

In the budget that the President is sending before the Congress which we support, the increase in the welfare and social accounts last year is equivalent to two entire space programs, just the increase. This year we are increasing by about 2.5 space programs. If we were to completely discontinue everything NASA does and disband all of our people, I would submit in some of these earthly human problems that you wouldn't see the difference.

The kind of wealth we are generating and the kind of wealth that has made this a great Nation is a result of our being in the forefront of science and technology; by having advanced techniques in electronics, computers and aerospace that enable us to earn our living abroad in the world market.

AMERICAN AEROSPACE PRODUCTS

When you go to any airport in the world, you see the products of the American aerospace industry, and it is a fact that we are able to sell these to the nations of the world—and, incidentally, in the process employ more Americans at higher wages than many of the industries which are not competitive. So that when we buy textiles or electronics overseas, when we buy Scotch whiskey and Beatle records and French wine, we are paying for these through the advancing of our science and technology here in the United States—this is what makes it possible.

U.S. TECHNOLOGICAL LEAD

If we in the United States were to turn back from the technological lead we have built up over many years and fail to maintain the United States in the forefront, we would be like a surfer who so far has been riding on the curl of the wave very successfully, but if we let the other nations catch up with us in this regard, we will lose our momentum and balance in this wave. There is no question that other nations will be able to come in; our economy, our leadership, our competitive situation in world markets are very precarious things. They are based upon just about a 10-year lead. Any day that the IBM Corp., one American company, says "OK, we have reached the ultimate in computer design; from now on we are not going to bring out new and better models, we are just going to cost-produce what we already have," that will be the day that the Japanese computer designers will begin to develop the machines that will be sold in all the world markets, including the United States, replacing ours.

AMERICAN PRODUCTIVITY

Now, it is very important that our people understand the importance of this lead, and the tremendous productivity of the American working man. The fact that we have been able to keep inflation down to the level

we have is because of this great increase in productivity. I feel very strongly that the space program can take a great deal of credit, both for the performance of our aerospace industry and also for the performance of our electronic computer industry. About 45 percent of all NASA expenditures have gone into this general area.

ACTIVITY IN EARTH RESOURCES SURVEY

The fact that we have put up the communications satellites and that these are U.S. leadership items, the fact that we are going to be taking the leadership in this earth resource area—which I think will generate enough to pay for the whole space program probably, in later decades—these are the things we must continue to press. I think those voices that say, "Now, let's stop all of that laboratory work, let's stop all of these engineers," simply don't understand this.

Now, let me make one final comment: There is no program in the U.S. Government and maybe in the United States, that has outperformed the space program when it comes to meeting its accomplishments. And at the same time, there is no program in the U.S. Government that has taken the reductions that we have. In 1966 we had 420,000 Americans working. At the present time we have between 185,000 and 190,000 and I have just issued the orders to lay off an additional 45,000. So we will be down from our peak of 420,000, down to about 140,000, and yet the program that we are laying before this committee, I think, is a very effective and forward-looking program that will indeed lead to substantial achievements.

SUPPORT OF SPACE TEAM

It seems to me that the kind of team that we have put together that can carry out such programs in the face of this kind of austerity is one that deserves the support of the Nation and one that the Nation can really ill-ford to do without.

If we ever lose the things that NASA has brought to this Nation, we are going to be indeed in for some very dreary days, and eventually we won't have the wealth to fund many of these other programs.

NASA'S FUTURE

Mr. GIAIMO. I want to compliment you on that statement. That is what I was looking for. I agree with you. I think it is very important.

In view of the severe cutbacks in the budget, are we going to be able to keep NASA operating as a viable unit? Are we going to be in a position where we aren't going to lose the knowhow and the experience which we have earned and learned in the past?

Dr. PAINE. Mr. Giaimo, I would not appear before you and defend this budget if I did not think the answer was yes, but it is yes, on a very, very thin line indeed. As Dr. Gilruth mentioned, we are extremly reluctant, for example, to suspend production of our Saturn V launch vehicle. This is a vehicle that the American people have spent billions of dollars developing. We are suspending production at a time when we know the Soviets are working on the final stages of a rocket even larger, and we face the possibility that we will be going back to that earlier day which all of us remember so well, when the Soviets had major capability to put things into orbit, far heavier, with far greater performance than had the United States.

REDUCTION OF CONTRACTOR PERSONNEL

Mr. GIAIMO. When you spoke of a reduction in personnel, you were really speaking of a reduction in contractor personnel, weren't you?

Dr. PAINE. Primarily contractor personnel. In fact, in yesterday's Wall Street Journal you may have seen an announcement by North American Aviation of a layoff of 8,000 people in southern California. Primarly the people being laid off are the people that have been building the giant Saturn V systems. They are by and large the electricians, the plumbers, the metalworkers, the welders. They are primarily production people with a much smaller percentage layoff among engineers who are now beginning to convert over to space shuttle and space station studies.

Mr. GIAIMO. How much reduction has there been in NASA personnel?

Dr. PAINE. About 4,000 from our peak. We are down to around 30,000 now. You might ask, well, why haven't we taken more out of NASA? Of course, we did close down one of our centers this year.

Mr. GIAIMO. Was that the Electronics Research Center?

Dr. PAINE. Yes, the Electronics Research Center in Cambridge. We will be putting a test facility on a standby basis at the end of the year. When we built up to the peak, total employment, we did not correspondingly build up the NASA staff. This staff is the cadre of laboratory managers we need at the present time for the new programs of the seventies that we are beginning to develop.

When I say yes, we can hold the basic team barely together with this budget, it is that group and the key people in our contractors and universities that I refer to that we are holding together, but it is a very thin margin.

LAND RECOVERY OF VEHICLES

Mr. GIAIMO. I read recently in the paper where there may be need for a new flight center to replace Cape Kennedy so that you can have land recovery of vehicles. Do you know the article I am referring to?

Dr. PAINE. Yes. That is a somewhat exaggerated comment. At the present time we are conducting studies to determine the optimum launch sites, and there will probably be more than one for the future space shuttle system, if that becomes an approved program next year. We are reviewing Cape Kennedy and all the other areas because the launch mode here is somewhat different than in the past. Although we launch vertically as we do with current rockets, there is a horizontal recovery which requires a fairly extensive strip to land on, although it isn't much more than a modern jet airport, and in connection with where these should be located, we are looking at a number of areas. My guess is that the answer will come out that Cape Kennedy is a good site for this, but we are not trying to prejudge it yet.

BIOLOGICAL DISCOVERIES

Mr. GIAIMO. Some of the fallout information we get from the activities of NASA are interesting and I think should be pointed out. Recently I read about a space scientist having devised and demonstrated a theory that helps explain the source of uncontrolled malignant growth and indicates shortcuts to the development of chemical

countermeasures against cancer. The scientist was Clarence C. Cone, Jr., head of NASA's molecular biophysics laboratory at the Langley Research Center. Would you comment on that, please?

Dr. PAINE. This particular finding is a part of our more basic biological investigations and we were particularly interested in this case in the manner in which cell growth electrical charges appear on the surfaces.

In doing some primary work on this, some differences were discovered which have the possibility—and I wouldn't at this point say more than the possibility because this is very preliminary work—of accounting for the difference in the growth between cancerous and noncancerous cells. Interestingly enough, it may also throw some light on the fundamental aging process by which human tissue and people exhibit aging characteristics over the years. It is a very fundamental discovery and it is really a little too early yet to assess its importance, but it is a good example of the way in which the kind of research that we carry out which leads us very frequently into other areas where contributions can be made.

NUCLEAR PROPULSION

Mr. GIAIMO. We hear more and more discussions these days about the possibilities of new methods of rocket propulsion with particular attention paid to nuclear propulsion. What does the future look like in that area?

Dr. PAINE. We will testify in somewhat more detail on that later, but if I could be permitted to say just a few words. We have been testing our NERVA ground-based prototype of a nuclear rocket at our Nevada Test Station now for several years and the results to date indicate we have already been able to achieve twice the specific impulse that any other rocket system has even been able to achieve based on chemical energy. Specific impulse is the amount of thrust you get out of 1 pound of propellant and we have been able to double that in these tests. In addition to that, we have operated at full power for many minutes at a time now, have started it and stopped it many times and throttled it back and operated it at partial degrees of thrust.

I think the sum total of the experience we have had with this ground-based prototype indicates we are very much on schedule for a first flight of an American nuclear rocket for the end of the 1970's although probably not much before the end. The importance of this is that for missions outside of earth orbit, beyond earth orbit, missions to geostationary orbit or missions out to the moon, or indeed, later in the century even missions to the nearest planets, nuclear power will be a fundamental requirement and we feel that this is an area in which the United States very likely does have a lead. We feel that this program is a program that has a great deal to say about the future way that men will operate in space.

Mr. EVINS. Mr. Marsh, any general questions?

SAFETY PRECAUTIONS

Mr. MARSH. It is my understanding a substantial portion of our space program, to date, the costs, are associated with the costs of

manned space flight, a substantial part of which relates to the safety techniques that all of us want. Isn't that generally correct?

Dr. PAINE. The safety is built into the systems throughout. It is difficult to pull out the number, but reliability is also a very important thing in our unmanned program. I think it is probably about the same in cost there.

Mr. MARSH. Something that concerns many, many people that are interested in the space program, and this has concerned, I know, many citizens, and I know it has concerned this committee, is the danger of some possible accident which you have made every effort to guard against and the possibility of whether there are rescue techniques or capabilities that might be available. In these remaining flights of the Saturn V's, have you given some thought to the possible development of a rescue capability?

Dr. PAINE. We have looked at this and in this preliminary trip to the moon with the Apollo system we do not see a capability for rescue external to the system itself. The philosophy here is much the same philosophy we use in the modern jetliner where the passengers aren't issued parachutes, or in the modern submarine where, once the crew is submerged, the way they save themselves is by getting the submarine back up to the surface.

I think it is fair to say that the era of the space station and the space shuttle will be the first era in which we can say that we will have true rescue capabilities in space, but by the later 1970's, when those systems we expect will be coming onstream, we will at that time be able to effect a rescue of the type you refer to.

ENVIRONMENTAL PROBLEMS

Mr. MARSH. Mr. Giaimo pointed out the significance to the sixties of NASA's contributions, which I think are truly immense, and this suggestion that I make is not original with me, but it has been advanced that in order to come to grips with the environmental problems that we have here on earth—just recently the National Science Foundation was here and said we are really running at an oxygen deficit; we are destroying oxygen faster than it is being produced on earth—and being aware of the great capabilities of NASA and what you demonstrated was not simply putting a man on the moon as great as that was, but you also demonstrated the new techniques, systems, engineering, science, and combining all these great resources into an approach to achieve a great goal.

Suppose that NASA were to modify or to maintain its efforts and capabilities in space but were to be remissioned in the seventies with the assumption that by the eighties you would have come up with the answer to environmental pollution of air and water and the problems of the combustion engine where you simply change your mission or your thrust and it would use the same personnel in science and engineering to accomplish that mission of the seventies.

Dr. PAINE. That is an extraordinary complex question because it gets into many fields. Let me try to give a short answer to it.

I think the thing we demonstrated in NASA, with the ability to go to the moon and send the probes past Mars and develop an orbiting laboratory for astronomy, were all things which required advances in

the physical sciences and in technology, and we were going into new fields where we were free to operate with the support of this committee in a very flexible way.

When you get into the question of pollution, much of the science and technology we need to do a great deal about pollution already exists and has existed for many years. Problems often involve the entrenched institutions and who is going to pay for changes and how are we going to convert over to reduce pollution. There are so many local jurisdictions and regional problems involved that cross political boundaries that it would be difficult for NASA to effectively operate in these areas.

But having said that, at the same time, let me point out that I think NASA has many contributions to make to this area even within its present mission. As we study Venus, which has an atmosphere one hundred times as dense as that of earth; as we study the moon, which has no atmosphere at all; as we study Mars, which has an atmosphere one one-hundredth that of earth, and as we relate these studies right here on earth we are getting a much better feel for planetary atmospheres, their life, their evolution, how the interact, and in this way we can contribute much more fundamentally to an understanding of the problems of atmosphere and water pollution here on earth.

COMPARISONS OF ATMOSPHERES

We already have found some energy transport mechanisms in the atmosphere of Mars which we had overlooked as we studied earth because they are not so important here as they are in Mars. We are now able to modify some of our studies on earth with this new information.

I think the study of comparative planetary atmospheres which we can do over vast time scales in our planetary program is very important.

I say that because really it is only 500 generations ago your great, great, great, great, great, great grandfather, with 500 "greats," that we were in the last ice age in this planet. At the present time we are in a semiice age. We have an enormous part of the earth's fresh water piled up on the polar caps. If that ever melts—if Greenland ever melted and the South Pole, an awful lot American civilization would vanish under water.

The point is, I think we in NASA are getting fundamental understandings of atmospheric processes on large time scales. It has been mentioned we are bringing back rocks from the moon which show the long-time history of the output of the sun over billions of years. These are the kinds of things that are going to allow us to understand the balances between the sun, the earth, and the atmosphere around it in more fundamental terms.

WEATHER AND RESOURCES SATELLITES

Finally, the earth resource satellite program which we mentioned, combined with the weather satellites which are already aloft and have made great contributions in the first decade in space, I think will give us a much more fundamental understanding of the earth's atmosphere and will allow us to move ahead into much more sophisticated mathe-

matical models, using advanced computers, of the earth's atmosphere and interactions; and from this we will understand the fundamentals we need to understand on how best to go about curbing water pollution and air pollution. These space observations will give us more information about the phenomena and teach us more of the fundamentals needed to solve the problems.

POLLUTION FROM AUTOMOBILE ENGINES

If I can make a final comment, there is one other area which NASA has not addressed itself to and which in the long run may be something a NASA-like organization should undertake—perhaps in the Department of Transportation—and this is to ask the question, what density of motor vehicles can we allow in our urban areas, particularly those like Los Angeles, with local climate problems, and what would be the successors to the present-day automobile transport that would make it possible to have large individual transportation systems in the future that would not have the air pollution problem.

There are two lines of endeavor. One is to use the present chemical gasoline-like systems, and cleaning up the engines and fuels in such a way that you come up with a chemical solution. The other is to take a more radical approach and go to an all-electric computer-controlled system of some kind.

It is fair to say that this is not only a national problem but a world problem. Anybody who has landed in Tokyo or Santiago, Chile, or Mexico City, where they haven't seen Popocatepetl for some years understands that automobiles are a problem everywhere. If the United States indeed comes up with the successor system to the current type of automobile, I think there would be vast economic potential; I think we would go a long way toward seeing what kind of systems we can design in cities in the future.

That kind of problem, I think, is the kind of problem that a NASA-like organization, perhaps in the Department of Transportation is qualified to carry out, and I think we should be doing more work of that type.

AUTOMATED SPACE SYSTEMS

Mr. MARSH. Actually, with NASA's tremendous capabilities, had you been given the mission to do what the Soviets tried to do, to make a soft landing and pick up some moon rocks or dust and convey it back to the point of origin, you could have developed that type of vehicle, couldn't you?

Dr. PAINE. We could have developed that type of vehicle but let me make it very clear that we in NASA are very sympathetic to the problems that the Soviets have from time to time with their space systems because we too have had, and we still continue to have from time to time missions which don't succeed and this can happen to anybody.

Mr. MARSH. Right, but the point I am trying to make is that some of those things that are being done could be done by mechanization and automated type systems and without a manned landing to perform the mission.

Dr. PAINE. Yes, and what we find in general is that we will send a fly-by mission and a mission that crashes on the body as we did in the

Ranger program and this becomes more sophisticated and we put a soft, automatic landing down as we did with our surveyor program and as we learn enough from the automatic spacecraft that go before, eventually the man will develop the capability to go himself.

I think in the next hundred years or so, to take a very large view, this will be the general pattern of space research.

Mr. MARSH. That it will be more automated and instrumented?

Dr. PAINE. First automated and then followed by man after some period of years.

Dr. von Braun has used the analogy of arctic exploration where first we went in with sailing ships and dog teams and made a few traverses and incidentally had some losses in the early high-risk days, but we didn't really begin to go in with men on any scale until the development of the airplane and now you can fly to the South Pole almost on a regular scheduled basis, using modern aircraft technology. It is no great trick.

Mr. EVINS. Thank you, Doctor. I want to commend you again.

You point out that the space program creates wealth, goods, services, and technology that can be used to improve our society.

Will you elaborate again on what you said about cutting out the space program. If the space money was cut out, this money would not be diverted to welfare or any other program and we would be diminishing our wealth-producing capability.

INCREASES IN SOCIAL ACCOUNTS

Dr. PAINE. I wasn't speaking just of welfare alone. I was speaking of all the social expenditures, and I must say I heartily endorse these social expenditures. I think as a nation we certainly should be taking care of our people, but the point I was making is that it is also very important to know we are going to pay for these great social benefits which flow from these programs. In the last year, in 1970 budget, the total increase in the social accounts in the budget was the equivalent of two entire American space programs.

Mr. MARSH. The increases in social benefits in the budget were two and a half times that of the space program.

Dr. PAINE. In the 1970 to 1971 budget, it is 2.5 times.

Mr. MARSH. 2.5 times the increase alone?

Dr. PAINE. Just the increase is several space programs. My point was instead of increasing 2.5 space programs if we completely stopped NASA and increased by 3.5 space programs, on top of the total amount we have in these, you would hardly see the difference. And I don't think it would do the social programs, really, any appreciable good, and we would be losing some of the substantial future ability to pay for these programs, which NASA wealth-generating kind of research and development makes possible.

Mr. EVINS. Very good.

Mr. McDade, do you have a question?

SUPERCRITICAL WING OF AIRCRAFT

Mr. MCDADE. I was just going to ask the Administrator to focus on this a little bit for my education. The comment about the favorable U.S. balance of payments that results from our aeronautical industry.

You mentioned your responsibilities in connection with aeronautics generally, which I think are often overlooked, and you mentioned the supercritical wing as being an example of your contribution. Can you elaborate on that for me?

Dr. PAINE. We will testify a little more in detail on this when we review our aeronautics program but the supercritical wing is a basic new concept in the way in which air flows over a wing at speeds just below the speed of sound.

Now, as you know, all of our present commercial jets operate below the speed of sound, but they operate substantially below and this is because of the current aerodynamics of the wing structures and the fuselage.

What we have done in the super-critical wing is find a way to redesign the wing in a way that will allow these jets to fly substantially closer to the speed of sound, but amazingly enough, we have been able to do this in a way that at the same time doesn't increase the amount of drag and therefore the economies associated with it are also very substantial. So, by flying faster and with greater economy, we think we have a revolution here that may influence the design of all of our commercial jet aircraft. We will speak in a little more detail on this.

Mr. EVINS. We will suspend until 1:30.

Mr. EVINS. The committee will come to order.

We will resume our hearings with the National Aeronautics and Space Administration.

Mr. Jonas, I yield to you.

ELECTRONICS RESEARCH CENTER

Mr. JONAS. I had just one other question, Doctor. I don't recall whether you were present when we had the hearings over a period of several years about the Kendell Square deal. Some of us questioned the wisdom of embarking on that project and the way it was done. Now, I understand you are willing to release it because of budgetary reasons. How will it cost any less if some other agency of the Government operates it than NASA? You had finished construction?

Dr. PAINE. We had substantially completed a good deal of the construction. We had put some $24 million into the facilities and we have got about $26 million of equipment up there so there is about a $50 million total investment.

Mr. JONAS. While you are on that point, you can't tell us what the urban renewal part of that cost, can you?

Dr. PAINE. I can certainly furnish it for the record.

Mr. JONAS. You just told us NASA has an investment there already of $50 million. I would like to know what it costs to acquire the property which was acquired through an urban renewal program. You got the property without cost, but the taxpayers had to buy it and move a lot of people out.

Dr. PAINE. I will furnish that. We have that number.

(The information follows:)

We are advised by the Cambridge Redevelopment Authority, Cambridge, Mass., that the total cost of the approximately 29.2 acres of land involved was about $17.2 million. Of this, it is reported $1.5 million was absorbed by the city of Cambridge and about $15.7 million by HUD. In addition to acquisition, the above

costs include relocation, demolition, site improvements and related administrative expenses. Of the total of 29.2 acres only 14.3 acres have been transferred to NASA for which NASA has paid the Cambridge Redevelopment Authority $1,573,000.

Mr. JONAS. Did I understand you to say most of the construction is completed?

Dr. PAINE. Most of the construction is completed. We had just begun to move into the building at the time when the decision was made to terminate.

ERC EMPLOYEES

Mr. JONAS. What are you doing with the people you had on board who are in rented quarters?

Dr. PAINE. All the people who are there will either be terminated, or a small percentage transferred to other NASA facilities, in the event we don't find another Government use for the facility.

We have been working closely with the Department of Transportation to find out whether or not they can use this.

Mr. JONAS. I understand that is a possibility. I imagine they will run into the problem of finding money to operate it too.

Dr. PAINE. I really can't comment on that. They have been looking at this very closely, have been working with the Bureau of the Budget on it.

Mr. JONAS. Do you have any part of the building occupied?

Dr. PAINE. Yes.

Mr. JONAS. How many people do you have in it?

Mr. LILLY. Just a few hundred.

Mr. JONAS. The majority of your people are in rent space?

Mr. LILLY. Yes. We are terminating those leases and going in as fast as we can.

Dr. PAINE. We have some 700 people on board up there, 200 in the new facility and 500 in the rented.

COST OF LUNAR LANDING

Mr. EVINS. Mr. Administrator, a number of people have asked about the cost of the lunar landing and how it compares with the original cost estimate. Would you give us, in round figures, what the costs were and what the estimates were?

Dr. PAINE. We have some numbers that are fairly precise on that point.

Mr. LILLY. The original estimate to carry out the lunar landing, and assuming we would need all 15 vehicles, was a figure of just under $24 billion.

Mr. EVINS. That was your original estimate?

Mr. LILLY. No, sir, the original estimate was Dr. Dryden's estimate in a range between $20 billion and $40 billion and later revised down closer to the $20 billion. The first estimate we actually turned in at the request of Congress to accomplish the landing was at a figure just below $20 billion, $19.5 billion.

Mr. EVINS. You didn't have too much overrun then. You were pretty precise in your figures, as well as you were in your landing targets.

Mr. LILLY. Our actual costs—after the landing on the moon and taking in that full month—was at a figure of $21 billion. The $21 billion included $2 billion in hardware not yet flown.

Mr. EVINS. You had about a $2 billion overrun, purchasing more than needed to accomplish the mission; is that correct?

Mr. LILLY. I would not like to call that an overrun since our original estimate of just that $20 billion was made on the clear assumption there would be an Apollo applications program undertaken in the 1967 time period which would be sharing in the overhead and fixed costs. This did not occur and when that did not occur, Mr. Webb then changed the estimates to increase that estimate to $21.5 billion, as I recall.

PERFORMANCE OF CONTRACTS

Mr. EVINS. What have you to report as far as cost overruns are concerned with North American, Chrysler and Grumman? You have been dealing with these contractors for 10 years and are looking toward another 10-year program.

Mr. LILLY. Overall, Mr. Evins, I would say quite good. I think a lot of times people have misinterpreted the estimates of what a contract would cost, considering the first contracts awarded. For instance the original Apollo spacecraft contract would be a low figure but in the original contracting we were contracting just for the first flight article and we then made revisions of these contracts as we went on. There was some cost growth in some of our contracts. These occurred in the Lunar Module with Grumman and in the spacecraft contract with North American and some others and we had underruns in others. Overall, I would say the performance was quite good.

FUTURE COST OVERRUNS

Mr. EVINS. You have had overruns which have been reported to us by the authorizing committee. You should make more accurate estimates in the future based upon your experience for the past.

What steps are being taken, if any, with respect to future contracts and overruns?

Mr. LILLY. One of the most important things, in terms of estimating costs accurately, is to do the proper definition and design work and the trade-off efforts in our technology before we start trying to give precise estimates on development. The purpose of the money we have in this year for the space station and the space shuttle are principally to prepare our definition effort, and determine the unknowns to a point where we will be able to give what we hope to be improved or at least equally as good estimates as we had on the Apollo program.

EXAMPLE OF ESTIMATED AND ACTUAL COSTS

Mr. EVINS. Can you supply for the record specific amounts of the original cost estimates, the changes, and the final costs of some of your contracts?

Mr. LILLY. Yes, sir; we will be glad to.

(The information follows:)

Commitment for a manned lunar landing and return in the decade of the 1960's was made in 1961. Prior to that time there had been a number of Government study teams investigating various methods or modes of achieving the lunar landing and some in-house and contracted work in developing the technology. At the time the lunar landing commitment was made, there was considerable difference of opinion about the most efficient and economical manner for accomplishing the mission. Most of the technical experts involved agreed on the feasibility but there was no general agreement on the mission mode, the number of flights required, payload weight, etc. Three primary modes to achieve the lunar landing were being considered: direct; earth orbit rendezvous; and the one eventually selected, lunar orbit rendezvous. The mode in which the lunar landing mission was to be conducted was, of course, a major determinant of the entire space vehicle configuration and size, the launch vehicle payload capability, the need for a lunar module type vehicle and many other key program elements. Because of these uncertainties, as well as the thousands of others which depended upon their resolution, NASA could not initially give firm cost estimates. In April of 1961, NASA officials testified that the estimated cost of developing a manned lunar landing capability was between $20 and $40 billion. After intensive study, planning, definition and design effort, this estimate was refined, and in March 1964, NASA officials testified that the estimated cost "of developments, facilities, and operation necessary for the currently approved APOLLO program, which includes the manned lunar landing mission" was $19.501 billion. (See Hearings before the Senate Committee on Aeronautical and Space Sciences, NASA Authorization for Fiscal Year 1965, 88th Congress, Second Session, pp. 300 et seq.) This estimate was based on the assumption of timely initiation of follow-on programs which would utilize and share the cost of maintaining the development, test and operational capabilities built up by the Apollo program. The total program estimate was periodically updated as conditions and assumptions changed.

The actual cost accrued through the first manned lunar landing and return was $21.35 billion (July 31, 1969). Approximately $2 billion of this amount represents the value of flight hardware completed or in process and available for future flights. In addition, it includes capital assets of approximately $2.8 billion which are of continuing national value, such as the manned space flight centers; unique production, test and launch support equipment; the worldwide tracking communications and data acquisition network; instrumentation ships; etc.

The following table details the first definitive estimate made in 1964, the March 1966 estimate, the April 1969 estimate, and the actual cost incurred through July 31, 1969; a detailed breakdown for the April 1961 estimate is not available.

	Millions of dollars				
	April 1961 Estimate	March 1964 Estimate[1]	March 1966 Estimate[2]	April 1969 Estimate[2]	Actual Cost through July 31, 1969
Apollo spacecraft		$5,053	$6,642	$7,945	$6,939
Saturn launch vehicles		7,702	8,941	8,770	7,940
Engine development		1,190	1,053	854	854
Operations support		863	1,077	1,393	1,137
Total MSF R&D		14,808	17,713	18,962	16,870
Tracking and data acquisition		776	730	664	541
Facilities		1,664	1,773	1,830	1,810
MSF center operations		2,253	2,502	2,421	2,128
Total	$20,000 to 40,000	$19,501	$22,718	$23,877	$21,349
Flight Hardware Available					-2,000
Net Total					$19,349

1/Based on assumption of timely initiation of follow-on program.
2/Based on assumption that there would not be timely initiation of a follow-on program; also reflects the effects of program stretchout.

In arriving at the above estimates of total program costs, it was necessary to anticipate growth in the existing contracts as well as program requirements which were not yet on contract.

The national commitment for accomplishment of the manned lunar landing before 1970 required that major development contracts be let at earliest possible dates. This program was essentially one of research and development. As development proceeded, additional work as well as the costs associated therewith were specified and added to original contracts. In essence, NASA's management approach in executing the Apollo program was to

contract for increments of its intended program. Increases in initial negotiated costs in individual contracts resulted primarily from (1) modifications beyond the scope of the original contract; for example, additional spacecraft, stages, ground support equipment and spares, (2) technical and other contract changes that are necessary within the general scope of the original contract, and (3) adjustments in estimated cost of performance. Item (3) is generally referred to as "cost overrun."

In this regard, it should be noted that in a statement submitted for the record during the Hearings before the Subcommittee on Independent Offices of the House Committee on Appropriations, Independent Offices Appropriations for 1964, 88th Congress, First Session, at page 330, NASA defined the terms "overruns" and "percentage of overrun" on NASA's cost-reimbursement type of contracts. The term "overrun" was defined as that part of the final price of the completed contract on which fee is not allowed to the contractor. The term "percentage of overrun" was defined as the ratio of the overrun, as defined above, to that portion of the final price of the contract on which fee has been allowed. We stated that it is, therefore, "not possible to determine what the overrun or the percentage of overrun on a cost-reimbursement contract is until all work has been completed, all costs have been accumulated and the negotiations have been carried out with respect to the determination of the final fee." That statement is as true today as it was then, and therefore, when our data show a figure for overrun, that figure constitutes our best estimate at this point in time.

As indicated, the overall program estimates have been stable and have included provision for growth in individual contracts. To provide specific examples of individual contract cost histories, brief statements are provided on six contracts. These contracts include at least one contract from each MSF Center; i.e., one service contract from KSC; one engine contract (F-1) from MSFC; two stage contracts (S-IB and S-IVB) from MSFC; and two spacecraft contracts (CSM and LM) from MSC.

From these examples, and the table on the preceding page, two general conclusions may be drawn: the cost growth of the contracts was in nearly exact agreement with NASA's original projections and budgetary estimates, as demonstrated by the history of total costs; and the cost overruns, in terms of percentages, were generally small when compared with other research and development work.

1. KSC - Contract NAS10-1600 with Bendix Corporation for Launch Support Services

The contract between NASA and the Bendix Corporation for Launch Support Services was entered into in October 1964. KSC planned to cover a five-year period for these services, including the operation and maintenance of Launch Complex 39. The original contract covered only the first increment of support in the amount of $3.3 million. Most of the facilities involved were still under construction and the effort covered only formation of a nucleus staff and preparation for bringing the facilities to operational status. In addition, the contractor was required to: (1) furnish Photographic Systems Engineering; (2) activate the Self Contained Atmospheric Protective Ensemble Suit Facility; (3) activate the Ordnance Storage and Handling Facility; and (4) establish and maintain an Inspection Function in the Technical Shops.

Four additional procurements, each covering a twelve month increment were negotiated at a total estimated cost of $107.8 million. This represented a build up by year to the fully operational status. Cost overruns totalling $4.2 million (3.8%) are anticipated - primarily attributable to the need for additional material and overtime for several urgent program requirements and unforeseen projects such as making and potting cables and cable traps for use in expanding requirements of the Blockhouse at Launch Complex 34.

The current estimated cost to complete the scope of work under contract as of June 30, 1969 is $115.3 million.

2. MSFC - Contract NAS8-5604 with Rocketdyen Division of North American Rockwell for F-1 Engine Production

A definitive contract was executed on April 2, 1964 for seventy-six (76) engines, ancillary equipment and services at an estimated cost of $158.4 million. In the period since the award of the contract to June 30, 1969, additional requirements and schedule adjustments were added to the scope of the contract amounting to $52.8 million. This included test hardware for testing engines at MSFC, ground support equipment, thermal insulation, additional support services and new technology reporting. Since the engine was in a relatively early stage of development and had not been qualified as flight rated, a number of engineering changes were required which added $16.5 million to the contract. Current forecast to complete the scope of work under contract as of June 30, 1969 indicates an estimated cost of $239.4 million, including a projected net overrun of $11.7 million, or 5.2%.

The contract described above was for 76 of the 106 engines required for the Apollo launch vehicles through SA 515. Instead of placing the additional quantity under this contract, the remaining 30 engines were procured under a separate contract.

3. MSFC - Contract NAS8-4016 with Chrysler Corporation for SIB Stages

The contract between NASA and the Chrysler Corporation for the delivery of twenty-one S-I stages was entered into in July 1962. The contractor was required to furnish the necessary management, labor, facilities, materials, tools, and equipment, and do all things necessary or essential to perform the activation and modification of the contractor's assigned portion of the Michoud plant for fabrication, assembly, checkout, static testing, and delivery of the twenty-one stages to Cape Kennedy. The initial estimated cost of this contract was $215.5 million. At the time the contract was initiated, there was very little experience in clustering of propellants tanks and engines or in man-rated multi-staged rockets and as our understanding of the requirements increased, program and schedule changes resulted in contract changes and additions. Further, the original contract was modified to provide for the delivery of eight S-I stages for use in Saturn I vehicles and twelve SIB stages configured to operate with the SIVB stage in the Saturn IB vehicle. The major factors in the growth history for this contract have been the redesign of the S-I stages to an SIB configuration especially the requirement to accommodate higher thrust levels; initiation of a reliability program; schedule adjustments to meet revised program requirements; stage storage and extended stage deliveries, and other changes. These changes resulted in additional contract modifications which carried an estimated cost of $148.4 million. The estimated cost of this effort through completion as of June 30, 1969, is $353.9 million which is approximately a $10 million underrun, an underrun of 2.8%.

4. MSFC - Contract NAS7-101 with McDonnell Douglas for SIVB Stage

The contract between NASA and the McDonnell Douglas Corporation for the S-IVB stage program was entered into on April 2, 1962 and required the contractor to conduct a program of design, fabrication, checkout, and testing to develop the S-IVB Stage for the Apollo program. Six Saturn V/S-IVB Flight Stages (S-IVB-501 thru 506) were included together with five ground test stages: All systems, Battleship, Hydrostatic, Facility Checkout and Dynamics. The definitive contract for the first increment was $143.4 million. A major amendment to the contract increased the hardware quantities, the major portion being an increase in the number of flight stages from the initial six to twenty-seven (nine additional Saturn V/S-IVB's and twelve Saturn IB/S-IVB's) resulting in contract amendments totalling approximately $293 million. In addition, a large number of contract changes have covered new or added stage capabilities dictated by overall program requirements; schedule adjustments because of these changes and by overall program schedules; design and manufacture of the telemetry system; the addition of reliability test and verification programs; and a number of other modifications to the original contract. It was also necessary to replace one flight stage and repair a test stand as a result of an accident at the Sacramento test site. At the time this contract was entered into, there was very little experience in man rated launch vehicle technology to the depth and sophistication necessary to perform this contract (e.g., liquid hydrogen and common bulkhead technology and utilization, and stage restart in orbit). Moreover, many of the Apollo program mission requirements were still under study (e.g., Earth Orbit Rendezvous vs. Lunar Orbit Rendezvous). The initial contract was entered into with the recognition that it excluded significant areas which were known to be requirements but at that time the design had not been developed in sufficient detail to permit procurements (e.g., telemetry system). These contract changes authorized through June 30, 1969 totalled $664 million. The current estimated cost of this contract as of June 30, 1969 to completion is $1.1 billion and no overrun is anticipated on this scope of work.

5. MSC - Contract NAS9-150 with North American Rockwell Corporation for Command and Service Modules

The contract between NASA and North American Rockwell Corporation for the Apollo Command and Service Modules (CSM's) was entered into on December 21, 1961. This contract required the contractor to conduct research, development, design, fabrication, assembly, integration and testing of the Command and Service Modules of the Apollo program. The basic contract was negotiated at an estimated total cost of $884 million for an initial increment covering the period through May 15, 1965. In September 1964, the second major increment including schedule extensions through February 1966 was negotiated at an estimated cost of $388 million. The third major increment including schedule extension added another $231 million. The final increment to the basic program including schedule extension was negotiated in February 1968, at an estimated cost of $529 million. Provisioned (buy as needed) items such as spares for site support and test operations increased the magnitude of the contract by $338 million.

The content has been further increased by major changes in the scope of work which have been necessary as our definition and understanding of the mission grew and as a result of ground and flight tests. Design of the Block II configuration provided full lunar mission capability including docking mechanisms, heat shield for re-entry from lunar orbit, structural modifications and other improvements found to be essential during the development program. The spacecraft fire at KSC in January 1967 was followed by an intensive re-examination of all materials and design factors to provide maximum safety assurance. A significant test program and a large number of specification changes resulted. Further testing and flight operations brought additional design improvements such as redesign of the hatch window to prevent fogging. The total of these changes is approximately $564 million.

Our current estimate of the total contract cost is $3,762 million including all of the above items plus $439 million for four spacecraft planned for the Skylab program and $114 million for modifications to enhance lunar exploration capabilities. This amount also includes an estimated overrun of $275 million, or 7.9%.

6. MSC - Contract NAS9-1100 with Grumman Aircraft Corporation for Lunar Modules

The contract between NASA and the Grumman Aerospace Corporation, entered into on January 14, 1963, required the contractor to conduct a program of research, development, design, fabrication, testing, and operational support to develop the lunar module systems for the Apollo program. This contract covered delivery of ground test articles and eleven flight modules. The basic contract was negotiated at an original estimated cost of $362.5 million for the first increment of work. Development of the lunar module required many major technological advances and establishment of capabilities not in existence at the time of initiation of the contract. The large variable thrust engine for the descent stage, the rendezvous and docking system, and the ascent stage which could be launched from the lunar surface without major checkout operations are examples. Little was known at that time about the composition and weight bearing characteristics of the lunar surface which resulted in uncertainties in design of the landing systems.

Major factors in the growth have been: the engineering changes to achieve the modifications and improvements found necessary as a result of resolution of many of the uncertainties mentioned above; the provision of additional flight hardware; expansion and deepening of the test program and quality assurance procedures; weight control and reduction activities; development, production, and installation of the ground support equipment needed for spacecraft checkout and test; the schedule adjustments related to these changes; and extension of the lunar module capabilities for the later Apollo missions.

The spacecraft fire in January 1967 resulted in detailed re-examination of all materials and other design factors employed in the lunar module as well as the Command and Service Module to provide maximum assurance of astronaut safety. As a result, important engineering changes were made which resulted in additional contract costs and schedule adjustments, but provided a significantly higher level of confidence in mission accomplishment as well as safety. Flight experience in the Apollo 5 unmanned mission and in the Apollo 9 and 10 manned test flights as well as in the successful lunar landing missions have identified additional modifications required to improve vehicle performance and confidence levels.

As a result of all of the above actions, the contract has undergone a number of major revisions resulting in a current estimate of total costs of approximately $2.1 billion which includes the original scope, the additional flight hardware and ground support equipment, the engineering changes and extension in capabilities, the schedule extensions, and an estimated overrun of $310 million, or 17.3%.

MISSISSIPPI TEST FACILITY

Mr. EVINS. Regarding the mothballing of the Mississippi test facility, how long is this planned for and when do you think it may be reactivated?

Dr. PAINE. The test facility is going to process its last Saturn V tests in December of this year. At that time we expect to begin to put it in a stand-by status and probably complete that about next April.

In the meantime, we are also taking a very broad look at possible other Government uses of the Mississippi test facility, particularly in this area of the environmental studies of the gulf coast region. There are possibilities here which we have under study at the moment and if we can find some other things to do here this will help defray the cost of keeping the Mississippi facility in stand-by until such time as future testing loads are developed.

Mr. EVINS. Do you have any idea what it will cost to put it in stand-by status and what will be the annual cost of maintenance?

Dr. PAINE. We have some cost figures on that and I will defer this to Mr. Lilly.

Mr. LILLY. If you put it in essentially a mothball condition, where we are only protecting the Government's investment, it will range between three and $3½ million dollars on an annual basis. If you stepped that up so that you would be able to keep enough people to reactivate on fairly short notice or what you might call a caretaker status, it would range around $5 million a year.

Mr. EVINS. You built some Saturn V's at Huntsville. Do you still have the capability there?

Mr. LILLY. We built some of the first Saturn V's at Huntsville. We built the remainder at the Michoud plant in New Orleans and tested them in Mississippi.

Dr. VON BRAUN. This was activated after closing Michoud. If there was more Saturn V production, it would be planned to do this at Michoud.

SOLUTION OF SOCIAL PROBLEMS

Mr. EVINS. This morning we discussed some of the social problems here on earth and many of us wanted to know what NASA is doing to solve some of these problems. Are you making a contribution to these problems?

Dr. PAINE. By and large I think it is fair to say, Mr. Chairman, that the NASA activity as a whole and the centers which we built up in many different parts of the country, the contract activity and the jobs we have provided have indeed had a very favorable impact on training programs and I think on our national education effort. You will recall at the time of Sputnik the two things desired were to increase the ability of the Nation in space and at the same time to do something to upgrade our education effort. We in the space program have primarily worked in the nonsocial area. I wish we could say there has been comparable progress in the other areas. I think the record probably indicates there has not.

DOMESTIC COMMUNICATIONS SATELLITES

Mr. EVINS. Tell us about the use of satellites for domestic communications systems and what would be required for a fully operational

system for Alaska. How soon could this be done and what would be the cost?

Dr. PAINE. With your permission, I will supply most of that for the record. I can make the statement that the work we are doing both in communication satellites for point to point communications and also with our applications Technology Satellites F and G for direct broadcast of television and radio signals from orbit, undoubtedly have a great deal to say about the future application in places like Alaska.

Mr. EVINS. You can elaborate on that for the record.

(The information follows:)

Successful operational use of commercial satellites for international point-to-point service over the past 5 years has led to proposals for the establishment of satellite systems to serve domestic communications needs.

Exactly where and how satellites should be used in the overall domestic U.S. communications system is a subject of extensive recent study by the executive branch, the FCC, the common carriers, and various users of communications services, most notably the television networks. In the State of Alaska, where there is no extensive or adequately developed terrestrial communications system, considerable benefits may be derived from satellites.

On March 24, 1970, the FCC released a notice of proposed rule making and a report and order relating to Docket No. 16495 "In the matter of Establishment of Domestic Communication-Satellite Facilities by Non-governmental Entities." These documents establish guidelines for submission of applications for domestic communications satellite systems and for commenting on such applications.

There are a variety of approaches to the use of satellites in domestic communication. Development schedules, capacity, cost, and efficiency will vary widely from one approach to another. As stated in paragraph 19 of the report and order: "Here, again, the Commission is unable to determine on the basis of the information presently before us, whether domestic communications satellite opportunities would be more fully and effectively developed through one or more multi-purpose systems, specialized systems, through a combination of both, or through an essentially 'open entry' policy."

With regard to the development of an operational communications system for Alaska, satellites may well play a significant role in combination with terrestrial systems. Three Alaskan cities have a population over 5,000, about 14 others have populations above 1,000. There are over 300 villages of 50 to 1,000 people. Some 70 percent of the currently estimated population lives in settlements of less than 2,500 persons, and most of these settlements have no reliable real-time communications link with the rest of the State or the outside world. The first prerequisite for establishing a fully operational communication satellite system for Alaska is precise definition—by the State of Alaska—as to what communications services are to be provided, by whom, and to what portion of the populace. The cost and development schedule for such a system will be very sensitive to these services. NASA has agreed to make the ATS–1 satellite available to the State of Alaska for experimental use in determining the effectiveness, on a small pilot basis, of the types of services that could ultimately be provided by satellites.

We are aware of studies performed by the Comsat Corporation to define systems to meet most of the currently identified needs of Alaska. They propose that interim service to meet some of the intrastate requirements could be provided by the Pacific Intelsat IV (subject to approval by the Intelsat consortium) in the 1971–72 timeframe. Proposals have been made for domestic satellites to serve the United States, including provision of fuller services to the State of Alaska, perhaps using a committed spot beam and transponders on the satellite.

Such a satellite would provide interstate as well as intrastate services for Alaska. Such a system could be established in the 1972–74 timeframe, depending on a national decision regarding the establishment of domestic satellite systems, since the required technology is in being. The costs for services to be provided by the system would, as stated earlier, be dependent on the precise system established and the extent of the services required.

Mr. EVINS. Doctor, regarding the space shuttle and the space station, how much is carried in the 1971 budget for these two items?

Dr. PAINE. We have $110 million.

ACTION OF AUTHORIZING COMMITTEE

Mr. EVINS. The authorizing committee wanted to add about $80 million to that, didn't they?

Dr. PAINE. That is correct. They proposed $190 million in this area.

Mr. EVINS. I suppose there is no end to the amount you could expend. Who is right, the Bureau of the Budget or the authorizing committee?

Dr. PAINE. We are here, of course, to defend the $110 million figure, Mr. Chairman.

Mr. EVINS. What will be the total cost of the shuttle and the space station? We are planning on a program here for 10 years. This is the first year.

Dr. PAINE. We are not really in a position today to give you these costs. One of the purposes of this definition study next year is to get us in a position where we can give you a reliable estimate of these costs.

Mr. EVINS. You and the committee are pretty far off as to how much you can spend on planning and definition. You can't at this time give us a projected ultimate cost of the shuttle and the station, is that correct?

Dr. PAINE. That is correct. We will be prepared to do that at the time we come before you with the 1972 budget, at which time we will request permission to proceed if this appears to be the thing to do.

SPACE SHUTTLE SCHEDULE

Mr. EVINS. What is the timeframe for the shuttle?

Dr. PAINE. We are looking forward to the possibility of a first shuttle flight in the 1977–78 period if we don't encounter any unexpected technological problems.

Mr. EVINS. You have to have the station before then, haven't you? What is the timeframe for that?

Dr. PAINE. No, sir; we expect these two projects would be roughly brought along together and the space station would probably be in the 1978 period.

Mr. EVINS. Which goes up first, the station or the shuttle?

Dr. PAINE. Probably we will have the shuttle operational before we have the space station up.

Mr. EVINS. I thought the station would go up, you would dock to it, and run back and forth; that the shuttle would run later. You will need the station before the shuttle, won't you?

Dr. PAINE. The two are really intertwined. It doesn't make much sense to have a station up there without a low-cost access to it, but it doesn't make any more sense to have a low-cost round trip capability unless you have the station. We plan to bring them along together.

Mr. EVINS. What is the basis for the $110 million? How do you arrive at that figure?

Dr. PAINE. The $110 million is broken down into really three different things. One is the continuing definition project for the space station; one is the engine definition for the space shuttle; and a third is the space shuttle total system.

SPACE TUG SYSTEM

Mr. EVINS. Tell the committee in a few words—and we will get into it later—about the space tug system. What is here proposed?

Dr. PAINE. The space tug is a system which we are not at this time proposing, but upon which some very preliminary work has been done. The space tug would be designed to be a spacecraft similar to the shuttle in that it will be reusable but without the aerodynamics and the capability to re-enter the earth's atmosphere. It will be a small vehicle which will operate only in earth orbit and above. It will have rocket engines such that it can take payloads and bring them over to the space station for reuse and rework, or will be able to take payloads from the space station, place them in different orbit and then return to the space station.

Mr. EVINS. What is the estimated cost of the space tug?

Dr. PAINE. We are even further from a cost estimate on the space tug. It will probably be some time before we even have the definition work started on that.

Mr. EVINS. You don't even know the time frame on that. This is planning for the future.

Dr. PAINE. This is a future system.

UNOBLIGATED AND UNEXPENDED BALANCES

Mr. EVINS. Furnish for the record the unobligated balances, the unobligated but unexpended balances, expenditures for 1969, 1970 and 1971 for each of your appropriations.

(The information follows:)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION FISCAL YEAR 1971 BUDGET DATA

[Dollar amounts in millions]

	Actual 1969	Estimated 1970	Estimated 1971
Expenditures	$4,251.7	$3,889.4	$3,403.0
Research and development	3,530.2	3,150.0	2,638.0
Construction of Facilities	65.3	60.0	72.0
Research and program management	656.2	679.4	693.0
Obligations	4,045.2	4,003.9	3,353.7
Research and development	3,342.4	3,235.6	2,606.1
Construction of Facilities	54.8	79.9	55.3
Research and program management	648.0	688.4	692.3
Balances, end of year: Unobligated	286.7	20.7	
Research and development	239.3		
Construction of Facilities	47.4	20.7	
Unexpended	1,735.8	1,584.4	1,514.4
Research and development	1,540.0	1,386.4	1,354.5
Construction of Facilities	120.4	113.6	76.2
Research and program management	75.4	84.4	83.7

CARRYOVER FUNDS

Mr. EVINS. Do you anticipate any carryover, Mr. Lilly?

Mr. LILLY. No, it is not intended to move out of 1970 with any significant carryover. There will be about $20 million unobligated in the construction account and there will be some small amounts not under actual contract in the R. & D. budget.

Mr. EVINS. In 1969, your appropriations totaled $3,995,273,000 nearly $4 billion. For 1970 you have $3,696,633,000, about $300 million

less. Then you have a proposed supplemental of $41,767,000 for pay cost, is that right?

Mr. LILLY. That is correct, sir.

Mr. EVINS. This will bring you up to $3,738,400,000 in your estimate for 1970. In 1971 you request $3,333,000,000. Your decrease in 1971 from 1969 is $662,273,000 and the decrease in 1971 from 1970 is $405,400,000.

Mr. LILLY. Yes, sir. As you are aware, Mr. Evins, the actual amount shown in the budget which we are programing for and using in fiscal 1970 is a figure of $3,855 million. This is because of the $117 million withheld in 1969 under the provisions of the Expenditures and Control Act and should be applied against the 1970 so the actual reduction of work being performed from fiscal 1970 then is $3.8 billion down to the $3.3 billion.

PERSONNEL REDUCTIONS

Mr. EVINS. Doctor, we observe that you have not had any appreciable reduction in personnel in NASA. According to our figures you had 31,745 permanent positions in 1969; you have 31,350 in 1970; and you project 30,550 in 1971.

Dr. PAINE. We are planning on a decrease of some 800 people in this budget.

Mr. LILLY. I will point out also that when we had our peak employment in Civil Service we reached a point slightly over 34,000 in permanent employees. We are now coming down to the 30,550. At the same time, within that 30,550 we have absorbed about 956 contract-performed functions from contractors. You will remember there was a requirement for us to convert certain contracts at the Goddard Space Flight Center from contractor operation to civil service operation. So, effectively, we have dropped from our peak by about 4,500 permanent civil service employees.

CONSTRUCTION OF FACILITIES

Mr. EVINS. What was the transfer of about $11,140,000 to construction of facilities for in 1969? This is out of your research fund.

Mr. LILLY. Yes, sir.

Mr. EVINS. They didn't give you enough in construction so you transferred $11,140,000, is that right?

Mr. LILLY. Yes, sir.

Mr. EVINS. What did you do with that?

Mr. LILLY. I can't give you the specific projects, but we laid out what we considered to be the minimum construction to carry on the program and transferred the $11 million to make up the total. The list of the projects conducted out of 1969 I can provide to you. I haven't them at the present time.

Mr. EVINS. Supply that for the record.

You had about $11 million more than you needed and you transferred that over to construction.

Mr. LILLY. I wouldn't put it that way, Mr. Chairman, that we had $11 million more than we needed. We needed the $11 million more in construction than we needed it in R. & D. in order to carry out the program.

(The information follows:)

In fiscal year 1969 against its request for $45 million NASA authorization provided for $39.6 million in construction of facilities. The ultimate appropriation level was $21.8 million. Our requirements were critically reviewed to determine the minimum essential level of funding necessary. These basic requirements totaled in excess of $32 million and as a consequence $11.1 million was transferred from the R. & D. appropriation to construction of facilities. Subsequently certain minor program adjustments have been made so that as of now the fiscal year 1969 construction of facilities program totals $32.1 million and is as follows:

CONSTRUCTION OF FACILITIES FISCAL YEAR 1969 OPERATING PLAN

Location and project	*Program plan*
Ames Research Center	$386,000
Water supply and distribution system	386,000
Kennedy Space Center	7,964,000
Launch complex 39	5,324,000
Utility installations	2,040,000
Alteration to launch complex 17	600,000
Manned Spacecraft Center	1,333,000
Modifications to the environmental testing laboratory	1,333,000
Michaud Assembly Facility	400,000
Rehabilitation, alterations, and improvements	400,000
Wallops Station	500,000
Beach erosion protection	500,000
Various locations	20,497,000
Repairs, rehabilitation and improvement at various locations	1,422,000
Air pollution control facility, Downey	200,000
Deep space antenna (210 foot) facility, Australia	10,680,000
Deep space antenna (210 foot) facility, Madrid, Spain	6,320,000
Powerplant replacement STADAN facility, Fairbanks, Alaska	1,875,000
Facility planning and design	1,000,000
Total	32,080,000

SUMMARY JUSTIFICATION MATERIAL

Mr. EVINS. Place in the record from volume 1 pages SUM–1 through SUM–12.

(The pages follow:)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1971 ESTIMATES

GENERAL STATEMENT

The National Aeronautics and Space Administration was established on October 1, 1958, pursuant to the National Aeronautics and Space Act of 1958, approved on July 29, 1958. The Act states that the policy and purpose of the United States activities in space will be: to conduct space and aeronautical activities for peaceful purposes for the benefit of all mankind. These activities should contribute materially to: the expansion of human knowledge in the atmosphere and space; the improvement and usefulness of aeronautical and space vehicles; the development and operation of space vehicles; the establishment of long-range studies, the preservation of United States leadership in aeronautics and space technology and utilization; the dissemination of pertinent information gained in the program to civil and military agencies; the cooperation with other nations in aeronautics and space activity pursuant to peaceful interests; and the effective utilization of scientific and engineering talents and facilities of the nation.

A total of $3,333,000,000 is requested to support current and proposed programs.

The industrial community, under contracts with the NASA, will continue to carry forward the prime design, development, and fabrication effort of the NASA program. Specific elements of the activity will continue to be pursued within NASA installations, other government agencies, universities, and research contractors which have the necessary level of expertise in special areas of engineering and science. The major elements of the program fall within the following categories:

MANNED SPACE FLIGHT: A program for the continued development and demonstration of a capability for manned space operations and exploration; to maintain progress in manned space flight; and to provide information required for future decisions concerning follow-on space programs.

SPACE SCIENCE AND APPLICATIONS: A program of unmanned space flight involving: (1) scientific investigations of the earth, solar system, stars and space environment; compiling new knowledge in astronomy; planetary and interplanetary studies and experiments on the effects of space environment on living organisms; and (2) the adapting of space technology so acquired for the direct benefit of mankind in areas such as weather, communications, navigation, traffic control, geodesy, meteorology, and earth resources.

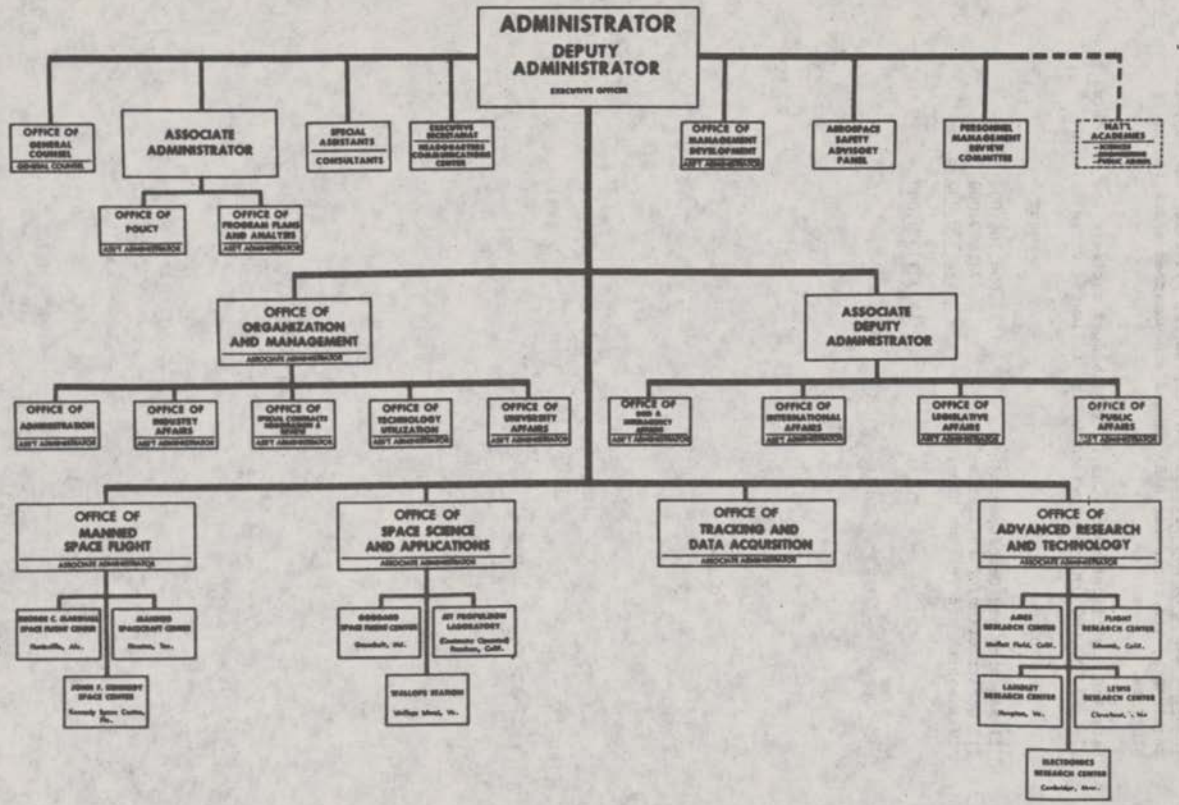
ADVANCED RESEARCH AND TECHNOLOGY: A continuing program to provide the technological base for significant future aerospace missions.

TRACKING AND DATA ACQUISITION: A program for providing the support required by the worldwide NASA manned and unmanned space flight programs.

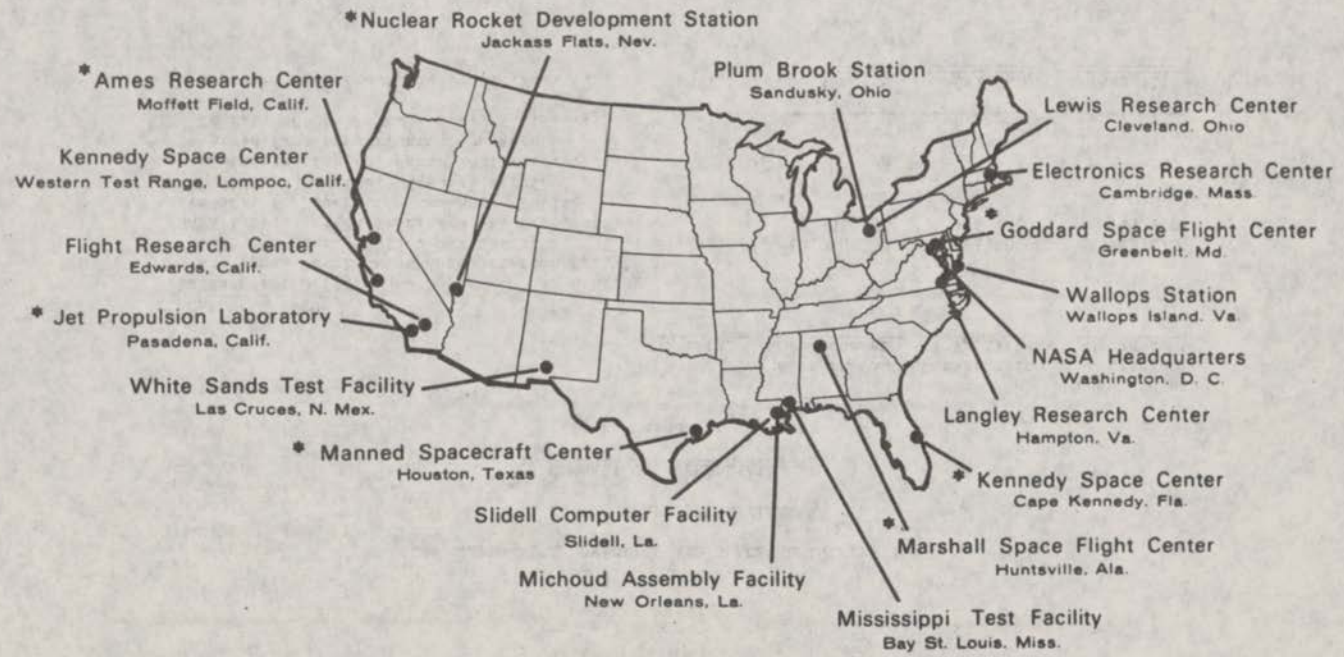
Detailed justification of the FY 1971 budget estimate for the total program of $3,333,000,000 is provided in the following three volumes:

Volume	Amount
II Research and Development	$2,606,100,000
III Construction of Facilities	34,600,000
IV Research and Program Management	692,300,000
TOTAL	$3,333,000,000

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION



NASA INSTALLATIONS



* Installations for which construction projects are requested in the FY 1971 budget estimates.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1971 ESTIMATES

SUMMARY OF APPROPRIATIONS

(In thousands of dollars)

	Total	Research and Development	Construction of Facilities	Research and Program Management
FISCAL YEAR 1969				
Independent Offices and Department of Housing and Urban Development Appropriation Act, 1969 (82 Stat. 945)	$3,995,273	$3,370,300	$21,800	$603,173
NASA Appropriation Transfers (82 Stat. 945)	---	-56,358	+11,140	+45,218
Transfer to "Operating Expenses, Public Buildings Service," General Services Administration (82 Stat. 943)	-280	---	---	-280
Reserved from apportionment pursuant to P.L. 90-364	-117,473	-117,473	---	---
Appropriation available	$3,877,520	$3,196,469	$32,940	$648,111

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1971 ESTIMATES

SUMMARY OF APPROPRIATIONS (CONTINUED)

(In thousands of dollars)

	Total	Research and Development	Construction of Facilities	Research and Program Management
FISCAL YEAR 1970				
Independent Offices and Department of Housing and Urban Development Appropriation Act, 1970 (83 Stat. 229)	$3,696,633	$3,006,000	$53,233	$637,400
NASA Appropriation Transfers (83 Stat. 230)	---	-9,708	---	+9,708
Transfer to "Operating Expenses, Public Buildings Service," General Services Administration (83 Stat. 229)	-474	---	---	-474
Application of 1969 appropriation reserved from apportionment pursuant to P.L. 90-364.	+117,473	+117,473	---	---
Proposed supplemental for civilian pay act increase	+41,767	---	---	+41,767
Appropriation available and proposed	$3,855,399	$3,113,765	$53,233	$688,401
FISCAL YEAR 1971				
Appropriation request	$3,333,000	$2,606,100	$34,600	$692,300

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1971 ESTIMATES

SUMMARY OF BUDGET PLAN BY APPROPRIATION BY BUDGET ACTIVITY

(In thousands of dollars)

Appropriation Title	Total	Manned Space Flight	Scientific Investigations in Space	Space Applications	Space Technology	Aviation Technology	Supporting Activities
Fiscal Year 1969.....	$3,881,474	$2,508,219	$420,240	$130,404	$307,452	$168,148	$347,011
Research and development.....	3,201,430	2,177,500	341,440	109,404	185,866	94,748	292,472
Construction of facilities...	32,080	10,719	1,100	---	386	---	19,875
Research and program management.....	647,964	320,000	77,700	21,000	121,200	73,400	34,664
Fiscal Year 1970.....	$3,855,399	$2,374,895	$469,762	$162,501	$300,772	$186,247	$361,222
Research and development.....	3,113,765	2,031,745	380,467	138,801	176,372	96,380	290,000
Construction of facilities...	53,233	14,250	1,595	---	---	4,767	32,621
Research and program management.....	*688,401	328,900	87,700	23,700	124,400	85,100	38,601
Fiscal Year 1971.....	$3,333,000	$1,810,300	$469,200	$213,350	$292,575	$185,500	$362,075
Research and development.....	2,606,100	1,474,200	382,800	180,800	164,300	102,000	302,000
Construction of facilities...	34,600	2,000	700	5,350	6,275	---	20,275
Research and program management.....	692,300	334,100	85,700	27,200	122,000	83,500	39,800

* Includes $41,767,000 for the proposed supplemental for civilian pay act increase.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1971 ESTIMATES

SUMMARY OF BUDGET PLAN

OFFICE OF MANNED SPACE FLIGHT PROGRAMS

	(Thousands of dollars) 1969	1970	1971
Research and Development	$2,177,500	$2,031,745	$1,474,200
Apollo	2,025,000	1,686,145	956,500
Space flight operations	150,000	343,100	515,200
Advanced missions	2,500	2,500	2,500
Construction of Facilities	10,719	14,250	2,000
Kennedy Space Center	7,364	12,500	575
Manned Spacecraft Center	1,333	1,750	900
Marshall Space Flight Center	---	---	525
Michoud Assembly Facility	400	---	---
Various locations	1,622	---	---
Research and Program Management	310,968	323,688	330,583
Kennedy Space Center	95,794	97,445	98,150
Manned Spacecraft Center	98,840	104,546	107,758
Marshall Space Flight Center	116,334	121,697	124,675
TOTAL, MANNED SPACE FLIGHT	$2,499,187	$2,369,683	$1,806,783

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1971 ESTIMATES

SUMMARY OF BUDGET PLAN

OFFICE OF SPACE SCIENCE AND APPLICATIONS PROGRAMS
OFFICE OF UNIVERSITY AFFAIRS PROGRAM

	(Thousands of dollars) 1969	1970	1971
SPACE SCIENCE AND APPLICATIONS PROGRAMS AND PROJECTS			
Research and Development	$453,238	$519,718	$565,700
Physics and astronomy	128,850	111,835	116,000
Lunar and planetary exploration	87,923	151,013	144,900
Bioscience	37,900	19,670	12,900
Space applications	98,665	128,400	167,000
Launch vehicle procurement	99,900	108,800	124,900
Construction of Facilities	1,100	1,595	6,050
Goddard Space Flight Center	---	670	2,050
John F. Kennedy Space Center, NASA	600	---	---
Jet Propulsion Laboratory	---	---	700
Wallops Station	500	500	---
Various locations	---	425	3,300
Research and Program Management	82,329	94,317	97,461
Goddard Space Flight Center	73,227	84,772	87,670
Wallops Station	9,102	9,545	9,791
TOTAL, SPACE SCIENCE AND APPLICATIONS	$536,667	$615,630	$669,211
UNIVERSITY AFFAIRS PROGRAM			
Research and Development			
Sustaining university program	$9,000	$7,000	---

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1971 ESTIMATES

SUMMARY OF BUDGET PLAN

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY PROGRAMS
OFFICE OF TRACKING AND DATA ACQUISITION PROGRAMS
OFFICE OF TECHNOLOGY UTILIZATION PROGRAM

	(Thousands of dollars) 1969	1970	1971
ADVANCED RESEARCH AND TECHNOLOGY PROGRAMS AND PROJECTS			
Research and Development	$278,220	$272,302	$264,200
Basic research	20,220	18,902	17,600
Space vehicle systems	31,349	30,670	30,000
Electronics systems	34,460	33,500	22,400
Human factor systems	19,402	21,900	17,900
Space power and electric propulsion systems	38,787	34,450	30,900
Nuclear rockets	33,502	36,500	38,000
Chemical propulsion	25,752	20,480	20,300
Aeronautical vehicles	74,748	75,900	87,100
Construction of Facilities	386	4,767	6,275
Ames Research Center	386	---	1,525
Jet Propulsion Laboratory	---	---	1,250
Langley Research Center	---	4,767	---
Nuclear Rocket Development Station	---	---	3,500
Research and Program Management	193,890	208,578	201,521
Ames Research Center	34,032	36,359	38,248
Electronics Research Center	17,237	19,483	4,470
Flight Research Center	9,697	10,131	10,549
Langley Research Center	62,945	67,973	70,734
Lewis Research Center	67,844	72,398	75,218
Space Nuclear Propulsion Office	2,135	2,234	2,302
TOTAL, ADVANCED RESEARCH AND TECHNOLOGY	$472,496	$485,647	$471,996

	(Thousands of Dollars) 1969	1970	1971
TRACKING AND DATA ACQUISITION PROGRAMS AND PROJECTS			
Research and Development			
Tracking and data acquisition...	$279,672	$278,000	$298,000
Construction of Facilities	18,875	17,000	1,275
Various Locations.....	18,875	17,000	1,275
TOTAL, TRACKING AND DATA ACQUISITION.....	$298,547	$295,000	$299,275
TECHNOLOGY UTILIZATION - Research and Development	$3,800	$5,000	$4,000

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1971 ESTIMATES

NUMBER OF PERSONNEL POSITIONS

	Fiscal Year 1969	Fiscal Year 1970	Fiscal Year 1971
MANNED SPACE FLIGHT	13,410	13,033	12,883
John F. Kennedy Space Center, NASA	2,877	2,779	2,748
Manned Spacecraft Center	4,384	4,250	4,200
Marshall Space Flight Center	6,149	6,004	5,935
SPACE SCIENCE AND APPLICATIONS	4,625	4,900	4,900
Goddard Space Flight Center	4,141	4,412	4,412
Wallops Station	484	488	488
ADVANCED RESEARCH AND TECHNOLOGY	11,617	11,294	10,694
Ames Research Center	1,992	1,972	1,972
Electronics Research Center	802	600	---
Flight Research Center	539	535	535
Langley Research Center	3,912	3,872	3,872
Lewis Research Center	4,268	4,215	4,215
Space Nuclear Propulsion Office	104	100	100
SUPPORTING OPERATIONS			
NASA Headquarters	2,093	2,123	2,073
TOTAL PERMANENT POSITIONS	31,745	31,350	30,550
POSITIONS OTHER THAN PERMANENT	2,196	2,300	2,300
TOTAL POSITIONS	33,941	33,650	32,850

LIAISON WITH NATIONAL ACADEMIES

Mr. EVINS. What are the functions of the National Academy of Sciences and the National Academies of Engineering and of Public Administration as they relate to NASA?

Dr. PAINE. Mr. Chairman, we receive advice from the National Academy of Science and the National Academies of Engineering and of Public Administration.

Mr. EVINS. This is not a part of your organization, but an information source, is that right?

Dr. PAINE. It is more or less a committee structure to give advice to the Administrator.

Mr. EVINS. Is the Office of University Affairs being phased out?

Dr. PAINE. We have money for other parts of our university activities, but the university program which we have called the sustaining university program; that has been discontinued.

Mr. EVINS. What funding has been provided for universities in the space program? Is more money going into education today from other sources? The space agency has made substantial contributions and perhaps you can taper off in this area.

How much money did you reach in the peak in making annual contribution to education?

Mr. LILLY. The peak level in the sustaining university program was around $45 million.

Mr. EVINS. What is projected for next year?

Mr. LILLY. For the Sustaining University Program, zero.

Mr. EVINS. But you will continue to make contributions to universities with research contracts. The funds for the sustaining university program is down from $45 million to zero next year, but tell us the other amounts.

Mr. LILLY. The amount of money from NASA from the total appropriations in the research and development area, other than what had gone in from the Sustaining University Program is around about $85 million to my recollection.

Mr. EVINS. About $85 million in this budget will go to university support, is that right?

Mr. LILLY. To support specific requirements for the projects we are carrying out.

Dr. PAINE. A direct contract basis?

FUNDING OF JPL AND MIT

Mr. JONAS. Does that include JPL?

Mr. LILLY. That does not include JPL.

Mr. JONAS. What would that be?

Dr. NAUGLE. It is about $160 million, I believe.

Mr. JONAS. We are talking about a couple hundred million dollars.

Dr. PAINE. It also does not include, Mr. Jonas, the money going into the instrumentation laboratory at MIT. Those two large items are separate.

Mr. EVINS. You make it appear that your funds are cut out for the university affairs program when in reality that is not really accurate, is it? How much money is going into university support in next year's budget?

Dr. PAINE. I think the point is there are three separate things to look at here. One is the direct contract work which NASA carries out in the universities under contract. For example, providing experiments on the Mars program. This is the $85 million Mr. Lilly mentioned, which is down about 15 or 20 percent from last year. In addition to that, we operate under contract the Jet Propulsion Laboratory—this is a contract carried out by the California Institute of Technology. It is somewhat similar to the NASA centers. In addition to that, we have had a substantial amount of funding in the Instrumentation Laboratory operated by MIT for work on the Apollo guidance system and guidance in general.

Mr. JONAS. Do you have the figure on that?

Dr. PAINE. We can furnish for the record all of these. The Apollo guidance activity at MIT is also going down sharply.

(The information follows:)

Planned funding for MIT guidance system effort for the Apollo and skylab programs in the current fiscal year totals $14.6 million. In addition, about $1 million is programed for guidance work at MIT under the advanced research and technology program.

Mr. EVINS. What is that total for these three items for universities, including JPL?

Mr. LILLY. About $245 million.

Dr. PAINE. This is substantially reduced from previous years, Mr. Chairman.

MAJOR PROGRAM OFFICES

Mr. EVINS. Under the office of Manned Space Flight, you have the George C. Marshall Space Flight Center at Huntsville; the Manned Spacecraft Center at Houston; and the John F. Kennedy Space Center in Florida. Under the Office of Space Science and Applications you have the Goddard Space Flight Center, the Jet Propulsion Laboratory, and the Wallops Station.

In your Office of Tracking and Data Acquisition you go up to $298 million in 1971. Your work is down and you are having less shots, but the program goes up $20 million.

Dr. PAINE. We had more spacecraft aloft and we are getting back more data. We can discuss this particular account in more detail, but we have taken quite a bit out of it but we still must go up.

Mr. EVINS. The Office of Advanced Research and Technology includes the Ames Research Center, the Flight Research Center, the Langley Research Center, the Lewis Research Center, and the Electronics Research Center. These are being cut back sharply, are they not?

Dr. PAINE. Yes, we will be taking some 800 positions out.

EXPENDITURES CONTROL ACT

Mr. EVINS. Under Public Law 90-364 you held back $117,473,000 for research and development, didn't you?

Mr. LILLY. That is correct.

Mr. EVINS. This money is now available in 1970, is that right?

Mr. LILLY. Yes.

Mr. EVINS. In 1971, for Research and Development you are requesting $2,606,100,000. This is $399,900,000 less than your appropriation for the previous year. Is that correct?

Dr. PAINE. Yes.

Mr. EVINS. For construction of facilities in 1970, your figure was $53,233,000, and in 1971 it is estimated to be $34,600,000, which is a reduction of $18,633,000.

Mr. EVINS. Then for research and program management——

Dr. PAINE. This includes all of the research done in the NASA centers.

Mr. EVINS (continuing). For 1970 it was $688,401,000 and for 1971 you request $692,300,000, which is an increase of $3,899,000. Is that right?

Mr. LILLY. Yes.

Mr. JONAS. You are there increasing in-house research and cutting down on contract research, is that correct?

Mr. LILLY. No, sir.

Mr. JONAS. You just told us or Dr. Paine did, that the cost at JPL, MIT and the $85 million is substantially below last year, but you're $4 million above last year in total.

Dr. PAINE. I said the total university accounts in totality are less than the university accounts last year. JPL is not going down.

Mr. LILLY. The increase in research and program management, over these past years has come from the pay raise increases that have occurred. As you know, it was $41 million in fiscal year 1970. The estimate takes into consideration full account of these in fiscal 1971. Even with a few less people it is still costing more.

COST COMPARISON

Mr. EVINS. I notice one or more of our colleagues on the Legislative Committee asked for a comparison of costs you incur on in-house research compared with contract research. I understood from his supplemental views that you were going to make that comparison and furnish that Committee with a table. Could you provide us with one too?

Dr. LOW. Yes, we will.

Mr. EVINS. Is that data available?

Dr. LOW. It is available and in comparing Goddard with Jet Propulsion Laboratory, for example, where Goddard has civil service employment and Jet Propulsion is run by a contractor, the personnel costs are quite comparable. In the aggregate the numbers are almost the same. Salaries for our own people and JPL.

Mr. EVINS. Your comparative figures will demonstrate that I am sure but, someone was under the impression that the cost of JPL was far in excess of the costs at Goddard, for example.

Dr. LOW. Since then we prepared the analysis and furnished the information. We will furnish it here.

(The information follows:)

The average salary for all permanent employees of JPL at the end of fiscal year 1969 was $12,917. This compares to an average salary for all permanent employees of the Goddard Space Flight Center (GSFC) of $13,259. Although

there are some differences between the NASA and JPL systems of classifying personnel, the following provides a reasonable comparison of groups at JPL and GSFC and their average yearly salaries as of the end of fiscal year 1969:

	GSFC	JPL
Scientists and engineers	$16,734	$17,930
Professional	12,929	13,062
Other	9,256	7,189

Another form of compensation which must be considered along with salaries, is personnel benefits, the cost of which averaged $1,015 per year, per person, at GSFC and $1,111 at JPL.

Mr. EVINS. The appropriation request for Research and development is down almost $400 million, construction of facilities is down $18,633,000, but Research and program management is up about $4 million. Overall your budget request is down over $400 million. This is how I see your budget for next year.

UNOBLIGATED BALANCES

Dr. PAINE. This also reflects the fact that I mentioned earlier in the testimony that we are putting a special emphasis on our aeronautics research.

Mr. EVINS. What is the unobligated balance in Research and development at the present time?

Mr. LILLY. I will have to supply that precise number for the record.

(The information follows:)

In the Research and development appropriation there is about $1.1 billion, of the $3.1 billion available, unobligated.

Mr. EVINS. What is the primary mission of JPL as it compares with Goddard? Is there any overlap between JPL and your Goddard work?

Dr. NAUGLE. No, sir, there is not. JPL is primarily associated with the planetary program. It managed last year's Mariner missions to Mars. Goddard, on the other hand, is involved primarily in the Physics and Astronomy and Space Applications programs. Both institutions also do a good deal of advanced research and technology development for NASA's Office of Advanced Research and Technology. These programs are handled out of headquarters and we see to it that there is no overlap.

NUCLEAR ROCKET DEVELOPMENT

Mr. EVINS. I notice that the budget for nuclear rockets goes from $33 million in 1969, to $36 million in 1970, and you request $38 million in 1971. In Nuclear Rocket Development Station there are no funds for 1969 and 1970, but $3.5 million in 1971. More emphasis on nuclear rockets. Where is the station located?

Mr. LILLY. Jackass Flats, Nev., sir. That $3.5 million in the construction of facilities program is to allow us to get a start on the long lead time items that are required for the stage test stand a Jackass Flats.

1970 TRANSFERS

Mr. JONAS. What transfers have you made during the year?

Mr. LILLY. For fiscal 1970?

Mr. JONAS. Yes.

Mr. LILLY. In fiscal year 1970 we did transfer into our research and program management account from the R. & D. account about $9 million, Mr. Jonas.

Mr. JONAS. Did you transfer anything into administration?

Mr. LILLY. Into the "Research and Program Management," which used to be called Administrative Operations, yes, sir.

Mr. JONAS. I notice on page 12 of the summary that actually your personnel at Kennedy and Marshall and the other centers is going to be up 300 people.

Mr. LILLY. No, sir.

Mr. JONAS. Up above 1969, I mean; 4,900 as compared with 4,600.

Mr. LILLY. That is in the Space Applications area. That is a summary for the Goddard and Wallops Station.

Mr. JONAS. You go up, don't you?

Mr. LILLY. Yes, sir; the totals are at the top.

IN-HOUSE VERSUS CONTRACT SUPPORT

Mr. JONAS. That provoked my question a little while ago. Aren't you increasing your activities in your own in-house stations and cutting back on contracts, contract support?

Mr. LILLY. At some individual centers, Mr. Jonas, they have grown; however, they are mostly taken up at Goddard, where we had contracts for these support services at Goddard, we have now established 965 civil service positions to convert the contractual effort to civil service operation. In effect, on the same basis, it would be down.

Mr. JONAS. It is the same as 1970 but it is up from 1969. When did you do this?

Mr. LILLY. We did it over 2 years, Mr. Jonas. If you look at 1969 for Goddard, it is 4,141. Then you went to 4,412. It reflected the pick-up in Civil Service of work previously performed under support contract effort.

Mr. JONAS. At Goddard?

Mr. LILLY. At Goddard and we were finishing it up—we will have finished it up by fiscal year 1971.

Mr. JONAS. Why did you make that reassignment?

Mr. LILLY. That, Mr. Jonas, was initiated several years back, based upon a review by the General Accounting Office of work being carried out at the Goddard Space Flight Center. They suggested to the Civil Service Commission, and the Civil Service Commission agreed, that the work under several specific contracts should be performed by Civil Service on the basis that it was so closely related to the management activities.

There was also an opinion by the General Counsel of the Civil Service Commission who felt that we could be considered to be in violation of personnel statutes. We, therefore, undertook a study with the Civil Service Commission and GAO which led to a decision to convert personnel from a number of contracts to Civil Service operation.

Mr. JONAS. Did GAO concur in that opinion of the Civil Service Commission?

Mr. LILLY. They were the ones who originally raised the question, yes, sir.

CIVIL SERVICE COMMISSION

Mr. JONAS. I didn't know you were under any such mandate from the Civil Service Commission. I can understand why you would abide by rulings of the General Accounting Office, but the Civil Service Commission hasn't any business telling you whether you should operate by Civil Service personnel or contract, have they?

Mr. LILLY. Yes, sir; they have certain functions to carry out. They are responsible for the personnel practices to be conducted by the agencies of the Government and they indicated that the work that was being performed should be done by Civil Service rather than by contract.

Mr. JONAS. Have you phased out all of the contract work at Goddard?

Mr. LILLY. Have we phased out all of the work? No, not all of it. Just certain specific contractor effort conducted right on site, but this has not phased out all of the support contract effort.

Dr. PAINE. With respect to the work that is now being done by these civil servants, the contract effort was phased out, however—these particular contracts which were held to be in violation.

Mr. JONAS. Did you transfer just individuals or contracts or programs?

Mr. LILLY. What we did was to take the work being performed by those support contractors and say that that work is now going to be performed by civil service employees. We did give an opportunity of employment to those contractor employees who were previously performing the work if they met the qualifications and standards of the Civil Service Commission. In most cases they were offered jobs and I would say that the actual number of people who converted to civil service was probably 80 percent.

Mr. JONAS. As you say then, there hasn't been any increase in personnel at all and the bodies you have shifted to civil service will show up as a minus factor on contract employees?

Mr. LILLY. That is correct, sir.

REPROGRAMING OF FUNDS

Mr. EVINS. Dr. Paine, you wrote to the Speaker on January 28 of this year advising that the Lunar and planetary programs must be increased to support the Pioneer and the Mariner-Mars 1971 missions and the space vehicle systems program is being increased to focus attention in critical technology areas in support of the space shuttle definition and design. In addition, a program increase is still required for the research and program management appropriation to provide minimum funding levels to adequately support the approved research and development programs and for the costs of new legislation relating to salaries, per diem and retirement benefits. In other words, you can transfer funds for the research when you couldn't absorb the pay cost increase. Why not?

Mr. LILLY. Mr. Evins, the pay increase that became effective at the start of the year was the third increment of the pay increase that Congress had voted. At the time the 1970 budget was prepared, the administration decided that no agency would be allowed to budget for what was projected to be the pay increase since we did not know what this would be. In lieu thereof, the administration provided in the overall budget an estimate of approximately $2 billion, as I recall, for pay raises for all Government agencies. When the pay raise did become effective, the impact upon NASA was about $41 million to cover that third increment of the pay raise.

The total planning of the administration and the agency had been on the basis that we would not be required to absorb that kind of money. Now, if we had attempted to do it on 1 July, we would have had to go through a reduction in force of about 5,000 people.

Mr. EVINS. We wouldn't want that to happen. We can't understand why you can transfer money out, but still you don't have enough money for pay purposes. If you hadn't transferred this money out, you probably would have had sufficient funds to take care of your pay increases, wouldn't you?

ADJUSTMENT BETWEEN BUDGET LINE ITEMS

Mr. LILLY. No, sir. When Mr. Jonas talked about transfers, I was talking about transfers between appropriations. That was the amount transferred from R. & D. to research and program management.

The matter which you referred to was the matter of notifying the House and Senate Space Authorization Committees whenever there is an adjustment between the budget line items in the research and development programs. That action reflected certain adjustments in lunar and planetary, to increase the Mars 1971 and decrease other programs within it, based upon the particular problems and adjustments required at that time.

Now, the pressure was certainly put upon all agencies to see what could be done to absorb any of these increased costs. The Bureau of the Budget and others were convinced, along with us, that we could not absorb that $41 million for the pay increase without giving up major parts of our program. I would say we had to have a very strong case since this year was the first time we have ever been allowed to be included in the supplemental.

Mr. EVINS. How much was this transfer in lunar and planetary programs?

Mr. LILLY. That was about a $12 million item. If we hadn't put that $12 million in we wouldn't get a Mars 1971 flight. We had to get the work done in order to be prepared to meet that date in 1971. It wasn't a matter of having a choice.

Mr. EVINS. These programs were funded but needed to be increased, and you did not have the money to absorb the pay raise, is that correct?

Mr. LILLY. That is correct.

Mr. EVINS. We will place the letter in the record, Mr. Reporter.

(The document follows:)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

JAN 28 1970

OFFICE OF THE ADMINISTRATOR

Honorable John W. McCormack
Speaker of the House of Representatives
Washington, D.C. 20515

Dear Mr. Speaker:

Enclosed is a report to the Committee on Science and Astronautics of the House of Representatives indicating proposed actions by the National Aeronautics and Space Administration to conduct certain programs at levels in excess of those authorized in the National Aeronautics and Space Administration Authorization Act, 1970 (83 Stat. 196), together with the facts and circumstances related to those actions. This report is being made pursuant to Section 4 of the cited Act and is being submitted through the Speaker of the House of Representatives pursuant to Rule XL of that House.

The Lunar and planetary program must be increased to support the Pioneer and Mariner-Mars 1971 missions and the Space vehicles systems program is being increased to focus effort in critical technology areas in support of space shuttle definition and design. In addition, a program increase is required for the Research and Program Management appropriation in order to provide minimum funding levels to adequately support the approved research and development programs and for the costs of new legislation relating to salaries, per diem and retirement benefits.

Sincerely yours,

T. O. Paine
Administrator

Enclosure

REPORT ON PLANNED ACTIONS IN THE NASA FY 1970 PROGRAM

The NASA program levels for FY 1970, as reflected in the National Aeronautics and Space Administration Authorization Act of 1970, and the revised program levels are summarized below:

Program	(Thousands of dollars) FY 1970 Authorization Act	Planned FY 1970 Program Levels
Apollo	$1,691,100	$1,686,145
Space flight operations	225,627	225,627 1/
Advanced missions	2,500	2,500
Physics and astronomy	117,600	111,835
Lunar and planetary exploration	138,800	151,013 2/
Bioscience	20,400	19,670
Space applications	128,400	128,400
Launch vehicle procurement	112,600	108,800
Sustaining university program	9,000	7,000
Space vehicle systems	27,500	30,670 2/
Electronics systems	33,550	33,500
Human factors systems	22,100	21,900
Basic research	20,250	18,902
Space power and electric propulsion systems	36,950	34,450
Nuclear rockets	50,000	36,500
Chemical propulsion	22,850	20,480
Aeronautical vehicles	77,700	75,900
Tracking and data acquisition	278,000	278,000
Technology utilization	5,000	5,000
Total "Research and development"	$3,019,927	$2,996,292
"Construction of facilities"	58,200	53,233
"Research and program management"	637,400	646,634 2/
Subtotal	$3,715,527	$3,696,159
Amount included in Government-wide supplemental appropriation for pay raise	---	41,767
Total, NASA	$3,715,527	$3,737,926

1/Does not include $117,473 thousand to be applied from funds reserved in FY 1969 pursuant to the Revenue and Expenditure Control Act of 1968.

2/Programs planned at level which exceed amounts contained in FY 1970 Authorization Act.

Research and Development

Two research and development programs are planned for execution at levels in excess of the authorization levels. These are Lunar and planetary exploration and Space vehicle systems. The facts and circumstances related to those increases are described below.

Lunar and Planetary Exploration

The following table compares the Lunar and planetary exploration authorization with the current FY 1970 program plan:

Project	Authorization	Planned Program
Supporting research and technology/ advanced studies	$24,600,000	$21,780,000
Data analysis	2,700,000	2,600,000
Pioneer	18,200,000	20,800,000
Mariner-Mars 1969	4,900,000	4,491,000
Mariner-Mars 1971	45,400,000	60,342,000
Mariner-Mercury 1973	3,000,000	1,000,000
Viking	40,000,000	40,000,000
Total	$138,800,000	$151,013,000

The increase required for Pioneer is related to the F and G missions. Since submission of the FY 1970 budget, the spacecraft contract for these missions has been negotiated and the scientific payload has been selected. Pioneer F and G will carry eleven scientific instruments, compared with five to six on previous missions. These additional instruments will greatly enhance the return from these missions, particularly with regard to our knowledge of Jupiter. However, these instruments were a primary cause in increasing FY 1970 funding beyond that previously estimated.

The Mariner-Mars 1971 spacecraft requires significant modifications from that used in Mariner 1969. These include the adaptation of retro propulsion to provide orbiter capability and improvements in the television and data storage subsystem. Final contractor negotiations to complete these modifications exceed earlier estimates used in the FY 1970 budget. In order to proceed on the firm schedule demanded by a fixed-opportunity Mars mission, it is necessary to increase the FY 1970 funding from $45,400,000 to $60,342,000.

The increases noted above have been partially offset within the Lunar and planetary program by the following actions:

1. The Lunar supporting research and technology data analysis efforts will be reduced consistent with the increased interval between Apollo flights.

2. The Mariner-Mars 1969 mission was successfully completed without requiring all of the previously planned funds.

3. The development schedule for the Mariner-Mercury 1973 will be rephased to delay experiment selection.

Space Vehicle Systems

The following table sets forth the amounts authorized for Space vehicle systems and compares those amounts to the current FY 1970 program plan:

Project	Authorization	Planned Program
Research and Technology		
Space Vehicle Aerothermodynamics	$7,545,000	$ 9,673,000
Space Vehicle Structures	8,830,000	10,355,000
Space Environmental Protection and Control	8,455,000	8,048,000
Space Vehicle Design Criteria	1,470,000	1,394,000
Aerospace Safety Research	1,200,000	1,200,000
Total	$27,500,000	$30,670,000

The additional funds are provided to augment technology efforts in critical areas of aerothermodynamics and structures in support of space shuttle definition and design. Among the key technologies in which advances must be made to provide a sound basis for the space shuttle development, the following have been identified as most critical and in need of earliest concentrated attention:

(1) Booster and orbiter configuration aerothermodynamics, including entry heating, high and low-speed performance and flying qualities, and other aspects of configuration design;

(2) Lightweight reusable thermal protection systems, including the fabrication of advanced experimental systems utilizing high-temperature metals and non-metallic materials and new insulation methods;

(3) Efficient, reliable, and extremely lightweight structures, involving the development of advanced structural analysis and design methods, the incorporation of new structural materials, and the fabrication of large structural specimens for test and verification; and

(4) Dynamics of large, lightweight vehicles involving the determination of loads and motions of the coupled and separated booster and orbiter vehicles in all phases of flight.

All of the foregoing technology efforts in support of space shuttle design and development are included in the Space vehicle systems program of the Office of Advanced Research and Technology. In addition to these efforts, funds in the amount of $12.5 million are planned within the Space Flight Operations program to initiate "Phase B" studies on both the engines and the vehicle.

Research and Program Management

The Research and program management appropriation will be increased by $9,234,000 to provide for: (1) the minimum funding level necessary to support adequately the approved research and development programs and projects; and (2) cost increases in 1970 related to new legislation, including (a) the increased rate of the Government's contribution to the civil service retirement fund from 6½% to 7%, and (b) the increased rate of per diem paid federal employees while in travel status, and the transfer to NASA of 50 Air Force employees located at the Seal Beach and Downey, California, performing reliability and inspection services for NASA.

The FY 1970 budget requested $650.9 million for this appropriation. The House Committee on Science and Astronautics recommended and the House approved an authorization level of $643.7 million. The Senate Committee on Aeronautical and Space Sciences recommended a level of $637.4 million for R&PM, which was then approved by both Houses. After careful review of program requirements in light of final action on the FY 1970 budget and the current status of NASA activities, we have concluded that the minimum level at which the

OFFSET

research and development programs could be supported is $643.7 million, exclusive of the added costs related to new legislation and added personnel functions. These added costs are:

1. P.L. 91-93, approved October 20, 1969, increased the Government's contribution to the civil service retirement fund from 6½% to 7% of regular salaries. This legislation resulted in $1,154,000 increased costs to NASA.

2. On November 10, 1969, P.L. 91-114 was approved and increased the per diem rates payable to employees while on Government travel. This legislation will increase NASA's costs in FY 1970 by $1,866,000.

3. In the fall of 1969 NASA and the Air Force agreed that 50 Air Force civilian employees at the Seal Beach and Downey, California, industrial plants, who are providing reliability and inspection services to NASA, should be transferred from Air Force rolls to NASA rolls. The $338,000 cost to R&PM in FY 1970 represents no additional cost to NASA inasmuch as these costs have been reimbursed to the Air Force through the R&D appropriation in the past.

In addition to these adjustments, the Research and program management appropriation must be increased to cover the cost of the general salary act increases effective July 1969 in the amount of $41,767,000. This amount is to be included in a Government-wide supplemental appropriation request.

The planned program level for the Research and program management as it relates to the Authorization amount is summarized as follows:

	(In thousands)
Authorization amount	$637,400
Increase to minimum operating level	+6,350
Subtotal	643,750
Adjustments required for added costs of new legislation and additional personnel functions:	
Increased contribution for civil service retirement	+1,154
Increased per diem rates	+1,866
Transfer of 50 people from Air Force to NASA	+338
Subtotal	647,108
Transfer to GSA	-474
Subtotal	646,634
Proposed supplemental appropriation for general salary increases	+41,767
Planned FY 1970 program level	$688,401

Research and Development

Mr. Evins. Mr. Reporter, place in the record the budget schedules for "Research and development" and summary pages 1 through 5 of volume 2.

(The pages follow:)

Program and Financing (in thousands of dollars)

Identification code 27-00-0108-0-1-250	Budget plan (amounts for research and development actions programmed)			Costs and obligations		
	1969 actual	1970 estimate	1971 estimate	1969 actual	1970 estimate	1971 estimate
Program by activities:						
Direct program:						
1. Manned space flight:						
(a) Apollo	2,025,000	1,686,145	956,500	2,263,331	1,629,000	1,100,000
(b) Apollo applications program	150,000	324,600	405,200	167,144	341,000	470,000
(c) Space shuttle and station	----------	18,500	110,000	----------	10,000	65,000
(d) Advanced manned mission studies	2,500	2,500	2,500	5,086	5,400	3,000
2. Scientific investigations in space:						
(a) Physics and astronomy	145,283	129,535	127,600	150,856	139,400	120,500
(b) Lunar and planetary exploration	101,379	165,413	165,100	97,427	179,000	171,000
(c) Bioscience	39,100	19,670	12,900	39,762	21,200	14,200
(d) Launch vehicle development and support	55,678	65,849	77,200	73,186	64,300	77,800
3. Space applications	109,404	138,801	180,800	98,861	116,300	176,000
4. Space technology	185,866	176,372	164,300	211,537	198,400	176,900
5. Aviation technology	94,748	96,380	102,000	85,874	96,800	98,000
6. Supporting activities:						
(a) Tracking and data acquisition	279,672	278,000	298,000	326,136	285,000	289,000
(b) Sustaining university program	9,000	7,000	----------	27,167	21,000	15,000
(c) Technology utilization	3,800	5,000	4,000	3,939	4,000	4,000
Total direct program costs, funded	3,201,430	3,113,765	2,606,100	3,550,306	3,110,800	2,780,400
Reimbursable program:						
1. Manned space flight:						
(a) Apollo	1,257	685	725	592	1,500	725
(b) Apollo applications program	----------	----------	----------	----------	300	----------
2. Scientific investigations in space:						
(a) Physics and astronomy	3,711	1,347	895	1,104	3,200	895
(c) Bioscience	95	----------	----------	95	----------	----------
3. Space applications	37,246	48,774	16,180	39,472	86,600	16,180
4. Space technology	26,130	32,227	48,650	26,902	33,100	48,650
5. Aviation technology	999	3,300	3,350	2,673	5,900	3,350
6. Supporting activities:						
(a) Tracking and data acquisition	593	667	----------	726	699	----------
(b) Sustaining university program	27	----------	----------	----------	27	----------
(c) Technology utilization	144	----------	----------	2	142	----------
Total reimbursable program costs	70,202	87,000	69,800	71,566	131,468	69,800
Total program costs, funded	3,271,632	3,200,765	2,675,900	3,621,872	3,242,268	2,850,200
Change in selected resources [1]	----------	----------	----------	−209,134	124,813	−174,300
10 Total	3,271,632	3,200,765	2,675,900	3,412,738	3,367,081	2,675,900

Note.—Reconciliation of budget plan to obligations:	*1969 actual*	*1970 estimate*	*1971 estimate*
Total budget plan	3,271,632	3,200,765	2,675,900
Deduct portion of budget plan to be obligated in subsequent years	126,117	----------	----------
Add obligations of prior year budget plans	267,223	166,316	----------
Total obligations	3,412,738	3,367,081	2,675,900

Selected resources as of June 30 are as follows:	*1968*	*1969 adjustments*	*1969*	*1970*	*1971*
Stores	35,357	13,704	40,492	40,492	40,492
Unpaid undelivered orders	969,409	-------	766,858	891,671	717,371
Advances	12,123	-------	14,109	14,109	14,109
Total selected resources	1,016,889	13,704	821,459	946,272	721,972

Program and Financing (in thousands of dollars)

Identification code 27-00-0108-0-1-250	Budget plan (amounts for research and development actions programed)			Costs and obligations		
	1969 actual	1970 estimate	1971 estimate	1969 actual	1970 estimate	1971 estimate
Financing:						
Receipts and reimbursements from:						
11 Federal funds	−47,720	−56,420	−63,828	−47,720	−56,420	−63,828
14 Non-Federal sources [1]	−22,482	−30,580	−5,972	−22,482	−30,580	−5,972
21 Unobligated balance available, start of year:						
For completion of prior year budget plans	.....	.....	.....	−311,148	−166,316	.....
Available to finance new budget plans	.....	−117,473	.....	.....	−117,473	.....
22 Unobligated balance transferred from other accounts	.....	.....	.....	−1,235	.....	.....
Reprograming to or from prior year budget plans	−4,961	.....	.....	.....	.....	.....
24 Unobligated balance available, end of year:						
For completion of prior year budget plans	.....	.....	.....	166,316	.....	.....
Available to finance new budget plans	117,473	.....	.....	117,473	.....	.....
Budget authority	**3,313,942**	**2,996,292**	**2,606,100**	**3,313,942**	**2,996,292**	**2,606,100**
Budget authority:						
40 Appropriation	3,370,300	3,006,000	2,606,100	3,370,300	3,006,000	2,606,100
41 Transferred to other accounts	−56,358	−9,708	.....	−56,358	−9,708	.....
43 **Appropriation (adjusted)**	**3,313,942**	**2,996,292**	**2,606,100**	**3,313,942**	**2,996,292**	**2,606,100**
Relation of obligations to outlays:						
71 Obligations incurred, net				3,342,536	3,280,081	2,606,100
72 Obligated balance, start of year				1,443,923	1,256,241	1,386,322
74 Obligated balance, end of year				−1,256,241	−1,386,322	−1,354,422
90 Outlays				3,530,218	3,150,000	2,638,000

[1] Reimbursements from non-Federal sources are receipts for services performed on Communications Satellite Corporation projects (42 U.S.C. 2473).

Object Classification (in thousands of dollars)

Identification code 27-00-0108-0-1-250	1969 actual	1970 est.	1971 est.
Direct obligations:			
22.0 Transportation of things	12,661	12,300	11,000
23.0 Rent, communications, and utilities	59,473	57,700	53,000
24.0 Printing and reproduction	1,267	1,200	1,000
25.0 Other services	3,054,256	2,955,913	2,357,100
26.0 Supplies and materials	122,572	119,000	100,000
31.0 Equipment	82,605	80,200	75,000
32.0 Lands and structures	6,424	6,200	8,000
41.0 Grants, subsidies, and contributions	1,106	1,100	1,000
42.0 Insurance claims and indemnities	24	.....	.....
Total direct obligations	3,342,638	3,235,613	2,606,100
Reimbursable obligations:			
22.0 Transportation of things	297	500	300
23.0 Rent, communications, and utilities	42	75	40
24.0 Printing and reproduction	3	5	5
25.0 Other services	69,247	129,588	68,755
26.0 Supplies and materials	376	700	400
31.0 Equipment	335	600	300
Total reimbursable obligations	70,300	131,468	69,800
99.0 Total obligations	3,412,238	3,367,081	2,675,900

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

RESEARCH AND DEVELOPMENT

GENERAL STATEMENT

The National Aeronautics and Space Administration program of research and development and supporting activities is directed toward maintaining the United States in a position of world leadership in aeronautics and space. The major programs for achieving this objective are:

MANNED SPACE FLIGHT: A program for the development of a capability for peaceful manned space operations and the utilization of that capability for earth orbit and lunar missions.

SPACE SCIENCE AND APPLICATIONS: An unmanned space flight program directed toward scientific investigations of the earth, moon, sun, planets, stars and interplanetary space; and the development of technology and spacecraft systems which can be utilized for meteorology, communications and geodetic and earth resources observations.

ADVANCED RESEARCH AND TECHNOLOGY: An effort required to provide the fundamental knowledge and the technological base for future aeronautics and space programs.

TRACKING AND DATA ACQUISITION: The worldwide activity required to support the NASA manned and unmanned flight programs.

MANNED SPACE FLIGHT

The largest portion of the budget request, although substantially less than in previous fiscal years, continues to be in support of the Manned Space Flight activities. The historic flight of Apollo 11, on July 20, 1969, accomplished the national goal of landing men on the moon and returning them safely to earth. Having met its initial objective, the program continued with Apollo 12 in November 1969 in its quest to expand man's knowledge, not only of the moon, but through a study of the moon, of the earth, the sun, and the solar system. Seven more Apollo landings are presently scheduled, two in 1970, two in 1971, one in 1972, and two in 1974. Modification of basic Apollo procured hardware is planned to provide greater scientific return through improved experiment payloads, longer stay-times, and increased mobility while on the lunar surface.

The Space Flight Operations program focuses on the development of future space systems for conducting manned missions in near earth orbit supporting a variety of experiments and other activities in space. The Space Flight Operations program missions will commence with the Apollo Applications Saturn Workshop launch scheduled for 1972. This is to be the precursor to a

space station and will investigate new technological concepts, conduct experiments, and develop operational techniques applicable to the Station. The flight program for Apollo Applications consists of the following basic missions: (1) initial launch of the Saturn Workshop into orbit on the first two stages of a Saturn V; (2) activation of the Workshop and Apollo Telescope Mount (ATM) by the first flight crew launched to orbit in a modified Apollo Command and Service Module on a Saturn IB; (3) revisit and reactivation of the Workshop for up to 56 days; and (4) a second revisit also lasting as long as 56 days. The space station effort will concentrate on completion of the station module and experiment definition studies now underway and on initial station design. Definition and preliminary design of a recoverable and reuseable Space Shuttle to reduce the cost of space activities and provide convenient and economical transportation to and from earth-orbit is also proposed in this budget.

In the area of advanced missions, studies to examine manned space flight program concepts and the requirements for future systems will be continued. The aim of this effort is to provide the technical information upon which to base future program decisions.

SPACE SCIENCE AND APPLICATIONS

The FY 1971 Research and Development budget provides for the expansion of an applications program which permits the utilization of space technology for the practical benefit of man and the continuation of a space science program designed to increase human knowledge through space research.

The expanded applications program includes research on Meteorological phenomena and their prediction, utilizing Tiros, Nimbus, and Synchronous Meteorological Satellites in addition to Sounding Rocket probes.

Applications Technology Satellites are being used to demonstrate and test techniques in communications, navigation, and air traffic control.

The Earth Resources Survey activity will utilize aircraft and satellites to test sensors and techniques for increasing our knowledge of the earth's natural resources.

Measurements, on a global basis, of the size and shape of the earth and its features will continue using Geodetic satellites.

In addition, studies will be initiated in FY 1971 to (1) determine the proper project approach for U. S. participation in the Global Atmospheric Research Program (GARP) - a worldwide, international program directed toward obtaining data for increasing our understanding of the general circulation of the atmosphere and aiding in long-range weather prediction, and (2) study and design of a spacecraft system with the capability of improving navigation and traffic control services to ships and aircraft from over-ocean areas.

The scientific program encompassed within this activity is largely geared to extending man's knowledge of the solar system and the physical phenomena and interactions between and among the components of this system. In addition, investigations relating to our galaxy and other stars, galaxies and nebulae are conducted.

Investigations of phenomena associated with the earth and its interaction with its environment will be continued using: Geophysical Observatories already aloft, a series of small special purpose explorers, aircraft, balloons, and sounding rockets. Solar studies will continue with additional Solar Observatories.

The exploration of the planets will be extended with the launch of two Mars orbiting spacecraft in 1971, Jupiter probes in 1972 and 1973, a Venus/Mercury flyby in 1973, and two combined Orbiter-Lander systems (Viking) to Mars in 1975.

Investigations of phenomena occurring beyond the solar system will continue utilizing Astronomical Observatories and explorers, sounding rockets, aircraft, and ground based observations.

Funds are also included for additional scientific planning of lunar missions and biological studies and for analysis of data returned from previous flights.

ADVANCED RESEARCH AND TECHNOLOGY

The Advanced Research and Technology effort is a continuing program aimed at providing the essential technological base for significant future aerospace missions, such as Space Shuttle and Space Station. This effort covers the spectrum of activity from basic research to improve our fundamental scientific knowledge, through applied technology to improve our practical capability for developing advanced systems applicable to both space and aeronautical activity. The specific areas of effort in the program are Basic Research, Space Vehicle Systems, Electronics Systems, Human Factor Systems, Space Power and Electric Propulsion Systems, Nuclear Rockets, Chemical Propulsion and Aeronautical Vehicles. During FY 1971, specifications for all of the nuclear powered rocket engine components will be completed and the preliminary design review of the engine system and components will be conducted. The aeronautics program includes increased emphasis on aircraft noise reduction, flight test of V/STOL concepts, and a broad range of applicable research of importance to the nation's position of leadership in aeronautics.

TRACKING AND DATA ACQUISITION

The objective of the Tracking and Data Acquisition Program is to provide the ground support required by the NASA space flight programs. As the direction of the program has evolved from one of implementing a global support capability to one primarily of maintaining and operating this world-

wide capability, recent budget requests have reflected the operational nature of the program. Support of the Apollo missions will continue during FY 1971 at a reduced level. Activity in support of the planetary program will increase compared to the current year's level in preparation for the workload in the early to mid seventies.

Funds in FY 1971 for replacement and improvement of equipment and for facility maintenance will remain at a constrained level to provide the on-going network support required for previously approved projects. The major augmentation in FY 1971 is for the capability required to support the approved planetary program in the 1971 - 1975 period. The Supporting Research and Technology effort will continue at a constrained level but will include a small increase for studies on the Tracking Data Relay Satellite System (TDRSS) and on X-band telecommunications techniques.

SUSTAINING UNIVERSITY PROGRAM

The Sustaining University Program has brought the educational community into the space program through new laboratory facilities, training of highly capable individuals, and the carrying out of multidisciplinary research which has made unique contributions to space activities. This involvement will now be phased out in an orderly manner, and university participation will be primarily devoted to project oriented efforts.

TECHNOLOGY UTILIZATION

The Technology Utilization program provides for expeditious public availability of scientific, technological and engineering information and concepts which result from NASA programs. This promotes a maximum return from public investment in NASA's research and development to the non-aerospace sector of the economy as well as benefiting the aerospace industry. To assure fulfillment of this objective, the program provides for establishing effective mechanisms for: (a) assuring that all new knowledge is identified, collected and evaluated, and (b) announcing and disseminating this new knowledge to assure its wide application and utilization.

FINANCING

The FY 1971 Research and Development program plan discussed in this budget totals $2,606,100,000, a reduction of $507,665,000 below the FY 1970 program of $3,113,765,000.

Research and Development expenditures for the current fiscal year are estimated at $3,150,000,000 and at $2,638,000,000 for FY 1971, a reduction of $512,000,000.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1971 ESTIMATES

SUMMARY OF RESEARCH AND DEVELOPMENT BUDGET PLAN BY PROGRAM BY COGNIZANT OFFICE

BUDGET ACTIVITY	OFFICE/PROGRAM	Fiscal Year 1969	Fiscal Year 1970	Fiscal Year 1971
	MANNED SPACE FLIGHT.....	$2,177,500,000	$2,031,745,000	$1,474,200,000
1a	Apollo.....	2,025,000,000	1,686,145,000	956,500,000
1b&c	Space flight operations.	150,000,000	343,100,000**	515,200,000
1d	Advanced missions.....	2,500,000	2,500,000	2,500,000
	SPACE SCIENCE AND APPLICATIONS.....	453,238,000	519,718,000	565,700,000
2a	Physics and astronomy...	128,850,000	111,835,000	116,000,000
2b	Lunar and planetary exploration.....	87,923,000	151,013,000	144,900,000
2c	Bioscience.....	37,900,000	19,670,000	12,900,000
3	Space applications.....	98,665,000	128,400,000	167,000,000
*	Launch vehicle procurement.....	99,900,000	108,800,000	124,900,000
	UNIVERSITY AFFAIRS			
6b	Sustaining university program.....	9,000,000	7,000,000	---
	ADVANCED RESEARCH AND TECHNOLOGY.....	278,220,000	272,302,000	264,200,000
4&5	Basic research.....	20,220,000	18,902,000	17,600,000
4	Space vehicle systems...	31,349,000	30,670,000	30,000,000
4&5	Electronics systems.....	34,460,000	33,500,000	22,400,000
4&5	Human factor systems....	19,402,000	21,900,000	17,900,000
4&5	Space power and electric propulsion systems....	38,787,000	34,450,000	30,900,000
4	Nuclear rockets.....	33,502,000	36,500,000	38,000,000
4	Chemical propulsion.....	25,752,000	20,480,000	20,300,000
5	Aeronautical vehicles...	74,748,000	75,900,000	87,100,000
6a	TRACKING AND DATA ACQUISITION.....	279,672,000	278,000,000	298,000,000
6c	TECHNOLOGY UTILIZATION....	3,800,000	5,000,000	4,000,000
	TOTAL BUDGET PLAN.....	$3,201,430,000	$3,113,765,000	$2,606,100,000

*Funds for the procurement of launch vehicles are statistically distributed to unmanned flight programs (e.g., Physics and Astronomy, Space Vehicle Systems).

**Includes application of $117,473,000 which was reserved from apportionment in 1969 pursuant to the Revenue and Expenditure Control Act of 1968 (Pub. L. 90-364, 82 Stat. 251).

MANNED SPACE FLIGHT ACTIVITIES

Mr. EVINS. You say the largest portion of the budget, although less than previous years, continues to be in support of the manned space flight activities and seven more Apollo landings are scheduled. You say the space flight operations program focuses on development of future space systems. Missions will commence with the Apollo applications Saturn workshop launch scheduled for 1972. These Apollo Applications consist of: One, the initial launch of the Saturn workshop. That is in 1972, is that right?

Mr. LILLY. That is correct.

Mr. EVINS. No. 2, activation of workshop and Apollo telescope mount. When will this be?

Mr. LILLY. There will be three shots, Mr. Evins. One will be launched late in 1972 and the others in 1973.

Mr. EVINS. No. 3, revisit and reactivation of the Workshop for up to 56 days, and that will be in 1973, and No. 4, a second revisit also lasting as long as 56 days. When will that happen?

Dr. PAINE. 1973.

SPACE APPLICATIONS PROJECTS

Mr. EVINS. At the bottom of the page you mention, "In addition, studies will be initiated in 1971 to (1) determine the proper project approach for U.S. participation in the global atmospheric research program (GARP), and (2) study and design of a spacecraft system with the capability of improving navigation and traffic control services to ships and aircraft from over-ocean areas. These are studies in addition to the program definition, is that correct?

Dr. PAINE. That is correct.

Mr. EVINS. What is the cost of the GARP program?

Dr. NAUGLE. We are asking for $1 million in 1971 for studies for this global atmospheric research project. This is something that will not take place until about 1975 or 1976 and the actual cost of that we do not know yet, but our major share of the work that will be done as a part of this program will be done using the operational meteorological satellites and the experimental satellites that will be operational at that time.

I might mention here this is a joint program where we are working very closely with the Environmental Science Services Administration. I can't give you an estimate of the total cost of part of the work of this study that we plan to undertake. The funding we are requesting will be used to come up with a good cost estimate.

Another reason that it is difficult to say exactly how much this program will cost is because it is an international project in which other countries will be putting up meteorological satellites and we are in the process of negotiating with those countries to see what their contribution will be.

Now, the actual GARP, as presently envisioned, will involve seven satellites: four will be in stationary orbit, two in polar orbit and one in a low-inclination orbit.

Now, it is very likely a couple of the satellites in geostationary orbits will be operational satellites that ESSA will be using as a part of their regular weather program—that they will have put up as part of their

regular weather program, as will probably two of the polar satellites. We hope that France and perhaps the U.S.S.R. will also contribute satellites to this program. So it is a truly international program.

Mr. EVINS. Dr. Naugle, we haven't had too much contribution in a lot of programs. Other countries do not make their contributions towards the upkeep of the United Nations. I hope you are more successful.

Dr. NAUGLE. May I say one word on that? We have been having a very successful international cooperative project.

FUNDING OF INTERNATIONAL PROJECTS

Mr. EVINS. Cooperating, but how much are they participating by way of dollars, costs and funding?

Dr. NAUGLE. In the cooperative projects, generally the cost is about on a 50–50 basis. That is, we will put up the launch vehicle and the other nation will normally put up the money and build the spacecraft itself.

In the case of the cooperative project that we have with Germany, they will put up a good deal more of the total cost of that project.

Mr. EVINS. The GARP program would be confined to studies for 1971, is that correct?

Dr. PAINE. That is correct.

Mr. JONAS. Do you mean when they put up something, you finance the cost at our launch facility?

Dr. NAUGLE. In some cases, Mr. Jonas, there are two types of international projects in which we are involved. In some where it is a cooperative project, we may furnish the launch vehicle and pay for it ourselves and they will design and build and pay for the spacecraft, and then the data is shared and in some cases there are both American and foreign experiments carried on in this way.

There are other projects in which the other country will design, build and pay for the spacecraft and then pay us for the cost of the launching.

Mr. JONAS. How many countries in the world have the capability of putting objects into orbit?

Dr. NAUGLE. I believe it is four now.

Dr. PAINE. Four is correct. The United States, the Soviet Union, Japan, and France have all put satellites into orbit.

Mr. EVINS. Most of these people who are engaged with us in these international ventures use our facilities. When you say they share the cost, what you mean is, they just pay part of the expense of building the instrumentation, but they don't help defray the cost of operations, overhead, or any of that, do they?

Dr. PAINE. They do in the case where we do not judge the launching to be one that we wish to cooperate in for some reason and in which case we ask them to pay for the cost of NASA launching it for them. They buy the rocket and they pay us for the cost of the Cape Kennedy crew required to launch it.

Mr. EVINS. Does that happen very often?

Dr. PAINE. It happens occasionally. I would say more often we judge it to be a cooperative venture in which we have some interest and we contribute the rocket and they put the money into the spacecraft.

Mr. JONAS. If we have already engaged in the same activity and have produced satellites with the same mission, there would be no point in our bearing part of the cost?

Dr. PAINE. Exactly. That is the decision usually made. In the cases where the foreign nation buys the rocket and then pays us to launch it, this, of course, though it isn't a large amount of money every year, represents additional business for our aerospace manufacturers who are able to sell American rockets for the launches rather than having these nations do it through some other means.

FOREIGN EXPENDITURES RATIO

Mr. SHAPLEY. With regard to the cooperative projects, the expenditures on those particular projects of the foreign country have greatly exceeded our expenditures on those same projects. I think we computed roughly a four to one ratio. This results from the fact that the launch vehicle is usually the less costly part of the project and the spacecraft is the largest most expensive part, so I think by and large over the 10-year period there has been a four to one ratio of the cost on these particular projects performed with the other countries.

Mr. EVINS. We commend you.

MARINER-MARS 1971 PROJECT

You indicate that exploration of planets will be extended with the launch of two Mars orbiting spacecraft in 1971. Would you like to tell us a little about your plans for the next year, for the launching of the two Mars-orbiting spacecraft?

Dr. NAUGLE. Mr. Chairman, we have two spacecraft to orbit Mars in 1971. One will be placed in an orbit in such a way that it will primarily be used to give us a good map of the surface of Mars. We need that for selection of landing sites for the Viking Landers when they land on Mars in 1976. The other orbiter will be placed in orbit in such a way that it will repetitively cover the same areas on Mars so that we can watch such phenomenon as the seasonal changes on the surface of that planet.

EXPECTED LIFETIME OF MARS ORBITERS

Mr. EVINS. What is the duration of these spacecraft, Dr. Naugle?

Dr. NAUGLE. The nominal lifetime that we are asking for these is 90 days. There is no reason that they will automatically die at the end of 90 days. They may last a year or more. However, it does become something of a problem of communicating with them as they begin to get on opposite side of the sun from the earth.

MANNED SPACE FLIGHT PROGRAM

Mr. EVINS. Very good. Place in the record the "Manned Space Flight Program," page MSF–1.

(The page follows:)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1971 ESTIMATES

RESEARCH AND DEVELOPMENT BUDGET PLAN FOR

MANNED SPACE FLIGHT PROGRAMS

Program	Fiscal Year 1969	Fiscal Year 1970	Fiscal Year 1971
Apollo.....	$2,025,000,000	$1,686,145,000	$956,500,000
Space flight operations....	150,000,000	343,100,000*	515,200,000
Advanced missions.....	2,500,000	2,500,000	2,500,000
Total.....	$2,177,500,000	$2,031,745,000	$1,474,200,000

* Includes $117,473,000 of FY 1969 funds applied to FY 1970 budget plan.

Mr. EVINS. I notice you have named a lot of these future places where you are going to land. You have one named for a great philosopher, Descartes.

You have already concluded that the moon was not formed through the tearing away of portions of the earth, but rather through its own individual development.

MATERIALS DISCOVERED ON MOON

Scientists studying the rocks have discovered three new materials unknown on earth. Small amounts of copper, silver and gold have also been reported, as well as very small rubies.

You didn't find much gold up there, did you?

Dr. PAINE. Not much. Just trace quantities.

Mr. EVINS. There has been some scientific theorization that new "naturally occurring" elements may be on the moon. These elements are the products of fission and would possess very heavy atomic waste. No evidence of surface water has been reported on the Sea of Tranquillity.

APOLLO PROGRAM

Place in the record the section on Apollo.

(The pages follow:)

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1971 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT — APOLLO PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

Having accomplished the national goal of landing man on the moon and returning him safely to the earth, Apollo continues to expand man's knowledge, not only of the moon, but through study of the moon to better understand the earth, sun, and solar system. The moon is a most unique laboratory. It is the only planetary body, other than the earth, which man can investigate and study in detail. It thus provides a comparative basis for a greater comprehension of the earth, and the processes that affected the development of our planet. The moon's value to man further increases with the growing indication that it was not formed through tearing away of a portion of the earth, but rather had its own individual development. By possessing detailed information from two different and apparently independently formed planetary bodies, scientists can now develop an increased understanding of the other planets in the solar system.

Apollo 11 and 12 have discovered that the moon can be a most remarkable chronicle of the early years of the solar system and a record of events since that period. Nearly all rocks found on the earth fall within the age range of a few million years to 500 million years, with the oldest being about 3.5 billion years. The lunar dust found at Tranquility Base was dated as being 4.6 billion years old. The meaning of this very old age is not clear at this time and further work is continuing. The crystalline rocks returned by the Apollo 11 astronauts were formed approximately 3.7 billion years ago by some volcanic event. A preliminary dating of the rocks from the Ocean of Storms site of Apollo 12 indicates that these may have been formed one billion years after those in the Sea of Tranquility. Both the Apollo 11 and 12 landings were made at sites in the lunar maria which are characterized by their flatness and a lack of rough surface features such as mountains or major craters. Many now believe, based on the analysis of Apollo samples, that the maria were formed by the flooding and cooling of a vast sea of lava. Future Apollo missions, beginning with Apollo 13, will include highland areas of the moon, which are believed to be older than the maria and where rocks dating back to the very beginning of the moon may be discovered.

The moon appears to have preserved the history of its past since its very beginning, while on earth continuing geological phenomena combined with changes in climate and the biological processes have obliterated much of the earth's early history, and all of the first billion years.

Another discovery resulting from the analysis of the Apollo 11 rocks is that the moon, lacking an atmosphere, has been directly exposed through the eons to solar radiation, and has preserved the history of that radiation in its surface materials. By analyzing samples of the lunar surface and subsurface, scientists believe a record of the sun's activity over hundreds of millions of years can be developed, and man may be able to correlate the onset of ice ages or periods of near tropical warmth with changes in solar activity. The most recent ice age covering the northern United States was less than 15,000 years ago, and significant climatic changes have occurred in this millennium. From a study of lunar rocks, we may be able to associate patterns of solar activity with these major cyclic changes in the earth's climate.

The density of the surface material returned from Tranquility Base is approximately the same as the density postulated for the entire mass of the moon. This is quite different from the density distribution on earth, where surface rocks are about four times less heavy than the material in the center. The relationship of this finding with the nature of the internal structure of the moon is under review. Other surprising data bearing on the internal structure of the moon includes the seismic signals, as recorded by the Apollo 12 seismometer, that resulted from the impact of the Lunar Module ascent stage 45 miles from the landing point. The vibration from this impact lasted nearly 50 minutes, and took almost seven minutes to build in intensity. The implications of this finding are still under study, and the phenomenon will be subjected to further analysis when the third stage of the Apollo 13 launch vehicle is impacted onto the moon in April.

Scientists studying the Apollo surface samples have reported discovering three new minerals, unknown on earth. Very small amounts of the elements copper, silver and gold have also been reported as well as very small rubies. Although it is highly unlikely that exploitation of such valuable resources will take place in the near future, their discovery tells us much about the composition and evolution of the lunar material.

There has been some scientific theorization that new "naturally occurring" elements may be discovered on the moon. These elements, the product of fission, would possess very heavy atomic weights. Another interesting finding was the high concentration of titanium and other refractory elements, and the relative depletion of volatile elements such as lead and bismuth in comparison to earth rocks. No evidence of surface water having ever been present at Tranquility Base was detected. The surface of the moon also appears to contain a significant amount of material believed to have come from a particular type of meteorite called carbonaceous chondrite. These meteorites are extremely rare on earth, and are important for their high concentration of carbon. Carbon molecules form the underlying basis for all living organisms on earth, and the structure and arrangement of carbon molecules in nonterrestrial material is of great interest.

During quarantine, terrestrial plants and animals were exposed to the lunar samples to observe any effects. An unexpected result was that some terrestrial plants thrived on a nutrient enriched with lunar soil and grew much larger than their counterparts planted in the control nutrient. The cause of this surprising growth is being investigated.

These initial results from man's first detailed study of material from another planetary body are his first step toward understanding the overall character of the moon, both past and present.

This greater understanding of the moon can also promote a greater understanding of the earth. The moon is invaluable not only because it has apparently preserved its history so well, but in so doing has provided a comparative basis by which man may examine the early history of the earth, and the earth's evolution. The laser reflector placed on the moon by the crew of Apollo 11 has been used to determine the relative earth-moon distance to an accuracy of one foot. Measurements using this reflector may prove that the earth's continents are drifting apart, and have been doing so for several hundred million years. Over a period of years, accurate distance measurements will give us precise information on the Chandler Wobble of the earth's axis which is thought to be related to major earthquakes and thus, possibly make such events predictable.

A more complete understanding of the moon will be produced by visiting different sites, each characterized by a major surface feature. Among the candidate sites selected for future Apollo missions are: Fra Mauro, the site for the Apollo 13 mission this April, which is a hilly upland area believed to be material ejected from a nearby mare as a consequence of impact; Littrow, a mare region, adjoining the Taurus Mountains and a "Mascon" associated with the Sea of Serenity, and containing domes and a wrinkle; Censorinus, a highland site and the location of a fresh impact crater; Descrates, a highland with many long grooves and furrows reminiscent of volcanic regions on earth; the Marius Hills, a major ridge system with volcanic domes and cones; Copernicus, a major crater nearly 60 miles in diameter, with a central peak rising to a height of 2,500 feet, a crater floor with domes and flow areas, and crater walls towering about 13,000 feet above the floor; Hadley-Apennine, featuring a sinuous rille reminiscent of a stream bed on earth at the foot of the 20,000 foot high Apennine mountain front; and Tycho, a large fresh impact crater in the highlands and the location of the Surveyor VII spacecraft.

Each of these sites is characterized by surface topography that is much rougher than the relatively smooth landing areas selected for Apollo 11 and 12. The Apollo 12 flight successfully proved the capability of the guidance and control system of the Lunar Module to land at a precisely targeted point. This accuracy is essential if successful landings are to be made at these future sites.

Some of the sites are also located at areas quite distant from the lunar Equator, the region to which the initial Apollo landings were restricted.

Because of earth-moon positions, the Apollo spacecraft will be able to land at several of these sites only during a one to two month period every year. This will require a continuing precision of the entire Apollo team to meet these very exact launch windows.

A lunar roving vehicle is being developed to assist the astronauts in exploring the moon. It will be especially valuable in exploring the later sites where important features are somewhat dispersed over a large area.

The lunar surface experiments during the next several Apollo missions will complement those already landed on the moon, so that a network of geophysical stations can be established. This will be essential for such things as learning the nature of the moon's structure, for the location, speed, and pattern of seismic waves that can only be derived through simultaneous measurements at seismometers in different locations. During the last series of Apollo missions, the initial experiments may be modified to better record the conditions discovered on the surface, and will be supplemented by additional experiments for measuring physical phenomena existing on the moon. The return to earth of substantial quantities of lunar surface material will continue to be a prime objective in all lunar landings. Lunar surface experiments will also be complemented by several sets of orbital experiments to be included in a scientific instrument subsystem on the Apollo Command and Service Module. These experiments will measure the moon's magnetic field, survey the surface temperature and indicate areas with pronounced thermal anomalies; perform geodetic measurements; map the topographic features of the surface; delineate subsurface structure and indicate the relative abundance of certain elements existing on the moon's surface.

This last series of Apollo missions will contribute greatly to man's understanding of the moon, and thereby increase his knowledge of the earth and the solar system. Man will have investigated the form, regional setting, and subsurface nature of major lunar surface features and the relationships between regions of the moon. Through a chemical analysis of lunar samples, man will be assisted in his investigation of the origin and history of the moon. On an overall basis, we will begin to understand the internal structure and processes of the moon, including seismic activity, heat flow, and generation of gases from the moon's interior. By surveying and measuring the lunar surface we can provide the basis for comprehending the overall surface structure and interrelationship of regions and major surface features. Finally, we will begin to understand the interaction of the moon with the space environment including phenomena such as the solar wind, micrometeorites, and other environmental components.

Seven more Apollo landings are presently planned: two in 1970, two in 1971, one in 1972, and two in 1974.

SUMMARY OF RESOURCES REQUIREMENTS:

	1969	1970	1971
Spacecraft	$913,127,000	$778,978,000	$402,500,000
Saturn V	535,710,000	484,439,000	231,000,000
Operations	533,887,000	422,728,000	323,000,000
Saturn IB	42,276,000	---	---
Total	$2,025,000,000	$1,686,145,000	$956,500,000

Distribution of Program Amount by Installation:

John F. Kennedy Space Center, NASA	$382,800,000	$258,318,000	$205,000,000
Manned Spacecraft Center	1,014,856,000	873,540,000	465,300,000
Marshall Space Flight Center	586,065,000	512,010,000	248,000,000
Goddard Space Flight Center	50,000	200,000	---
Jet Propulsion Laboratory	100,000	664,000	---
Ames Research Center	---	50,000	---
Electronics Research Center	---	10,000	---
Langley Research Center	---	1,410,000	---
NASA Headquarters	41,129,000	39,943,000	38,200,000

BASIS OF FUND REQUIREMENTS:

Spacecraft			
Command and service module	$356,902,000	$282,821,000	$95,500,000
Lunar module	299,240,000	231,433,000	102,900,000
Spacecraft support	198,682,000	170,764,000	137,000,000
Guidance and navigation	42,703,000	33,866,000	24,200,000
Science payloads	15,600,000	60,094,000	42,900,000
Total	$913,127,000	$778,978,000	$402,500,000

The three spacecraft modules - the Command Module, the Service Module, and the Lunar Module - developed for the Apollo program have, in every flight mission, successfully proven their capabilities. The Command Module has been manned six times, including four flights to and from the moon. Astronauts have flown the Lunar Module four times, and performed two landings on the lunar surface. During all these flights, the Apollo spacecraft has responded to the environment of space and the complexity and difficulty of the assigned missions with near perfection. Within 13 months of the first manned flight of the Command and Service Module, and within nine

months of the first manned flight of the Lunar Module, these spacecraft had twice carried man to and from the surface of the moon, in a remarkable demonstration of successful design, engineering, and reliability.

Command and Service Module (CSM)

The Command and Service Modules were developed by the North American Rockwell Corporation. Four unmanned CSM's were successfully flight tested before the crew of Apollo 7 conducted the first manned operational test in October 1968. Since then, astronauts have flown five additional CSM's with all but one journeying to the moon. Two more CSM's, for Apollo 13 and 14, are presently at the Kennedy Space Center being readied for their flights to the moon later this year.

Modifications will be made to four Command and Service Modules to provide them with the capability of conducting extended lunar missions. These modifications include: increasing the cryogenic storage capability of the hydrogen and oxygen tanks to provide for a 16 day mission; installing a scientific instrument subsystem to conduct experiments while the CSM is in lunar orbit; adding controls and displays, and wiring harnesses for cryogenic management and the scientific instrument subsystem; and providing within the Command Module, equipment and stowage provisions for the support of extravehicular activity, science experiments, additional crew supplies and consumables, and scientific data to be returned to earth.

The scientific instrument subsystem will be located in one quadrant of the Service Module and will be an integral platform upon which the orbital experiments can be placed. These experiments will vary with each mission. It will feature a pyrotechnically jettisonable door, an instrument deployment mechanism, and an individual data system. The design and engineering of the basic structure, power system, and thermal controls for the scientific instrument subsystem are nearing completion, and fabrication and assembly of the first flight unit was recently initiated.

During FY 1970, and FY 1971 the remaining Command and Service Modules will be in various stages of production, and checkout or in storage. These Command and Service Modules will be used for lunar missions, and in the Apollo Applications program. For the CSM's used in the AAP, the Apollo program is funding completion of spacecraft structures and Apollo Applications is funding development, production, and integration of modified subsystems, and the checkout of these modified spacecraft. Spacecraft will be placed in storage at various stages during the production process to assure the most effective and economic production cycling possible within this schedule.

Lunar Module (LM)

The Grumman Aerospace Corporation developed the Lunar Module. Five Lunar Module flights have been conducted, the first being an unmanned test

in January 1968. This successful flight permitted the first manned flight in February of 1969, by the crew of Apollo 9. The Apollo 10 astronauts in May 1969, took the LM to within 50,000 feet of the surface of the moon. Citizens on every continent and in nearly every country witnessed the ultimate demonstration of LM's capability in the July and November, 1969 lunar landings. The next two Lunar Modules assigned to land on the moon are presently at the Kennedy Space Center where a checkout of their systems is underway.

Major modifications to four Lunar Modules are underway to give the LM the capability of remaining on the lunar surface for up to 54 hours, or one and one-half times the present capability. These modifications will increase both the payload weight to the surface and the lunar sample weight returned to earth; and expand the range and hover capacity of the LM, allowing it to land at sites that feature difficult terrain and locations remote from the more easily reachable sites on the lunar equator.

The design changes to the Lunar Module to incorporate this extended capability include: larger propellant tanks for the descent engine; additional oxygen and water storage; additional electrical power; provisions for carrying the lunar rover; improved cabin habitability and crew life support for the increased staytime; and the necessary structural modifications to support the 10 percent increase in total Lunar Module weight, and to accommodate the relocation of components and installation of new components.

Modifications to the Lunar Module ascent and descent engines to provide increased performance will also be designed and tested through mid-1971 and modified engines will be installed in the last four LM's. Three Lunar Module test vehicles will undergo static, dynamic, and propulsion tests during FY 1970 and FY 1971 to verify the Lunar Module modifications.

During fiscal year 1971, final assembly, checkout, and modification of the last four Lunar Modules will be in progress. One additional Lunar Module is expected to be delivered to the Kennedy Space Center in FY 1970. As with the CSM, the production of the Lunar Modules may be rephased and the spacecraft stored, to provide for the most effective and economical production cycle.

Spacecraft Support

Funds for Spacecraft Support provide for test operations, crew equipment, spacesuits, logistics, integration, checkout and reliability efforts, operation of the Lunar Receiving Laboratory, and instrumentation. Among the test activities conducted are: spacecraft development testing, thermal vacuum testing, component and subsystem reliability and verification testing, and electronic systems compatability testing. Testing during FY 1970 and FY 1971 will be directed toward supporting the modifications being made to the Command and Service Module and Lunar Module.

Another major task during FY 1970 and FY 1971 will be to modify the astronaut Portable Life Support System (PLSS) to greatly increase the amount of time the astronauts can spend on the lunar surface. The PLSS is a self-contained terrestrial environmental system that helps protect the astronaut from the extremes of heat and cold that exist on the lunar surface, and provides him with oxygen to breathe, and purges the carbon dioxide that is exhaled. The modified PLSS will substantially expand the distance the astronauts can traverse on the surface. In the event of a malfunction of the PLSS while at some distance from the Lunar Module, a Secondary Life Support System (SLSS) will be available. The SLSS will provide the necessary life support to enable the astronaut to return to the Lunar Module. The SLSS is needed for the increased emergency operation time associated with the extended surface traverses. The SLSS will replace the current emergency system which has a short operating time and limits lunar surface activity to the close vicinity of the Lunar Module. Component and system design of the modified PLSS has begun, and design verification testing will be completed by the end of CY 1970. During FY 1971, fabrication of both flight units and systems test units will be accomplished, with both retrofitting of previously developed PLSS' and delivery of new additional systems beginning by the end of the fiscal year. Design of the SLSS began in FY 1970 and design verification testing will be conducted at the end of this fiscal year. Fabrication of systems qualification units and flight units will be underway during FY 1971.

The present Apollo lunar surface suit will also be modified to provide the astronauts with greater mobility at the waist. This will assist them in their activity on the lunar surface by allowing them greater ease and mobility of operation, particularly in stooping more easily. Design and testing of these modified suits are underway during the current fiscal year and a thermal vacuum test will be conducted at the Manned Spacecraft Center in FY 1971. Production of the suits will begin in FY 1970, and will continue in FY 1971.

Other areas funded by spacecraft support associated with crew requirements include survival equipment, food, extravehicular activity equipment, personal hygiene systems, and bioinstrumentation.

Funding in FY 1971 provides for the operation of the automatic checkout equipment (ACE) stations located at contractor plants and at NASA test and launch sites and which are used for the separate and combined checkout of spacecraft systems. Engineering changes to update the equipment for spacecraft modifications and spare components to maintain the operational equipment will also be funded.

Another area of spacecraft support is the development and procurement of specialized flight and mission instrumentation. Typical equipment includes: signal conditioners, sensors, transmitters, antennas, ground support equipment, and radiation measuring devices. A major task in this area

is the development of a lunar surface communications unit which will operate when the astronauts are no longer within line of sight of the Lunar Module. Surface and orbital television systems are also funded by spacecraft support.

An increasingly important area funded by spacecraft support is the operation of the Lunar Receiving Laboratory at the Manned Spacecraft Center in Houston, Texas. This laboratory, beyond its special quarantine capabilities, is also a unique facility for conducting special scientific studies in the areas of geology, chemistry, physics and biology. All lunar samples are examined, studied, and catalogued here before being released to the scientific community throughout the world for detailed study. The scientists at this laboratory perform the preliminary determinations as to the nature of the samples, and assure that the principal investigators receive material properly associated with their investigations. The laboratory also serves as the central forum for compiling the results of the detailed studies.

Logistic funding in FY 1971 is needed for transportation of spacecraft between installations, and procurement of spacecraft fuels and propellants.

Guidance and Navigation

The Guidance and Navigation system units for the Apollo spacecraft were designed by the Massachusetts Institute of Technology and were produced by the A. C. Electronics Division of General Motors, with major subsystems produced by the Raytheon Company, and the Kollsman Instrument Corporation. All Guidance and Navigation units for both the Command and Service Module and the Lunar Module have been produced and delivered.

Fiscal year 1971 funding will be applied to the development and testing of flight programs to accommodate the forthcoming series of Apollo missions with their landings at difficult sites involving very complex trajectory and orbital paths. Pre-launch checkout of delivered units, analysis of flight data, and engineering and technical support for resolution of any problems, will also be supplied.

Science Payloads

Having demonstrated that man can land on the moon and safely return to earth, future Apollo missions will increasingly be directed toward greatly expanding man's knowledge of the nature of the moon, its evolution and processes, and relating these to man's better understanding of the earth and the solar system. Science will be the principal objective of these missions.

To assist man in this exploration, a lunar roving vehicle is under development. The lunar rover, weighing about 400 pounds and powered by battery driven electric motors, will permit the astronauts to venture from five to

fifteen kilometers from the Lunar Module. The rover will be capable of a top speed of 10 miles per hour, and can carry two astronauts with their tools about the moon as they collect samples, place instruments, and conduct experiments. The rover, beyond expanding the radius of exploration for the astronauts, increases the quality of the science that can be conducted on a mission by quickly transporting the crew to areas of great scientific interest. Engineering and fabrication of the rover is underway and assembly of test and training units will soon commence. Testing of the lunar rover will be conducted in FY 1971, and the first rovers for use on the moon will be in various phases of assembly during the fiscal year.

Apollo 11 astronauts deployed three experiments, and of these the passive seismic experiment which was powered by solar energy has been turned off.

The crew of Apollo 12 deployed the first Apollo Lunar Surface Experiments Package (ALSEP) on the moon. The ALSEP, with a central station for collecting and transmitting data back to earth and supplied with electrical power from a nuclear fuel element, has a planned operational life of one year.

The remaining Apollo missions will deploy additional ALSEP's on the lunar surface. Among the instruments deployed will be seismometers, ion detectors, magnetometers and particle detectors. Continuing operation of previously placed ALSEP's will permit establishment of a scientific network that can lead to increasing our basic understanding of the moon. The next three missions will carry ALSEP's similar to that carried on Apollo 12, although with somewhat different experiment groupings. Development and production of scientific equipment for the following two missions, Apollo 16 and 17, will be initiated in FY 1970 following final review of the proposed experiments. Studies of experiment package experiments for the final two missions will be undertaken during 1971.

Prototype lunar orbital science experiments for the last Apollo missions are being developed, and production of the flight experiments has begun. The initial group of lunar orbital experiments are scheduled to be completed and delivered to the North American Rockwell Corporation for integration into the CSM by the end of FY 1971.

Saturn V

	1969	1970	1971
Flight stages.....	$402,057,000	$357,116,000	$134,400,000
Vehicle support.....	133,653,000	127,323,000	96,600,000
Total.....	$535,710,000	$484,439,000	$231,000,000

Developed as this country's most powerful launch vehicle, the Saturn V has flown seven times. Following the second of its two unmanned flight tests in April, 1968, the Saturn V was next used to launch the crew of Apollo 8 on their historic Christmas Eve journey around the moon. Each of the four manned missions performed by the United States during 1969 was launched on a Saturn V vehicle.

The Saturn V can launch payloads weighing 145 tons into low earth orbit and inject spacecraft weighing over 53 tons on voyages to the moon. It is seven to eight times as powerful as the Saturn IB and Titan III launch vehicles, neither of which is capable of a manned lunar mission. With a first stage sea level thrust of 7,750,000 pounds, and two high performance liquid oxygen/liquid hydrogen upper stages, it is the only vehicle comparable to the expected capability of the new launch vehicle reported being developed by the Soviet Union, whose predicted first stage thrust is 10 or more million pounds.

Fifteen Saturn V launch vehicles are being produced for the Apollo program. Of the eight vehicles that have not yet been flown, one is positioned on Pad A Launch Complex 39 at the Kennedy Space Center (KSC) being readied for the April launch of Apollo 13 to the moon, and the launch vehicle for Apollo 14 has been delivered to KSC. One is in storage. Five vehicles are in the concluding phases of production and testing. One of these has been assigned to the Apollo Applications program to launch the Saturn Workshop in 1972.

Further production of the Saturn V launch vehicle beyond the currently approved 15 vehicles has been suspended. Fiscal year 1970 and 1971 funding is primarily for completion of current production and activities in support of the flight schedule.

While the planned advent of the space shuttle during the last half of the decade will permit some heavy payloads to be carried to earth orbit by that system, a vehicle with the performance of a Saturn V will remain this nation's only launch vehicle capable of orbiting such diverse and essential payloads as space station modules, space tugs, nuclear propulsion stages, lunar orbit station modules, manned planetary mission modules and landing vehicles, and the systems required to establish a lunar surface base. The Apollo funding for Saturn V launch vehicle includes conserving the acquired skill techniques accumulated through eight years of Saturn V development and production. Videotapes and other graphic records of manufacturing techniques, test and checkout procedures, and other associated production tasks, will be made in an attempt to reduce the cost of reinitiating production. This effort will be supplemented by documenting the diverse production tasks and the efficient and economical methods developed for performing them. Funding will be used to preserve and store tooling, inventory and assess the future usefulness of equipment and materials, and performing any other necessary tasks related to concluding a production run while preparing for a future reinitiation.

Flight Stages

The first stage of the Saturn V, the S-IC, is produced by Boeing at the Michoud Assembly Facility near New Orleans, Louisiana. The S-II, or second stage, is manufactured by the North American Rockwell Corporation at Seal Beach, California. The McDonnell-Douglas Corporation builds the third stage, the S-IVB, at its Huntington Beach, California plant. The instrument unit, which controls the vehicle's flight, is built by the IBM Corporation at Huntsville, Alabama. The first and second stages are presently being test fired at the Mississippi Test Facility in Hancock County, Mississippi. The third stage was test fired at the Sacramento Test Facility in California. No further test firings of the third stage are planned. The F-1 and J-2 engines were developed and produced by the Rocketdyne Division of the North American Rockwell Corporation at Canoga Park, California.

During the remainder of FY 1970, one Saturn V launch vehicle will be delivered to the Kennedy Space Center. Three S-IC stages and two S-II stages will have completed static firing during the fiscal year and will be placed in storage. One S-IC stage is being refurbished to repair damage resulting from an F-1 engine malfunction that occurred during static firing. Two spare engines replaced those damaged by the accident. Assembly and systems installation on the last two S-IC and S-II stages will be completed. All S-IVB stages have completed fabrication. Static firing of S-IVB stages has been concluded. All undelivered S-IVB stages are in final assembly, checkout or storage. Three instrument units will be in assembly or checkout. Delivery of the last F-1 engine, this country's most powerful rocket engine, was made in October of 1969. Ninety-eight engines were produced in the Apollo program. Delivery of the last J-2 engine, this country's most powerful liquid hydrogen/liquid oxygen fueled engine was made in January 1970. For Apollo, 152 J-2 engines were built. These deliveries complete the present production of rocket engines for this country's manned space flight program.

In FY 1971, one Saturn V launch vehicle will be delivered to the Kennedy Space Center. All undelivered S-IC, S-II, and S-IVB stages will be in checkout or storage by the end of the fiscal year. Four instrument units will be in various phases of assembly and checkout during the fiscal year.

During FY 1971, funding for the flight stages, engines and instrument units of the Saturn V launch vehicle will be allocated toward completing production on those few remaining units on which work continues; test and checkout of completed stages; storage and maintenance of stages; analysis of flight data; and providing engineering and technical support for solving technical problems which may arise. The engineering and technical support by the prime contractors of the flight stages and engines is expected to form the major element of this and future year funding.

Vehicle Support

Funding in this area is for services and equipment that are common to more than one stage of a vehicle, and for the operation of the electrical and mechanical support equipment required to test and checkout the stages, instrument unit, and associated hardware. Saturn V checkout is based on the philosophy that improved vehicle reliability and minimum time at the launch site can be attained by using computer-controlled systems to verify component performance and systems operation.

Test operations at the Mississippi Test Facility, transportation of stages, operation of the Slidell Louisiana Computer Facility, range safety and tracking devices for vehicles, propellants, systems integration, computation services, engineering services, reliability, quality control and inspection, and flight evaluation programs are funded by this account.

Operations

	1969	1970	1971
Launch, flight and recovery...	$478,529,000	$369,998,000	$279,800,000
Technical.....	55,358,000	52,730,000	43,200,000
Total.....	$533,887,000	$422,728,000	$323,000,000

Operations funding provides for crew training, launch, flight, recovery and programwide technical and Department of Defense support required for manned space flights. Included in the Apollo portion of operations is funding for the basic capability to conduct all manned flight, regardless of program, together with activities necessary for specific Apollo missions. The associated operations project included in Space Flight Operations funds only those efforts unique to that specific program. Seven additional lunar missions are planned in the Apollo program; two in 1970, two in 1971, one in 1972, and two in 1974.

Launch, Flight and Recovery

The two principal centers for launch, flight control and recovery activities are the Kennedy Space Center (KSC), Florida and the Manned Spacecraft Center (MSC), Texas.

The Kennedy Space Center is responsible for checkout through system by system testing; analysis for possible hardware discrepancies during the preparation for launch of both the launch vehicle and spacecraft; maintenance and operation of the launch facilities; final integration and integrated checkout of the space vehicle and its payload; the operation and coordination of supporting facilities, ground support equipment and logistics support; and the conducting of the launch.

The major operational costs of the Kennedy Space Center are associated with the checkout of the spacecraft and the launch vehicles, and the launch support requirements.

Launch support is supplied by both NASA contractors and the Air Force Eastern Test Range (AFETR). The Department of Defense is reimbursed for AFETR costs incurred for NASA support. Included in launch support is the management and operations of launch complexes; systems engineering services; technical shop operations; propellant services and propellant systems laboratory operations; and ordnance storage. Also included are engineering design and fabrication services for the electrical and electronic systems that support the launch capability, the modification, installation and specialized maintenance of launch facilities, and post launch facility refurbishment.

Other operational costs at KSC include those associated with computation and instrumentation support, involving the operation and maintenance of computing systems, high speed plotters, magnetic tape data transmission equipment, and peripheral computer equipment. Additional operational support provided under this category includes the operation and maintenance of telemetry, antenna, and tracking systems that receive and process data from pre-launch tests and launches of NASA space vehicles.

The Manned Spacecraft Center in Houston is the headquarters for all crew, flight, and recovery operations. The astronauts are based at this Center along with most of their essential training equipment. This equipment includes proficiency aircraft, spacecraft mockups, procedures simulator, docking trainer, zero "G" simulator, systems trainer, lunar landing training vehicles and the mission simulators. The Manned Spacecraft Center is also responsible for mission simulation and other astronaut training equipment located at the Kennedy Space Center. Also at MSC is the Mission Control Center with its computer complex and communications links to the tracking network and other worldwide data sources. The Center controls flight operations from shortly after liftoff to recovery.

In addition to basic expenses to support these operations, there are requirements that are directly relatable to specific missions such as mission planning, including trajectory analysis; failure analysis and evaluation of operational performance; and the funding of recovery operations which encompasses the planning, development and operational phases of recovery activity including the location and retrieval of the astronauts and spacecraft following touchdown. The DOD provides most of the recovery operation elements required by NASA in this support category. Reimbursement is made for all DOD costs incurred based on the number of ships, aircraft, communications facilities and training personnel deployed and on the number of days these resources are used.

Technical

Technical operations provide for the systems engineering needed for the integrated technical support, review, and analysis of the entire Apollo program; supporting development; contractor administration, audit, and property administration services provided by the Department of Defense on a reimbursable basis; and for the nonrecurring maintenance and rehabilitation of government-owned industrial plants. In FY 1971 systems engineering services provide functional and performance standards for Apollo developed hardware; technical integration and evaluation; technical documentation; and overall trajectory analysis primarily through the principal systems engineering contractors - Bellcomm, Boeing and General Electric. Emphasis will continue to be placed on analysis of Apollo flight missions. Funding for supporting development will concentrate on engineering efforts to improve Manned Space Flight hardware. The nature of these efforts vary widely, extending from alternative subsystems to new material fabrication and testing. Effort in FY 1971 will continue to be devoted to those promising areas highlighted in previous work with new tasks focusing on applied systems development.

Saturn IB

	1969	1970	1971
Saturn IB.....	$42,276,000	---	---
Total.....	$42,276,000	---	---

Fiscal Year 1969 was the last year of Apollo funding for the Saturn IB launch vehicle. Seven unused Apollo Saturn IB launch vehicles have been transferred to Apollo Applications for use in that program. Production of the Saturn IB has been concluded.

Mr. EVINS. The command module has been manned six times. The lunar module has been used four times and performed two landings. During all these flights the Apollo spacecraft has responded to the environment of space and the difficulty of the assigned mission with near perfection. Within 13 months of the first manned flight of the command module and within 9 months of the lunar module, these spacecraft have twice carried men to and from the surface of the moon. That is success.

APOLLO CONTRACTORS

Rockwell produced the command and service modules and Grumman produced the lunar module. The spacecraft was produced by whom?

Dr. PAINE. The S-IB rocket was produced by Chrysler; our Saturn V rocket by Boeing, North American Rockwell, McDonnell-Douglas and IBM.

Mr. EVINS. During 1971 final assembly, checkout and modification of the last four lunar modules will be in progress.

Another major task of 1971 will be to modify the astronauts' portable life-support system to greatly increase the amount of time astronauts can spend in space and to protect them from extreme heat and cold. A secondary life-support system will be available if needed. Fabrication of systems qualification units and flight units will be underway during 1971.

PRODUCTION OF SPACESUITS

You say these suits will be modified so that stooping can be done more easily. Production of suits will begin in 1970 and will continue through 1971. How much do we spend for the astronauts' suits?

Mr. MYERS. We plan to obligate $6.8 million for spacesuits, including the development activity in fiscal year 1971.

Mr. EVINS. $6.8 million. How many are you going to buy?

Mr. MYERS. I haven't the quantity. It covers the astronauts and the backup crews.

Mr. EVINS. You are going to spend $6 million and you don't know how many suits it will buy?

Dr. PAINE. Twenty-nine spacesuits will be delivered in fiscal year 1971. The suit needs are based on the flight schedule and the astronaut corps.

Mr. BOLAND. The suits of the cosmonauts never seem quite to be as exotic as the suits of the astronauts. Would you say they are less reliable?

Dr. PAINE. I think they probably reflect more the fact that the cosmonauts have been inside the cabin and when they go out it has been for a short time. We have had to design these suits for lunar surface activity which requires more of the suits.

APOLLO COST BREAKDOWN

Mr. BOLAND. Will you give us a break down of the costs on Apollo and tell us how you arrive at these huge amounts? As I understand this tab, you will be spending, at the JFK Space Center, $205 million in 1971.

Dr. PAINE. That is correct.

Mr. BOLAND. Can you give us a breakdown on these amounts?

Mr. MYERS. On the $402.5 million, we will be spending $95.5 million on the command and service modules; $102.9 million for the lunar modules; $137 million on the spacecraft support, which covers the test operations, crew equipment, space suits and so on, in the basic program; guidance and navigation, $24.2 million, and the science payload, $42.9 million, adding up to $402.5 million.

In the Saturn V, a total of $231 million. The breakdown is as follows: The S–IC stage is $31.1 million; the S–II stage is $31.9 million; the S–IVB stage, $28 million; the instrument unit is $21.2 million; the F–1 engine for the first stage would be $11 million and the J–2 engine for the second and third stages would be $11.2 million. That adds up to $134.4 million of that total and we have vehicle support at $96.6 million. The vehicle support breaks down into support of the Marshall Space Flight Center of $78.6 million and ground-support equipment support of $18 million, adding up to the $96.6 million. A total of $96.6 and $134.4, I hope, adds up to $231.

Mr. BOLAND. It does. How about operations?

Mr. MYERS. $323 million and that breaks down into launch flight and recovery operations, $279.8 million, and technical activities at $43.2. Techanical activities cover systems engineering and advance development and contract administration. Saturn I–B this year has no fund requested in 1971.

APOLLO SCIENCE PAYLOADS

Mr. BOLAND. On page RD–1–17 you talk about science payloads. You have a good narrative on that. Give us an explanation of the objectives.

Mr. MYERS. In the Apollo program they started with the first science payloads to be placed on the surface of the moon and included the seismograph and solar wind experiments and it has grown from that time to a more sophisticated system on Apollo 12 where they added a magnetometer in which they determined a weak magnetic field on the surface of the moon, and it is continuing to grow as we continue into the additional flights. For example, Apollo 13 will have a core drilling item, along with the flight in which they will be able to drill as deep as 10 feet on the surface of the moon, not only to get a deep core sample, but also to leave in that drilled hole a thermometer that will measure the undersurface conditions of the temperature of the moon.

LUNAR SCIENCE

Lunar science payloads continue into the later Apollo flights to include in the Apollo 16 the lunar rover that we spoke of earlier that will allow traverses as much as 5 miles away from the lunar module, covering of course a much greater area of the surface of the moon, and an orbital science package will be carried in an empty bay of the command and service module, in which case we will be able to do overall surveys of the surface of the moon with spectrometers, and various receiving equipment that can photograph and receive various spectrum from the moon.

Mr. EVINS. What new contracts will be entered into for Apollo in the next year and in what amounts?

Mr. MYERS. I know of no major new contracts.

We are continuing to look at the experiments area to see if there are any experiments that should be included for the late flights, Apollo 18 and 19, that would be flown in 1974. We are going to continue to view the science data that come out of these early flights. If there is the opportunity to make last-minute changes, it will give us a last look at the moon before we shut down from some indefinite period of time, we will go forward with additional science experiments.

Other than that, there are no major contracts associated with hardware.

LUNAR RECEIVING LABORATORY (LRL)

Mr. EVINS. I was interested in the increasingly important area of operation of the Lunar Receiving Laboratory which we authorized and appropriated for several years ago. Some of us were apprehensive that we were going to build the laboratory before we had the man up there. But wisely, we had it built.

Beyond its speical quarantine facilities, it is also a unique facility for conducting special scientific studies in the areas of geology, chemistry, physics and biology. All lunar samples are examined, studied, and cataloged here before being released to the scientific community throughout the world for detailed study.

How many laboratories are studying the moon rocks, how many have been distributed? Tell us about that, Dr. Gilruth.

Dr. GILRUTH. I think there are 191 principal investigators. There might be two of those in one major laboratory, but there are a great many laboratories studying these rocks.

Mr. EVINS. You have examined, studied, and cataloged them before you released them, didn't you?

Dr. GILRUTH. Yes. And we had to, in many cases, prepare them in special ways like cutting very thin slices of these rocks for X-ray type of examination to be made.

Mr. JONAS. You got those back from the souvenir hunters, did you not?

Dr. GILRUTH. Yes, sir.

Incidentally, for the dating of the lunar samples, there is a very fine facility in that lunar receiving laboratory for this dating function, where you have to have very low level of radiation.

There is a facility there where its age is determined.

Mr. JONAS. They are cataloged when they are released; are they to be returned after a definite period of time?

Dr. GILRUTH. Yes, sir, they are to be returned.

Mr. EVINS. Very good.

LUNAR ROVER

To assist man in his exploration of the moon, we have the lunar roving vehicle which is under development. This vehicle weighs about 400 pounds and powered by battery, will permit the astronauts to ventuer 5 to 15 kilometers away.

The first rovers for use on the moon will be in various stages of assembly during this fiscal year. How many are you going to buy?

Mr. MYERS. We are buying four for flight operations.

COST OF LUNAR ROVERS

Mr. EVINS. How much will each cost?

Mr. MYERS. The program cost in fiscal year 1970 and fiscal year 1971 is about $30 million.

Mr. EVINS. For the four of them?

Mr. MYERS. That will include the development and the production of the four.

Mr. EVINS. That is a pretty expensive vehicle.

Dr. PAINE. The award of that contract includes General Motors as a part of the contract team.

Mr. EVINS. Has the award already been let?

Dr. PAINE. Yes; we had a competitive contract, got bids from various manufacturers, this was the best we could do. These are being built partly in Huntsville, are they not?

Mr. MYERS. Yes; assembled at Huntsville.

Mr. EVINS. How do you propose to control these rovers?

Mr. MYERS. The present design is man-controlled. There have been proposals made to make an unmanned capability out of one of the operators. In fact one of the things we are looking at is the possibility on the last flight of having one of the lunar rovers stay on the moon's surface in an unmanned mode of operations as the last of the 1970's exploration of the moon. That is in a very early preliminary design right now.

FINAL LUNAR MISSION

Mr. EVINS. Prototype lunar orbital science experiments for the last Apollo mission is being developed. Production of the flight experiments has begun. The production for the last manned mission presently planned is underway, though yet not funded.

You are taking Congress and the country for granted, are you not, Doctor?

Dr. PAINE. You know there was a proposal when we got down to the end of the program we should send the last flight up with astronauts and then ask for the money to bring them back. [Laughter.]

Mr. EVINS. You are going to be developing experiments for the last Apollo mission and you have several yet in the meantime to be funded. So you are way ahead.

Mr. JONAS. I must have misunderstood your statement. Surely these rovers do not cost $7.5 million apiece?

Tell me I misunderstood that.

Mr. MYERS. Total program development cost, including all the development activity, qualification of the system and the building of four of them, does cost $30 million.

Mr. JONAS. You wish you had not put this picture in here?

Mr. CLAWSON. It does not look like that much, does it?

Mr. JONAS. What is there about it?

Mr. MYERS. It is a pretty sophisticated vehicle when you get right down to it. We have to get it down to 400 pounds and it is folded up and inserted into the side of the LM in the space that we have available for it. So it has to be unfolded in a very clever geometric arrange-

ment, to open it up, let it down the side of the LM onto the surface of the moon. It has communications equipment aboard it.

Mr. JONAS. Are these tires solid or inflated?

Mr. MYERS. No; they are a special wire tire to avoid contamination of the area the scientists are working in. So there is very little of it that is standard automotive practice.

Dr. LOW. It has to operate over the lunar terrain which is very difficult. It has to operate at minus 250 degrees and plus 250 degrees.

Mr. JONAS. I see on television jeeps being driven over rugged terrain. Anyway, we cannot change that.

Mr. BOLAND. It is not the same type as this terrain.

Dr. PAINE. It is pretty rugged terrain.

Mr. EVINS. How many unmanned flights with the Saturn V, if any, will you have?

Dr. PAINE. We have none unmanned with the exception of the Saturn V, which we have pulled out to launch the workshop in 1972. There will be no man aboard that flight. The astronauts will fly up later.

Mr. EVINS. While the planned advent of the space shuttle during the last half of the decade will permit some heavy payloads to be carried to earth orbit by that system, a vehicle with the performance of a Saturn V will remain this Nation's only launch vehicle capable of orbiting such diverse and essential payloads as space station modules, space tugs, nuclear propulsion stages, lunar orbit station modules, manned planetary mission modules and landing vehicles, and the systems required to establish a lunar surface base.

That is a pretty versatile, able and powerful vehicle.

PROJECTED APOLLO COSTS

You are asking for $956.5 million in 1971 for Apollo.

What is the present projected cost for the next 5 years? Does anybody have any estimated costs for the Apollo program for the next 5 years?

Mr. LILLY. Depending upon the schedule we fly, the schedule we have laid out, including 1971, I believe is around $3 billion.

Mr. EVINS. Each year?

Mr. LILLY. Year by year?

Mr. EVINS. Yes. You have less than $1 billion this year for the Apollo program. How much is the cost going to be for each year until the program is completed?

Mr. LILLY. I will have to supply that for the record. It will depend on whether or not other items such as the space shuttle and the space station are undertaken and whether or not they are bearing some part of the operational cost involved in operating our bases.

(The information follows:)

The funding required to maintain the Apollo program through completion in the first half of fiscal year 1975 is dependent on many factors. However, under the existing guidelines and schedule, assuming continued success, our current estimates for the program by fiscal year are as follows: 1971, $956 million; 1972, $880 million; 1973, $780 million; 1974, $740 million; 1975, $310 million.

These estimates assume continued lunar exploration flights through Apollo 19 in late calendar year 1974 and that during this period, the Apollo program will continue to bear costs of maintaining the development, production, test and operational capabilities to meet the common requirements of all manned space flight programs. To the extent that new programs are undertaken and would bear their proportionate share of relatively fixed costs, i.e., space station, space shuttle, second skylab, the costs allocated to the Apollo program would, of course, be reduced.

Space Flight Operations

Mr. Evins. Gentlemen, let's turn to the "Space Flight Operations Program" and place that section in the record.

(The pages follow:)

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1971 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT — SPACE FLIGHT OPERATIONS PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The Space Flight Operations program is directed toward capitalizing on this nation's investment in trained manpower, facilities and the technology developed in the Gemini and Apollo programs for the launch, production and operation of manned space systems. The program incorporates and initiates some of the key elements of the recommendations of the President's Space Task Group in their September 1969 report. Provision is made for definition and design effort necessary for developing new systems and technology for space operations with emphasis upon the critical factors of (1) commonality, (2) reusability, and (3) economy. This program will be directed initially toward development of a new space transportation capability and space station modules which utilize this new capability and will provide an opportunity for broad international participation and cooperation.

Initial Space Flight Operations will be conducted in the Apollo Applications program building on the strong base of flight experience, ground facilities, and trained manpower developed in the Apollo program. Apollo Applications employs a Saturn Workshop, launched atop the first two stages of a Saturn V, an Apollo Telescope Mount for observing the sun, and the basic space vehicle hardware developed and procured in Apollo. This hardware is being modified to meet the unique requirements of the Apollo Applications missions and to accomplish a limited but carefully selected number of scientific, technological, medical and space application investigations.

Apollo Applications will determine and evaluate in a series of progressively longer missions, reaching up to 56 days, man's physiological responses and aptitudes in space under zero-gravity conditions, and equally important, his post-mission re-adaptation to the earth environment. The solar astronomy and other physical science experiments will greatly increase man's understanding of the sun and interplanetary space. Acquisition of earth resources data may accelerate international cooperation in understanding, improving, and controlling the management and use of earth resources of the entire world.

Great stress will be laid on investigating and evaluating the unique capabilities of man for judgment and discriminating observations, sensor operation, data selection and assessment, maintenance, repair, assembly and set-up, instantaneous and flexible reaction, manned flight control, and mobility while conducting experiments and operations. The Workshop mission will also develop and demonstrate techniques for increasing systems life and evaluate techniques for in-flight test and qualification of advanced subsystems.

The Apollo Applications missions are a prelude to the operation of a space station and space shuttle. This combination of a shuttle and a multi-purpose station or base will be a major step in realizing the potentialities of space science to make a visible contribution to the vitality and forward progress of both this country and the world.

The versatility of the space station and space shuttle to perform many varied tasks should lead to a productive and economical utilization of space. The long-term and multi-purpose nature of the station, and the space base which will develop from it, provides the means for consolidating many diversified efforts in space to obtain advantages of commonality. Scientific and applications experimentation will be strengthened with the initiation of new tasks previously not achievable. The station and base, with the logistics support of the space shuttle, will be a basic supportive system for much of the investigative activity to be conducted in earth orbit. The introduction of the reusable space shuttle will reduce the cost of this activity, simplify the operational procedures, and provide convenient and economical transportation.

SUMMARY OF RESOURCES REQUIREMENTS:

	1969	1970	1971
Apollo applications.....	$150,000,000	$300,052,000	$364,300,000
Operations.....	---	24,548,000	40,900,000
Space shuttle and station.....	(8,800,000)	18,500,000	110,000,000
Total	$150,000,000	$343,100,000	$515,200,000

Distribution of Program Amount by Installation:

John F. Kennedy Space Center, NASA.....	---	$9,600,000	$18,600,000
Manned Spacecraft Center...	$54,707,000	139,208,000	136,900,000
Marshall Space Flight Center.....	93,458,000	165,897,000	310,700,000
Jet Propulsion Laboratory..	---	150,000	---
Ames Research Center.....	145,000	3,407,000	1,870,000
Electronics Research Center	---	400,000	---
Langley Research Center....	125,000	638,000	330,000
NASA Headquarters.....	1,565,000	23,800,000	46,800,000

BASIS OF FUND REQUIREMENTS:

Apollo Applications

Apollo Applications will be directed toward near-earth missions emphasizing the utilization and application of space for man's benefit and knowledge. With flights commencing in late 1972, the program is structured about an

earth orbiting workshop containing a solar observatory, laboratories, work areas, control stations and crew living quarters. Following the launch of the Workshop, three manned missions using Apollo Command and Service Modules will visit and use the Workshop during its planned eight month flight sequence.

The program will be a precursor of space station operations that will begin in the last half of the decade. While Apollo Applications will investigate new technological concepts, conduct experiments, and develop operational techniques applicable to the station, its greater importance will be to demonstrate during long duration manned flights the inter-association of man and his experiments.

Medical Science

Man first journeyed into space nearly nine years ago, and has since progressed through longer and more distant flights. To date, he has successfully adapted to this new environment. The Gemini program demonstrated the ability of man to retain both his health and his capacity to perform physical and mental tasks for periods up to 14 days. Apollo has proved that he can readily acclimate himself to the 1/6th gravity force existing on the moon.

The first manned Apollo Applications flight will be a mission lasting up to 28 days, or twice the duration of existing experience, and will investigate the effects of prolonged weightlessness on man's health and behavior and on his ability to carry out his various duties. The second and third flights are planned for up to 56 days each, and will approach the regular crew cycles anticipated on the space station and space base.

The medical and behavioral studies of the flight crews during the Apollo Applications mission will focus on the effects of space flight on man, and the sequence through time of these effects. Man, to date, has seemingly been able to adjust to weightlessness and any physiological effects have apparently stabilized. Longer flight times could change these conditions. If undesirable effects are noted during the mission, the program will then evaluate means of mediating the effects, predicting their onset and severity, and determining the most effective method of prevention or correction. It is expected that a physician astronaut will be a member of one flight crew.

Included among the experiment studies that will assess the effects of weightlessness on man are: an evaluation of calcium and endocrine balance within the body; a determination of the occurrence and degree of bone demineralization; a survey of changes in the cardiovascular system and functions, including the electrical activity of the heart; an investigation of the frequency of chromosome aberrations in blood cells, and the changes in red cell mass, red cell survival and plasma volume; an examination of the effects of space on blood coagulation and cellular immunity; studies on the effects of a prolonged absence of gravity on the body's metabolic rate, and also on the functioning of the inner ear, which provides the body with its sense or orientation and balance.

These medical studies are expected to contribute to basic medical knowledge, not only on the effects of space on man, but by establishing reference points through the detailed and documented study of healthy human subjects, who are infrequently the object of medical research. As in the past, the experiments and their measurement systems may find applications here on earth in the diagnosis and treatment of the ill.

Bioscience

Several biological experiments will be conducted. These are: a study of the effect of zero-gravity on living human cells in a tissue culture, and three experiments examining biological rhythms. Living organisms possess periodic rhythms, influenced by unknown factors, which govern their life processes, activities and behavior. If these rhythms are altered, a condition may develop among the different functions of the organism, resulting in metabolic confusion that may induce discomfort and illness. Potatoes, vinegar gnats, and mice will be studied for the effect of the space environment on these rhythms.

Space Physics and Astronomy

Knowledge of the sun with its tremendous range and combination of temperatures, pressures, and magnetic and radiative field strengths, provides the basis for new studies in various physical disciplines. Man is limited in his study of the sun because of the atmosphere that protects him from it. Our atmosphere shields terrestrial observation of the ultraviolet, extreme ultraviolet, X-ray, and most infrared radiation from the sun. The atmosphere, with its turbulence, blurs any optical images of the sun and clouds and atmospheric pollution also interrupt viewing. To overcome these problems and barriers, the Saturn Workshop will operate as a support base for a solar observatory - The Apollo Telescope Mount (ATM). The ATM contains five experiments: a White Light Coronagraph to monitor the brightness, form, and polarization of the solar corona in white light; an X-ray Spectrographic Telescope for studying solar flare emissions in the soft X-ray wavelengths; an Ultraviolet Spectrometer for photoelectrically recording high resolution solar images and surveying spectral emissions of selected areas of the sun; a Dual X-ray Telescope for obtaining time-histories of the dynamics of the solar atmosphere in selected X-ray ranges; and an Ultraviolet Spectrograph and Heliograph for recording high resolution images in the ultraviolet wavelength.

The information received from the Apollo Telescope Mount will substantially increase man's knowledge of the sun and bring closer the day when he can understand the remarkable physical pehnomena evident there and the effect of these phenomena on man's existence on earth.

During the eight month flight of the Workshop, the crew will conduct other astronomical and space physics experiments. In one, nuclear emulsions will measure cosmic rays for return to the ground where physical and chemical characteristics can be observed. Cosmic radiation is the only particulate matter from outside the solar system that can be directly observed. Additionally, several sky surveys will be made by photographing selected areas of the sky in the ultraviolet wavelength, and examining it for possible X-ray sources. The brightness of light in the night sky will be measured in an evaluation of the phenomena known as Gegenschein and Zodiacal light. A study of the night and twilight earth horizon light and atmospheric airglow will be undertaken. Using a particle collection device, the distribution, composition, and morphology of micrometeoroids in near-earth space will be studied.

Earth Science

The Apollo Applications Workshop will orbit at an inclination of 50°, and at an altitude of 235 nautical miles. This is the highest inclination of any manned flight conducted by the United States. Inclinations of 50° are valuable for they permit earth resources survey coverage of the entire contiguous United States. Four earth resources experiments are proposed for the Apollo Applications program. The first would utilize multispectral photographic equipment and film for recording resources data. A second experiment is a proposed multispectral radiometric scanner. Another preposed experiment employs an infrared spectrometer and a fourth consists of a micro-wave radiometric experiment. The four instruments will be used to compare the relative value of data in the different spectral regions for their usefulness for application to agriculture, forestry, geology, geography, oceanography, water management, etc.

Manufacturing and Engineering Technology

The final set of Apollo Applications experiments is in the area of engineering and manufacturing technology. Among the experiments to be performed are: an analysis of aerosol dispersion in zero gravity; an evaluation of various thermal control coatings; a study of the effects of crew motion on the dynamics of a space vehicle; precision optical tracking; the nature and speed of flame in zero gravity; and an assessment of the use of aerodynamic and electrostatic force fields instead of gravity for holding tools and parts in

place while working. An important experiment will be the evaluation of the feasibility of manufacturing selected materials in space utilizing the space vacuum and zero gravity conditions existing there. This will include investigations into the melting of metals, brazing techniques, composite and spherical casting, and crystal growth. Much of this work shows great promise and may provide the basis in future years for using space stations as commercial facilities for use in manufacturing either perfectly formed products or unique materials.

Mission Sequence

During the summer of 1969, the Apollo Applications mission sequence was considerably altered. The principal changes resulted from the decision to develop a ground-outfitted Orbital Workshop, with the first two stages of a Saturn V vehicle launching it into space. Previously, the Workshop was to be set up inside the empty tank of a spent S-IVB, after both that stage and the first stage of a Saturn IB vehicle had launched it into orbit. Formerly, the solar observatory, (the ATM), was to be launched by a Saturn IB as a separate mission and rendezvous and dock with the Workshop after reaching orbit. With the greatly increased performance capability of the Saturn V, the Workshop will be launched with all the principal hardware elements, such as the Airlock Multiple Docking Adapter, and solar observatory, integrated before launch. Further, it will be in a higher inclination orbit to provide improved coverage for the survey of earth resources. A final major change is that the Workshop will now provide its own electrical power, life support, and logistics supplies. In the previous mode of operation, the Workshop was to have relied on the Command and Service Module (CSM) for this support. Now the CSM while attached to the Workshop becomes the recipient rather than the provider.

After an unmanned launch from Launch Complex 39 at the Kennedy Space Center in late 1972, the Saturn Workshop will be positioned into a 235 nautical mile orbit with a 50° inclination. During the launch, the Multiple Docking Adapter, Airlock, and Apollo Telescope Mount will be protected by a payload shroud and will occupy the area taken by the Lunar Module and Command and Service Module during Apollo missions.

Following the orbiting of the Workshop, a Saturn IB with a modified Apollo Command and Service Module will be launched from Launch Complex 34 at the Kennedy Space Center sending the first flight crew toward a rendezvous and docking with the Workshop. The crew of this flight, as in each of the three manned missions, will consist of three astronauts.

The crew will dock the CSM with the Multiple Docking Adapter and transfer to the Workshop through the Command Module hatch and a hatch in the Adapter. They will then activate its systems and begin a mission planned to last up to 28 days. The Multiple Docking Adapter will provide access to both the Workshop and the Airlock. The Airlock will permit the crew to have access to

space where, wearing pressure suits, they can perform extravehicular activity. This first mission will emphasize medical experiments and initiating and verifying the operation of the ATM. Upon completing this first manned mission, the Workshop systems will be shifted to a standby condition, and readied for the next crew visit.

Approximately two months after the first crew has left the Workshop, a second flight crew will be launched to revisit and reuse the Workshop. The planned duration of their mission will be up to 56 days and it will focus on operating the solar observatory, and conducting the medical, earth resources, physics, biology, and technology experiments planned for the Workshop. Again, the Workshop will be placed in a standby condition upon the departure of the crew.

The third and last astronaut crew will revisit and reuse the Workshop in another mission that is also planned to last for as long as 56 days. Arriving about one month after the previous crew has returned to earth, they will continue making solar observations and performing the various scientific and technological experiments. With their departure, the Workshop will be deactivated approximately eight months after its launch.

Backup hardware, including a Workshop, Multiple Docking Adapter and Airlock, will be brought to the point of completion of manufacturing and systems installation, so that final checkout and delivery can be expeditiously accomplished. This hardware will also be available to conduct a second Workshop mission if such a future mission should be in the national interests.

Apollo Applications

	1969	1970	1971
Space vehicles.....	$52,645,000	$99,506,000	$89,600,000
Payloads and experiments.....	97,355,000	200,546,000	274,700,000
Space station.....	(8,800,000)	---	---
Total.....	$150,000,000	$300,052,000	$364,300,000

Space Vehicles

The Apollo Command and Service Module will be modified to support the long-duration missions its crew will be conducting in the Workshop. The CSM will operate in a quiescent mode while docked to the Workshop, with the Workshop supplying it with electrical power and an oxygen/nitrogen atmosphere. The principal modifications to the CSM include: providing an electrical power transfer umbilical and an atmosphere interchange duct with the Workshop; adding new descent battery packs for re-entry as the CSM fuel cells will not be operational by the time of re-entry; adding heaters and control wiring to

warm that portion of the spacecraft shadowed from the sun; installing additional Reaction Control System propellant tankage with a common manifold system, thus providing an alternate means for returning to earth in the event of a malfunction in the main engine of the Service Propulsion System; changing the spacecraft caution and warning system so that it can be monitored while the astronauts are not on board; allowing for communication and telemetry switching through the Workshop; making changes to the electrical power and propellant storage systems; and providing, within the Command Module, for the 900 to 1,000 pounds of supplies, equipment, and data that will be carried to and from the Workshop by each manned mission.

FY 1971 funding will continue the engineering and manufacturing effort begun in previous years for these program modifications to the Command and Service Module. Four spacecraft are being modified for this first Workshop, with one spacecraft held in reserve as a backup. All four spacecraft are presently in manufacturing assembly, and during FY 1971 the first of these spacecraft are scheduled to complete systems integration, and checkout of two spacecraft will begin during the fiscal year. FY 1970 and FY 1971 funding will also be used for testing and qualifying any modified or new components for these four spacecraft.

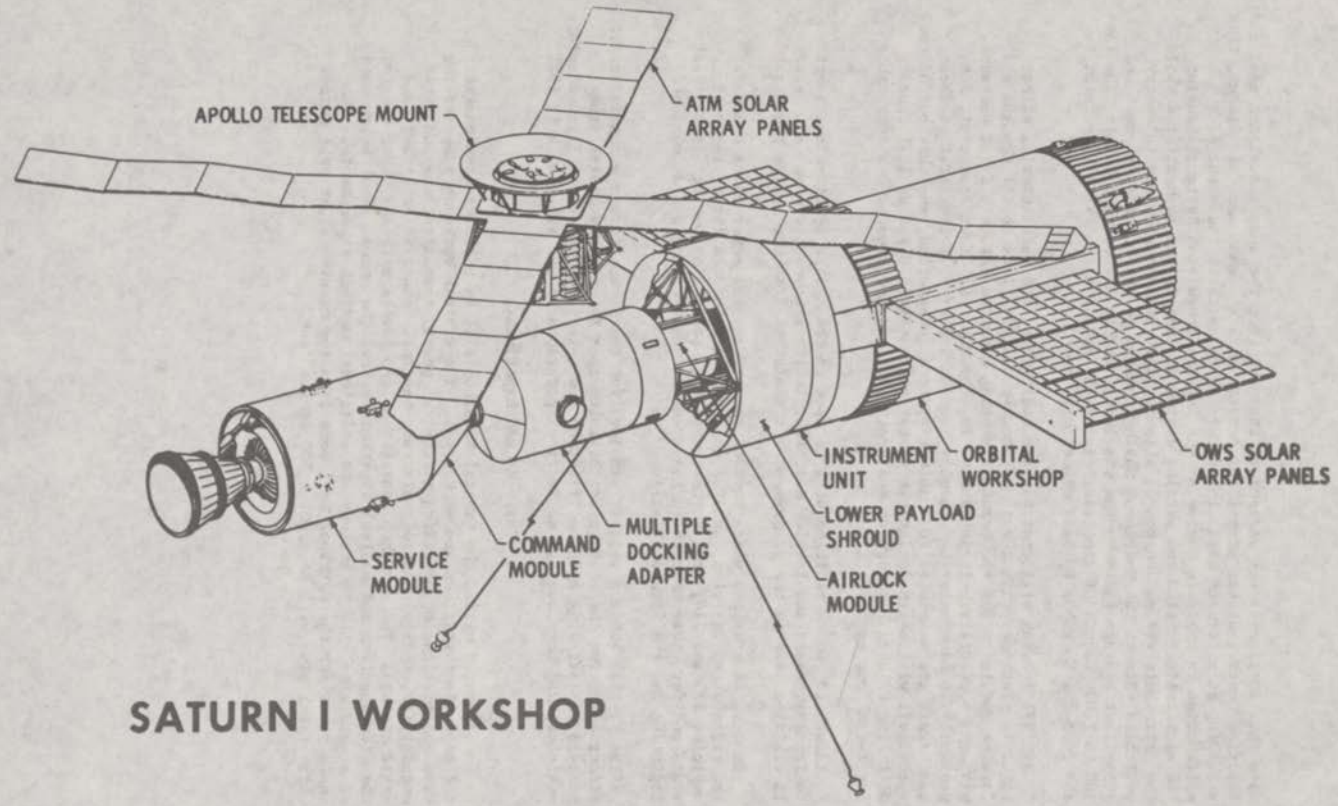
Saturn IB launch vehicles will be used in the Apollo Applications program to launch Command and Service Modules with its astronaut crews. All Saturn IB vehicles used in the program were transferred from the Apollo program.

Funding in previous years covered the storage and maintenance costs for the transferred vehicles, and for the production of the first stages of vehicles 213 and 214, (all further Saturn IB production was terminated last year) and for cadre efforts in the areas of engineering, operations, and logistics for the Saturn IB stage.

The FY 1971 funding request provides for continued storage and maintenance efforts, and for the costs of withdrawing four Saturn IB vehicles from storage, undertaking both modification and refurbishment of the first several vehicles, and checkout and delivery preparations of one vehicle in FY 1971.

Payloads and Experiments

Incorporated within the Orbital Workshop will be both the crew quarters and experiment stations and work areas. The Orbital Workshop supports the crew and missions by providing electrical power, communications and data acquisition, thermal control, attitude control, meteoroid shielding, and water storage. The Workshop consists of two levels with one level housing the crew quarters and medical experiments, and the second level being used as a work area with technology and additional medical experiments. The basic power for the Workshop will come from two massive solar cell arrays whose total area will be about 1,500 square feet.



SATURN I WORKSHOP

The Workshop is being constructed by the McDonnell-Douglas Corporation using the basic structural frame of an S-IVB stage. The stage will have the engine and propellant piping removed and the tanks will be sectioned to provide floors and ceilings. A hatch with a window will be installed in the Workshop to allow access during pre-launch checkout and viewing during earth orbit.

Subsystem design, development, and fabrication began several years ago and will be completed in FY 1971. Systems installation began in FY 1970 and will continue in FY 1971, with the Workshop being checked out during the latter half of the year prior to delivery to the Kennedy Space Center. During FY 1970, thermal, dynamic and environment testing of the Workshop will be conducted.

Attached to the Workshop will be the Airlock Module, which provides systems for the Saturn Workshop in the areas of life support and thermal control, power conditioning and distribution, instrumentation, and controls and displays. The Airlock will contain an extravehicular activity hatch for access to space and the necessary EVA support systems. Around the Airlock, oxygen and nitrogen will be stored in pressurized vessels to provide the crew with a two gas atmosphere. The gases and tanks will weigh nearly 23,000 pounds.

The Airlock Module is also being developed by the McDonnell-Douglas Corporation. Subsystem design, manufacturing, and testing have been conducted for the past several years. The structural test article was delivered to MSFC for testing in May 1969. Fabrication and assembly of the flight unit was underway in 1969, and will be continued during both the current fiscal year and FY 1971. A series of systems tests in the operating mode of the Airlock Module and the Multiple Docking Adapter are scheduled in FY 1971.

The Multiple Docking Adapter, being developed by the Marshall Space Flight Center, includes: a docking part which connects the Command and Service Module with the Workshop, a crew access hatch to the Airlock, viewing windows, experiment work and storage areas, and the control and display unit for the solar observatory.

Fabrication, assembly, and checkout of vibration and structural test units were completed during FY 1969. Testing of these units will be conducted during FY 1970. Structural fabrication and assembly of the flight unit will begin in FY 1970, and will be continued in FY 1971, as will checkout and testing of the flight unit.

With the change to a Saturn V launched workshop, the Apollo Telescope Mount was modified from a free-flying module capable of automated rendezvous and docking with the Workshop, to an integrally attached experiment platform. This solar observatory weighs over 21,000 pounds and will be the heaviest

single scientific experiment unit yet flown in space by this country. (It utilizes three 415-pound control moment gyros and three axis control to give it precise pointing accuracy.) The Apollo Telescope Mount contains five major experiments for observing and recording solar activity. The film record of these observations will be returned to earth by the astronauts for analysis by scientists.

Fabrication of structural vibration and thermal test units of the ATM was underway in FY 1969, and testing of these units will be conducted during FY 1970 and 1971. Fabrication and assembly of the prototype unit will begin in FY 1970 and fabrication and assembly of the flight unit beginning in FY 1971, with delivery in FY 1972. Development and production of the ATM experiment began in 1967, and the tested flight units will be delivered to the Marshall Space Flight Center in early FY 1971.

Design, development, production, and testing of all other experiments for the Workshop have been underway for several years and will continue during FY 1970 and 1971. Most of these experiments will be delivered for incorporation into the Workshop, Airlock, or Multiple Docking Adapter by the end of FY 1971.

An essential element in achieving a successful mission is properly coordinating and locating the various experiments, so that each can function with minimal interference upon the operation of others, and is positioned so that it can obtain the maximum amount of data. To achieve this, efforts including payload analysis, systems engineering, and design and development work are undertaken.

Other tasks directed toward incorporating the experiments in the Saturn Workshop include supplying requirements data, program and planning specifications, payload interfacing, test and checkout plans and procedures, and ground and in-flight support equipment.

FY 1971 funding will continue this experiment integration effort and will also support the design, development, and fabrication of mission hardware, and associated studies and analyses of experiment alternatives and experiment performance. In addition, FY 1969 funding was applied to initiate Phase B studies for the Space Station. The continuing efforts in this area are discussed under the Space Shuttle/Space Station program.

Operations

	1969	1970	1971
Launch, flight and recovery.....	---	$18,198,000	$32,700,000
Technical.....	---	6,350,000	8,200,000
Total.....	---	$24,548,000	$40,900,000

Launch, Flight, and Recovery

This activity funds only the unique project requirements of missions to be conducted within Space Flight Operations. The basic support for manned space flight launch, flight, and recovery operations, is funded under Apollo.

Operations include efforts at the Kennedy Space Center and the Manned Spacecraft Center that are directly involved with prelaunch, launch, flight, crew, and recovery planning activities. Included are mission planning and analysis; procurement for an ATM simulator; trainer modifications to Apollo Application configurations; maintenance of Saturn IB launch capability; modification of launch checkout equipment to accommodate Apollo Applications unique hardware; test planning and procedures for checkout of previously deactivated equipment and systems as well as Apollo Applications unique hardware and planning for reactivation of launch complexes for Apollo Applications.

FY 1971 funds are required for mission planning, simulators and trainer modifications, crew training, initiation of reactivation of Saturn IB launch equipment and crews, including necessary equipment modifications to support the unique Apollo Applications missions; and test planning.

Technical

Technical operations provides for integrated technical support, review, and analysis of the Apollo Applications missions. These services include the development of functional and performance standards consistent with mission objectives and mission planning; technical integration and evaluation; formulation of test objectives and their subsequent integration; mission and systems specifications; trajectory analysis; checkout effectiveness; and technical documentation.

Space Shuttle and Station

During the last half of this decade, this country will commence a new epoch in manned space flight. In the short age of manned flight, man's journeys into space have been both brief and intermittent, focused on exploring this new region and testing his ability to survive. The space shuttle and space station will further transform this history.

To introduce this new epoch, when man will truly exploit the environment of space, this country must develop an economical system for ferrying men and materials to and from earth orbit. Without such a system, the performance of space tasks could become disproportionately expensive.

With the establishment of a space station and its continuous operation in near-earth orbit, and with the associated operation of the shuttle, the environment of space can be applied toward a tremendously quantitative and

qualitative expansion in human knowledge--to promote a better understanding of the earth, sun, solar system, and the universe beyond; of phenomena in the biological and physical sciences; and of the interrelationship and interaction of the many processes and phenomena that establish, control, and affect the environment of this planet. Many of these efforts will hopefully foster an improvement of human conditions.

The space shuttle, with its various capabilities, will be developed as a national vehicle and can be used by other government agencies and departments to assist them in meeting their responsibilities to the nation.

The space station can also be the basis for accelerating international cooperation in space. The station, possessing an environment where scientists, technicians, and observors, who are not astronauts, will perform tasks and conduct experiments; and permit citizens of many countries to participate in the exploration and application of space. It is expected that some countries may undertake the financing of from one to several experiments. It may contribute to greater cooperation among nations on earth as systematic studies and surveys of the earth demonstrate that environmental processes recognize no political boundaries.

Space Shuttle

The space shuttle is a reusable space vehicle system, which provides an economical method for meeting a variety of launch and orbital requirements, and represents the basic space transportation system for the remainder of this century.

Once operational, the shuttle could be the only vehicle used by the United States to transport men to and from earth orbit. As currently conceived, the shuttle will be able to carry at least 12 passengers to and from a space station or space base. With a cabin environment similar to that found in today's commercial airliners, and with gravitational forces of no more than 3G's being exerted during the launch and re-entry phases, passengers without special training can be carried to and from space safely and efficiently. This will permit men from many countries to travel in space and participate in the discoveries to be found, the experiences to be shared, and the knowledge to be applied.

The space shuttle is expected to have a payload capability of up to 50,000 pounds in low earth orbit (a capability presently exceeded only by the Saturn V) with a payload compartment 15 feet in diameter and 60 feet long and having a volume of 10,000 cubic feet. This capability can be utilized to meet a single requirement or distributed among several users.

As presently conceived, each space shuttle is composed of two stages - the booster and the orbiter. Both are reusable, and will be designed to perform 100 missions with a minimum of maintenance. It is expected that both stages will be manned, although the booster may have the capability of making an automated return and landing.

The shuttle has been assigned a preliminary design weight ceiling of 3.5 million pounds including propellant, or approximately 55% of the weight of a Saturn V. The projected height of the shuttle system is between 200 to 250 feet, considerably less than the 363 feet height of a Saturn V with the Apollo spacecraft.

The orbiter and booster will each use high-pressure liquid oxygen/liquid hydrogen fueled rocket engines for propulsion. Each engine will have a designed thrust of 400,000 pounds, or nearly twice the thrust of the J-2 liquid oxygen/liquid hydrogen engine used in upper stages of the Saturn V. It will be throttlable and capable of continued reuse and multiple restarts. In addition, both the orbiter and booster will use a set of jet engines similar to those used by aircraft, but which will be fueled by hydrogen. These engines will provide the power during the cruise return to the landing area.

The operational sequence of the space shuttle begins at the launch area where the mission payload, contained in modularized cargo containers, will be loaded into the payload compartment of the orbiter. The shuttle is then moved to the launch complex for a vertical launch. The booster stage propels the shuttle to a suborbital altitude of 40 to 50 miles. The orbiter and booster then separate, and the booster maneuvers for a return to earth. An aerodynamic 'gliding' characterizes the initial phase of the return, but at an altitude of about 10 miles the jet engines are started to fly the booster subsonically back to the landing runway.

After booster separation, the orbiter engines ignite and burn until the stage gains the velocity needed for insertion into a low elliptical orbit. The engines are later restarted to circularize the orbit at 100 miles. Restarts can also be made to execute transfers to other desired orbits.

The life support and power systems of the orbiter are designed to provide it with the capability to be self-sustaining for up to seven days. At the conclusion of its mission, the engines are refired to brake the orbiter back into the atmosphere. Aerodynamic braking slows the orbiter until it reaches a speed where it is able to perform a transition to the cruise configuration of an airplane. Using the jet engines for power, it returns to the launch area for another mission. Both booster and orbiter stages will be designed to land on runways approximately 10,000 feet in length.

Having landed, the booster and orbiter will be checked out, provided with new payloads, refueled, and readied for another launch two or three weeks later. An important element in the design of the space shuttle will be the ability to achieve short turn-around times between flights and reduce the number of vehicles required for the planned missions.

Initially, the shuttle will be used in transporting flight crews, scientists, experiments and supplies to space stations and space bases in earth orbit. Later it will also be used for transporting supplies and

equipment into an earth parking orbit for transfer by a nuclear stage to such distant destinations as lunar and planetary bases. Some of the anticipated logistics requirements for the station and space bases are: food, water, ammonia, medical and hygiene supplies, and personnel supplies; propellant for the reaction control systems; gases and liquids that cool and pressurize; computer tape and microfilm; materials and experiment module fluids for the scientific and applications work being performed; and replacement and spare components and subsystems for repairs. The space shuttle will also have the capacity to launch experiment modules associated with the operation of the space station and space bases.

A shuttle, flying missions in a polar orbit, can complement the scientific and applications experiments conducted by investigators on the space station or base. The orbital inclination of the station or base is not planned to be greater than 55 degrees and will not encompass the polar and near polar region of the earth. A shuttle, launched into a polar orbit, will be able to cover every point on the earth.

This is especially important in the development of instruments pertaining to surveys of the earth's resources which are important to an understanding of the ecological and climatological process in the polar regions and their effect on the temperate and tropical areas. In the study of space physics, and particularly the environmental perturbations produced by radiation of various kinds and sources, the polar region is again important as the local of important phenomena in the atmosphere, ionosphere and magnetic field.

The space shuttle will be capable of carrying from one to several automated satellites and positioning them in their selected earth orbits. The shuttle can be used for satellite retrieval and maintenance. Satellites that have malfunctioned or indicate a degradation in performance can be returned to earth for failure analysis, repair, and future reuse. The shuttle can also be used to review satellite performance, monitoring their orientation, systems operation, and instrument development. Another application is its use in the developmental flight testing and calibration of various sensors and scientific experiments in space, thus demonstrating their performance before committing them to operation.

The space shuttle can serve as an orbital staging platform for automated planetary probes and spacecraft. It would launch the planetary spacecraft, and possibly its attached propulsion stage, into the orbit around the earth from which the spacecraft is inserted into a trans-planetary trajectory. When spacecraft size and weight permit, the propulsion stage would be integrally attached to the spacecraft on earth, and carried as a unit by the shuttle.

Future manned space exploration to the moon and to the neighboring planets will be made using nuclear propulsion stages. These stages, using liquid hydrogen fuel, will be reusable and capable of making ten round-trips between

earth orbit and lunar orbit. For each trip, however, the stage must be refueled with approximately 250,000 pounds of liquid hydrogen. The space shuttle will be used to transport this liquid hydrogen to earth orbit.

Finally, the space shuttle will be designed so that it can be maintained in a state of launch readiness for lengthy periods, and yet be launched within two hours notice. In the event of an emergency in space, it could carry engineering or repair specialists to overcome the problem, or rescue an endangered crew.

The many expected uses for the space shuttle illustrate its versatility, and its unique ability to solve most of the logistics and transport problems associated with an effective utilization of the space environment. The expected high annual requirement, both in missions and in logistical weight, requires the development of a space transportation system that has a low operational cost. The space shuttle, through reuse, minimum post-mission maintenance and refurbishment, and aircraft type checkout operations, could reduce the cost per pound of payload in orbit by a factor of ten.

The NASA commenced detailed studies of the shuttle in 1969 with study contract awards to General Dynamics, Lockheed, North American-Rockwell, and McDonnell-Douglas. These contracts, which have been completed, were for preparing and analyzing conceptual designs for a reusable space logistics system that would reduce present payload launch costs by an order of magnitude. From the results of these contractor efforts and other NASA and Department of Defense studies, a preliminary space shuttle configuration has been established with the desired payload and performance characteristics, and a preliminary evaluation of various systems and technology requirements has begun.

During FY 1970, the NASA plans to award two sets of definition contracts for the space shuttle. One set of competitive contracts will be awarded for a study of the basic shuttle vehicle, including the aerodynamics, integrated thermal protection system and structure, avionics, and auxiliary propulsion. These studies will emphasize the reusability, maintainability, and low cost operational features of the shuttle and produce a proposed preliminary design of the space shuttle. Additionally, the contractors will assess the mass properties, performance and weight sensitivity, dynamics and control, and development risks inherent in the configuration. Finally, they will perform: system analyses, including safety, mission profiles, launch operations, and payload integration and logistics; design analyses, including structures and materials; and a cost and schedule assessment of the space shuttle program. A major element of the work in these contracts is expected to be the thousands of hours of wind tunnel testing undertaken to verify the soundness of the proposed preliminary designs.

A second set of competitive contracts will be for definition studies for the high performance liquid oxygen/liquid hydrogen engine to be used on the

shuttle. The contractors will undertake a design definition of the engine system and component configuration including the sequence of operation, performance limits, and design margins, and define the requirements for engine test stand facilities. The contractors will also identify and assess areas where economies can be achieved in the production and maintenance of the engines. In addition, they will conduct limited testing of critical components to demonstrate the capability of the components and subsystems to meet the requirements.

Presently, several contractors using other government and corporate funds are conducting test firings of smaller sized engines that contain some of the essential features of the shuttle engine; consequently, much of the technology required is under development.

Within the vehicle system, there are several important technology areas where additional work will be conducted to develop and apply technology for shuttle use. These include: analyzing the aerodynamic configuration of a vehicle that must engage in controlled flight through the orbital, hypersonic, supersonic, transonic, and subsonic flight regimes, and be landable on a contemporary runway; a thermal protection system using materials incorporating nonmetallic and metallic radiative heat shield concepts that can withstand temperatures that are expected to reach 2,000°F, and also provide reusability without refurbishment; dynamics and aerolasticity of the vehicle including dynamic loads and response, fuel slosh, shock loads at liftoff, staging, and landing; and within the flight dynamics and aerolastic environment the flutter, buffet, ground loads and divergence, coupled dynamics, POGO, winds, gusts, and control loads. Other important technology studies are: to produce efficient structural design employing materials with regard for vehicle weight, heat and dynamic loads, and reusability requirements; to improve materials such as: temperature bearings, lubricants and seals, and cryogenic insulation; and to explore methods for fabricating large quantities of high temperature metals. Much of the electronics technology is available but a major task will be to produce efficient integration of these systems.

This research is one part of a parallel effort. The results of this effort and of the information developed from the contractor design studies will be promptly coordinated between the various contractors to most effectively and efficiently progress toward the development of a technically and economically valid design of the space shuttle.

The NASA's Office of Advanced Research and Technology will undertake in FY 1970 and 1971 much of this supporting technology for the space shuttle. It is expected that much of the technology developed and demonstrated in the space shuttle will be used by military and commercial aircraft in future decades.

The FY 1971 funding for the space shuttle is for continuing definition efforts and for initiating a detailed design of elements of the shuttle,

especially the engine and the prototype development of selected critical components. Other funding may be applied to develop a necessary test capability through facilities modifications at selected sites where existing engine test stands are located. In addition, modifications in support of component and altitude testing may be required.

Space Station

An essential element in the continued exploration and utilization of space in future decades is the space station. Without the station many of our endeavors in space will be restricted and their application to all men limited.

The space station and the space base which will develop from it will be the central carrier through which man can increasingly progress toward a fuller understanding of his world and the universe. The station and base will also provide the support for aggregating many of the necessary tasks to be undertaken in space, and for consolidating and inter-associating the many scientific and technological disciplines whose results provide the means for this progress in knowledge.

The space station will have an initial crew complement of 6 to 12 people. The subsequent base could be a multi-purpose facility in earth orbit housing a crew of 50 to 100 men. The station will primarily serve as the supporting platform for a very diversified group of scientific, applications, and technology experiments encompassing nearly all scientific disciplines. The experiments for the space station and space base will be conducted in various modes--some in modules attached to the station or base and with an environment of zero gravity or artificial gravity, and some free flying in varying orbits, inclinations, and altitudes.

The following principal experiment groupings, building on those done on the Workshop, are being considered for the space station and for possible later use in association with a space base. These manned experiments will complement and extend the information available from automated satellites observing specific phenomena. The X-ray telescope will examine X-ray sources in the sky, especially areas and objects where the X-ray radiation exceeds all other forms of radiation. The resolution power of the telescope in the stellar astronomy module will significantly increase our knowledge of astronomical objects and permit the observation of faint objects not observable from the ground. High resolution studies of the structure of the sun, and the various forms of solar activity will be conducted using a solar astronomy module. The ultraviolet stellar survey will map the entire sky for ultraviolet radiation which is not observable from the ground. A high energy stellar survey will locate gamma and X-ray sources in the sky and the infrared stellar survey will search the sky in wavelengths not recordable on the ground.

Within the science of physics, using scientific airlocks and subsatellites, data on the environment in the near-space regions of the earth will be obtained. Airglow, Gegenschein and Zodiacal light, the chemical composition of the atmosphere, and solar light scattering are among the phenomena that will be examined. From ionospheric studies and mapping, a greater understanding of plasma physics and environmental perturbations will be developed. A cosmic ray physics module will gather cosmic rays over large energy regions and determine their characteristics.

Bioscience experiments will include studies on the role of gravity on the physiology, biochemistry, and behavior of small vertebrates, invertebrates, and lower and higher order plants through their entire life cycle. In an allied group of experiments, biomedical and behavioral research on the effects of very long-duration flight on man will be conducted. Any psychological and behavioral changes will be monitored, and a detailed study of any physiological and functional changes will be performed.

In addition, earth surveys will be undertaken using the space station to test a variety of sensor devices for potential application to the operational systems of the future. The use of the space environment, with hard vacuum and zero gravity conditions, materials manufacturing and processing will be examined. Thin-film electronic devices, glass casting, precision spherical casting, crystal growth, high strength composite castings, and variable density castings such as foams are among the candidate areas for study. Demonstration of the utility of space for this purpose could result in use of the station or base for commercial production of specialized materials that cannot be duplicated on earth.

Flight crews using the station and base will be ferried to and from orbit by the space shuttle. The space shuttle will also provide the logistics support of the station and base and will be able to carry many of the experiment modules.

Conceptual studies underway on the experiment modules emphasize commonality so that four or five basic module types will be able to support the wide variety of experiments. Basic structural design and the systems for power, thermal control, attitude control, and life support are the principal elements where commonality appears achievable.

The space station is being designed as a long life maintainable system for men working and living in space. Initially, it is expected to operate in a zero gravity condition. The station and base will be quite autonomous, having on-board command and control centers and life support systems that are capable of regenerating the environment, and operating for extended periods. The major source of power will be a nuclear reactor subsystem. A data relay satellite will provide continuous communications coverage with the ground. Living quarters will be attractive and comfortable, and housekeeping functions will be highly automated.

The technology required to achieve these systems characteristics and features will significantly increase the capability of the country and much of this new technology can be applied by government and industry in developing or improving products and services on earth. An example of this is the life support system for the station and base. The space station and base will be a confined environmental system with limited resources which are delicately balanced. This is not dissimilar to how man is now viewing his earth. The atmospheric regeneration subsystem on the station must perform the following functions: atmospheric supply and pressure control, carbon dioxide removal and reduction, oxygen reclamation, and contaminant control. Another subsystem must provide for the generation of oxygen, hydrogen, and nitrogen. A third must supply water and provide for waste management including collection, transport, reclamation, sterilization and storage. The final subsystem is for temperature and humidity control. Some of the technology being developed for these subsystems may find application here on earth especially in the control of life critical resources and management of sources of severe pollution.

Space Shuttle and Station

	1969	1970	1971
Experiment definition.....	---	$6,000,000	$12,000,000
Shuttle engine definition and design.....	---	5,000,000	48,500,000
Shuttle airframe definition.....	---	7,500,000	22,500,000
Station definition.....	($8,800,000)	---	6,000,000
Shuttle/station preliminary design verification.....	---	---	21,000,000
Total.....	($8,800,000)	$18,500,000	$110,000,000

Experiment Definition

The early and accurate definition of the experiments and supporting systems in the Space Shuttle/Station program is vital to eventual mission success and the achievement of program objectives. The major portion of the space station operation will be the conduct of manned observations and experimentation. These will impose major requirements on the space station and experiment module design and operation, and dictate an early definition effort.

Before an experiment can be committed to a flight program, it must be determined as being feasible for missions planned in the program and be assessed for its specific contribution to the program objectives. Additionally, it must have well-defined funding and schedule projections and specifications for power, temperature, volume, and any other mission constraints. Assurance is needed not only on the experiment's appropriateness, but on its ability to be readily incorporated in the program and managed effectively. Experiment definition funding provides the early impetus for acquiring the technical and scientific effort needed in identifying and verifying, through ground experimentation and analysis, those worthwhile experiments for conduct by man in space to assure an effective use of the space station and the space environment.

In FY 1970 and 1971, funding will be primarily used to clarify and define candidate experiments and to determine the experiment groupings and their equipment that will most effectively use the space station. Efficient program planning dictates that this definition work begin, along with the preliminary design studies.

Shuttle Engine Definition and Design

Special engine studies conducted by NASA and DOD, both in-house and by contractors, together with the results of independent contractor efforts,

indicate that the state-of-the-art in engine technology and engineering has advanced to the point where the definition of engines that could be used for the shuttle can be undertaken.

The FY 1970 and 1971 funding will provide for engine definition contracts. The contracts are of 11 months duration and are planned for award in the next few months. The studies will provide preliminary engine designs and specifications, define detailed engine requirements, and provide program plans for future development. The contractors will also conduct component testing that will support the preliminary design activities and they will coordinate their efforts with the airframe study efforts and identify the facilities required for the later project phases.

FY 1971 funding will also provide for the start of detailed design of the most promising engine candidates resulting from the engine definition studies. Design of the engines will begin in the last quarter of FY 1971. A need exists to agressively pursue engine design as an earlier phasing is required to provide the necessary information for integrating the engine systems into the airframe design. Design contracts are planned to obtain detailed engine design, manufacturing and test plans, detailed schedules, and the initiation of long lead time items required for component development.

Shuttle Airframe Definition

A series of special studies by NASA and DOD has produced several candidate shuttle configurations and permitted determination of systems characteristics. These results, together with other related studies, indicate that the technology required to proceed with the definition phase of the space shuttle airframe is available. As with the shuttle engine activities, the definition effort will be conducted through competitive contracts and will be of 11 months duration. Definition studies are scheduled to begin in the latter part of FY 1970.

FY 1971 funding supports continuation of the studies initiated in FY 1970. The definition studies will focus on specific point designs and supporting technology including: System analysis, (system safety analysis, mission analysis, system integration, launch operation analysis, system flight characteristics, payload integration, aborts); Design analysis; subsystem definition (propulsion, integrated avionics, mechanical landing, docking, etc.); configuration preliminary design; configuration preliminary verification (structural test program); and program management plan.

Station Definition

NASA is currently involved in the definition of a space station. The objective of this effort is to obtain the technical and program information needed for selecting a single design approach of a space station from the alternate approaches available.

The definition effort is being conducted in two parallel studies with industry--one managed by the Manned Spacecraft Center and the other by the Marshall Space Flight Center. The effort is focused on space station preliminary systems design and appropriate development and operation plans. Additional space station supporting activity includes a number of small competitive contracts for studies and technological investigations related to space station definition.

The first phase of the definition studies is scheduled for completion at the beginning of FY 1971. Funds are required in FY 1971 to exercise up to six one-month extensions of definition studies with each contractor. This will allow additional work which can be a beneficial extension of on-going definition efforts. This work will be based in part upon information derived from those contracts and will, within its general scope, include additional comparative analysis and detailed studies aimed at refining technical and program aspects.

At the present time, a number of in-house and contracted studies are underway in various disciplinary areas to ascertain how groupings of experiments, which form payload packages, can be integrated into the space station either in its initial flight configuration, or into separately launched experiment modules. In FY 1971, definition studies of candidate experiment modules which have long lead time requirements and whose operations will impact the station design and operating mode will be undertaken. Modules that can support such experiment packages as astronomical instruments, space physics equipment, materials analysis and manufacturing equipment, will be examined. This definition must take place early in the program cycle.

Shuttle/Station Preliminary Design Verification

The definition studies of the shuttle airframe and space station will identify systems, concepts and techniques critical to their final design. However, before final design criteria are established, additional trade-off analyses are required to verify contractor system selection. In addition, preliminary engineering designs will be initiated and advanced prototype testing conducted on selected long-lead systems to assure their timely availability. Although a considerable amount of research has been accomplished on critical systems such as power, environmental control and life support, design confirmation can be expedited by an early initiation of this prototype testing. This activity is a necessary bridge from the applied research effort of the Office of Advanced Research and Technology to the actual verification of specific technical approaches proposed by the definition contractors.

FY 1971 funding supports the above activities and as the studies progress, those other areas that will be identified as requiring additional verification prior to initiation of detailed design. Systems common to both the shuttle and station that are potential candidates for this effort are: integration

of the electronics systems, attitude control systems, and thermal protection systems. Wind tunnel tests of preferred shuttle designs will be performed. "Breadboard" fabrications representative of integrated electronics systems will be tested and dynamic simulations conducted to verify that the design concepts being produced will permit the initiation of detailed design. Similarly, testing of attitude control system components and systems/concepts will supply data on the use of liquid oxygen/liquid hydrogen propellents, thruster and system response, consistency of performance and thruster impulse capability.

Proof-of-concept testing of the thermal protection systems will be conducted on subsections to provide verification of materials selection, fabrication and installation techniques, characteristic weight, and inspection and refurbishment needs. It is planned that these tests will be conducted only with the more promising concepts.

These tests and studies will greatly increase the assurance that the later detailed design effort will be successful, and result in a more efficient and economical development program for the shuttle and station.

PROGRAM OBJECTIVES

Mr. EVINS. Dr. Paine, who wants to explain the objectives of the space flight operations program?

Dr. PAINE. Mr. Myers would be glad to give you some details.

Mr. MYERS. The space flight operations program is the one that covers the Skylab activities and develops the program that uses the hardware from the Apollo program for our beginning of space operations for long durations in space.

The activities cover the launch of a converted S–IVB, it has been converted into a dry workshop, and covers the development of an Apollo Telescope Mount that will be carried on this for solar observations during the flight of the vehicle and the experiments that are to be carried on in the program.

Dr. PAINE. Page RD–2–5 carries a photograph of that.

Mr. MYERS. Yes.

Dr. PAINE. This is a Command Service Module docking. This is the S–IVB rocket case which we have used to put the laboratory inside. These things on either side are the solar panels. The telescope mount is this appendage over to the side. It has its own solar panels.

Mr. EVINS. You state here that this program will embrace some of the President's Space Task Group recommendations. Emphasis will be on commonality, reusability and economy. Those are three good words.

I am not sure whether that will all be achieved.

COST OF SKYLAB

How many Skylabs are in the plans of NASA? What is the estimated total cost?

Mr. LILLY. There is one Skylab currently in our program. We do have the backup hardware in the program, but not for outfitting them. The total cost of the Skylab project is estimated at approximaely $2.1 billion in total.

Mr. EVINS. I got an estimate somewhere that the Skylab, the space shuttle, and the platform was all going to cost another $24 billion. Is my information correct in this area?

Mr. LILLY. No, sir. I cannot tie those figures down exactly.

As Dr. Paine said, the Apollo Applications Program, or Skylab, is a program, which we had undertaken originally as a wet workshop but is now converted to use the Saturn V. Our estimate has been $2.1 billion.

SPACE TASK GROUP ESTIMATE

The figures you may be referring to are the figures included probably in the President's Space Task Group in which there were some parametric kind of ranges used for development of the shuttle which was a range, I believe, of around $6 billion. But that is strictly a very rough estimate on it.

Then if you take the space station, first space station, I believe the number they give in the President's Space Task Group is roughly in the range of around $4 to $5 billion. Then if you add other items such

as the space tug and other developments, you might, way on out into the 1979's and 1980's it could add up to that number.

Mr. EVINS. Only one Skylab is in the planning and the estimated cost at this time is $2.1 billion, is that right?

Mr. LILLY. Only one is currently programed.

As I told you, this morning, we are studying and Mr. Myers does have work going on on what it would cost and what would be involved if we were to recommend a second Skylab.

MANNED FLIGHT BUDGET REQUESTS

Mr. EVINS. Gentlemen, page RD–2–3 shows the Apollo applications goes up from $300 million to $364 million; operations goes from $24.5 million in 1970 to $40.9 million in 1971; and space shuttle and station goes up from $18.5 million to $110 million, really mounting. Still, this is in the development stage.

Mr. LILLY. This is not even the development stage yet, Mr. Chairman.

Mr. EVINS. Program planning would be a better word.

Mr. MYERS. This does cover one activity in design verification. We would expect of the phase B definition program to do the studies for the planning and designing of the space station, but we would also design and test specific pieces of hardware that are those most critical technologies that are involved in the development of the shuttle.

Mr. EVINS. Will there be some tests within the next year?

Mr. MYERS. Yes, probably structural things that will have to be put up to very high temperatures. We would want to test those in this time period.

SPACE STATION

Mr. JONAS. Did I understand you to say you only plan one platform?

Dr. PAINE. At the present time we are planning one; we have some backup equipment.

Mr. JONAS. You plan three flights to it?

Dr. PAINE. Three flights to it, that is correct.

Mr. JONAS. The platform will stay in space?

Dr. PAINE. The platform will stay in space for the entire year. The flights will use the S–IB rockets remaining from the Apollo program.

Mr. JONAS. The program as you now visualize it contemplates three visits?

Dr. PAINE. Three visits, one of 28 days and two of 56 days, with probably about a month between visits.

Mr. JONAS. No plan to use it for unmanned flights?

Dr. PAINE. No, although there may be some equipment on board which is recording data while there are no astronauts aboard.

Mr. JONAS. How many men do you plan to send up on each of these flights?

Dr. PAINE. Three men, using standard Apollo hardware.

DOCTOR ASTRONAUTS

Mr. EVINS. You are planning to have a doctor astronaut. When do you have him planned to go up?

Mr. MYERS. They would be included in the skylab program, probably in the first flight.

Mr. JONAS. Are you taking reservations on the shuttle?

Mr. MYERS. Yes, sir.

Dr. PAINE. It would be an interesting thought that this Committee would be meeting with us a couple of years from now up there discussing this program.

Mr. JONAS. I have two candidates sitting on my right.

HEADQUARTERS COSTS

Mr. EVINS. Tell us why NASA headquarters goes up from $1.5 million in 1969 to $46.8 million in 1971. This is a fantastic increase.

Mr. LILLY. Mr. Myers, do you want to answer that in terms of the contracts?

Mr. MYERS. Yes, there have been a couple of areas that have been included in this. One is a transfer of some Air Force inspection costs at various contractors' plants that have been transferred to this fund. That has increased the costs in the 1971 budget.

Mr. EVINS. Doesn't inspection costs mean going out to a contractor and looking over his facilities and seeing how the project is coming along?

Mr. MYERS. More than inspection of the actual hardware being built at the contractor's plants. It was Air Force support that was transferred to the headquarters operation.

Mr. EVINS. This takes care of personnel that will be assigned to headquarters, but working in the field?

Mr. MYERS. Yes, sir.

Mr. LILLY. No, sir. Let me answer that if I could, sir.

There are Department of Defense contracting officers who have inspectors, quality control people, et cetera, in the plant to administer the total contracts in the plant. Rather than build up NASA personnel, we have paid the Department of Defense for quality control and inspection services in those plants. If we had tried to provide our own quality control people, we would have had to add several thousand more people to our own payroll.

We do fully reimburse them for this, and we reimburse out of the headquarters account directly to the Department of Defense.

Mr. EVINS. You are reimbursing DOD for inspection and quality control, is that correct?

Mr. LILLY. Yes, sir, that is correct.

Now, the reason you see it increasing here, as the Apollo is phasing down, the Apollo applications program is building up and is paying for more of the inspection services. That is what Mr. Myers was bringing out.

BIOSCIENCE PROGRAM

Mr. EVINS. In the bioscience program, you state that you will study potatoes, vinegar gnats, and mice for the effect of the space environment on these rhythms.

We cannot seem to solve the problems of the environment here on earth and we are proposing to continue to study the problems of the environment in space. Had we not better solve the problems of the environment here first?

Dr. PAINE. Of course, what we are learning here is very fundamental things about cell growth, about life, about the influence of both gravity and the diurnal cycles here on earth. This is a kind of new information from which sometimes very important unexpected discoveries have come.

APOLLO TELESCOPE MOUNT (ATM)

Mr. EVINS. You state in the space physics and astronomy program, that the Apollo telescope mount contains five experiments, which you list.

A white light coronagraph to monitor the brightness, form, and polarization of the solar corona in white light; and X-ray spectrographic for studying solar flare emissions in the soft X-ray wavelengths; an ultraviolet spectrometer for photoelectrically recording high-resolution solar images and surveying spectral emissions of selected areas of the sun, a dual X-ray telescope for obtaining time-histories of the dynamics of the solar atmosphere in selected X-ray ranges, and an ultraviolet spectrograph and heliograph for recording high-resolution imagines in the ultraviolet wavelength.

How much is this going to cost?

Mr. MYERS. I have a total cost of $22.7 million in 1971.

Mr. JONAS. May I create a diversion here now?

Mr. EVINS. Surely.

Mr. JONAS. This should have been asked some time ago.

We have now, Dr. Paine, spent billions of dollars of the taxpayers' money. We have made two excursions to the moon with men. They have brought back a lot of rocks and other materials.

What have we learned so far about the moon that we did not know?

NEW KNOWLEDGE

Dr. PAINE. We have learned many things about the moon and it would really fill volumes like this just to summarize it. I think the fundamental things we have learned though can be put very directly: We have learned that the surface of the moon is incredibly ancient. This was something which we had hoped very much would prove to be the case, because we had hoped that the surface of the moon would preserve a record of all of the life of the solar system.

This has very much proved to be the case. The rocks that we have brought back have evidence locked within them of the timed history of solar emissions from almost the beginning of the solar system, and also hold in them records of the cosmic radiation from outer space into the solar system.

So although it will take many years for the scientists to unravel all of this, the lunar rocks we have brought back, far from being something we put at the Osaka Fair to attract good will from the visitors to the fair, are much more important.

They really contain the history of the solar system locked into these rocks. They are at least 1 billion years older than anything we have found on the surface of the earth. The fact that they have not undergone the erosion we have here, but have lain there undisturbed, is the thing that is allowing us to unravel these facts.

Also, coming back from the surface of it, we have found minerals very much different from anything we have on the earth, we have found evidence that the moon has undergone in the first billion years of its existence tremendously energetic collisions with meteorites. We expect that probably this early history of the moon, which we can still read up there, probably is also the early history that the earth must have gone through. But all traces of that have long been erased on the surface of the earth.

ECONOMIC BENEFITS POSSIBLE

Now, from this ability to understand this long period of history, it may very well be that we will get much greater insight into the way minerals are distributed around the earth, the way in which the structure of the earth was originally formed, and the history of it, in such a way that there may actually be economic benefits.

Now Dr. Naugle mentioned that the laser reflector which we left on the surface of the moon has enabled us to measure within a distance of 1 foot the distance between the moon and earth. We can do this on a continuous basis.

One of the things that this is allowing us to do is to detect the very small amount of wobble that the earth has as it spins around its axis. There are geophysicists who believe that this wobble is associated with incidence of earthquakes on the surface of the earth. We hope to tie that down.

We also feel this will enable us to measure the movements of the continents, the very slow drift apart of the continents on the surface of the earth by using this as a reference point.

Beyond that, the fact that the moon is teaching us a good deal about how a body without any atmosphere behaves. We can then compare that with the earth which has an atmosphere; the moon is teaching us a good deal about the source of the earth's atmosphere and its probable evolutionary history.

ATMOSPHERIC CHANGE

The atmosphere that we find around the earth is very much the product of the living things on the surface of the earth. It is almost correct to say that the atmosphere is alive, a part of the life system here on earth. Venus, which has a very dense atmosphere, and Mars, which has a very thin one, and the moon, which has no atmosphere at all, I think, represent areas where we can learn a good deal about the problems here on earth as our own atmosphere changes.

The fact we have found no water whatsoever on the moon is very mysterious to us, because tremendous quantities of water are present here on earth. We do not know the answer, but this is probably going to tell us something important.

These are just a few of the things we are finding as these experiments bring back information.

I think that our knowledge of the sun alone and the history of the sun in the solar system that we expect to be able to read from these lunar rocks is an unexpected bonus, because all the energy we have on earth comes from the sun. Any changes in the energy of the sun would have serious impact on life here.

OTHER SIDE OF MOON

Mr. JONAS. Have you any reason to believe from the pictures that have been taken—because we have only taken steps on the moon in fairly close proximity to each other—on the other side of the moon the same condition exists?

Dr. PAINE. No; All the evidence is quite to the contrary, that the other side of the moon is quite different from the side that we see. The photographs that we have brought back, although men have never landed there, show a much more rugged terrain with many more craters and a complete absence of the large flat areas that we see when we look up at the side that the moon always turns to us.

We do not understand what this difference is due to, why the other side of the moon should be different than the side that we see, but we do observe that it is very different.

LUNAR CRATERS

Mr. JONAS. Do you have a theory that these craters were caused by earthquakes?

Dr. PAINE. It seems likely that most of the craters we see were caused by the impact of meteorites. It seems clear that some of the crates are probably volcanic. Also, there are some very flat valleys that contain sinuous markings, cuts, grooves in them, which have all the appearance of a river that has cut down through a canyon and then in its final days has begun to weave back and forth.

Yet, as far as we know, there has never been water on the moon.

One of the future missions that we hope to fly is a mission with one of the lunar rovers into one of these areas where these rills occur to see whether or not these are ancient streambeds in which perhaps there was once water that might have welled out of a volcano or something and visited for a while on the surface of the moon.

SPACE SHUTTLE/SPACE STATION

Mr. EVINS. Gentlemen, let's turn to the space shuttle and station program. Your budget justifications state:

> During the last half of this decade, this country will commence a new epoch in manned space flight. In the short age of manned flight, a man's journeys into space have been both brief and intermittent focused on exploring this new region and testing his ability to survive. The space shuttle and space station will further transform this history.

How long will the space station last? How permanent is it?

Dr. PAINE. We are planning it for a life of 10 years. Really, I think it is fair to say the life will be indefinite. It will be essentially a permanent structure in earth orbit.

Mr. EVINS. The space shuttle will be a reusable space vehicle and represents the basic space transportation system for the remainder of this century.

Once operational, the shuttle could be the only vehicle used by the United States to transport men to and from earth orbit. As currently conceived, the shuttle will be able to carry at least 12 passengers to and from a space station or space base.

Why make such a large and ambitious one when you can take three or four?

Dr. PAINE. It turns out that in order to build the shuttle vehicle at all, a fair amount of size is required and the payload then goes up very slightly. The particular project we have under way here, although it is a NASA project, has also been worked very closely with the Department of Defense so that when this capability comes into the American arsenal, it will be able to carry both the NASA payloads to orbit and also the Department of Defense, thus it will affect very large savings in both of the two programs.

With your permission, you might be interested in having me put into the record the agreement NASA has with the Air Force for the direction of this project to make sure we have an integrated project here.

Mr. EVINS. Without objection, it will be included in the record.

(The information follows:)

AGREEMENT BETWEEN THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION AND THE DEPARTMENT OF THE AIR FORCE CONCERNING THE SPACE TRANSPORTATION SYSTEM

This document establishes an agreement between NASA and the Department of the Air Force, acting as the agent of DOD, to insure that the proposed National Space Transportation System will be of maximum utility to both NASA and the DOD.

I. OBJECTIVE OF THE SPACE TRANSPORTATION SYSTEM

The objective of the Space Transportation Systems (STS) is to provide the United States with an economical capability for delivering payloads of men, equipment, supplies, and other spacecraft to and from space by reducing operating costs an order of magnitude below those of present systems.

The program may involve international participation and use. The development of the STS will be managed by NASA. The project will be generally unclassified. For purposes of this agreement, the STS will consist of the earth-to-orbit space shuttle.

II. NASA/USAF STS COMMITTEE

A. Organization

In order that the STS be designed and developed to fulfill the objectives of both the NASA and the DOD in a manner that best serves the national interest, a NASA/USAF STS Committee is hereby established that will report jointly to the Administrator of the NASA and the Secretary of the Air Force. The Committee will consist of eight members, four to be appointed by the Administrator of the NASA and four to be appointed by the Secretary of the Air Force. The cochairman of the Committee will be the Associate Administrator for Manned Space Flight (NASA) and the Assistant Secretary for Research and Development (Air Force). Any proposal for changing the composition or functions of the Committee will be referred to the NASA Administrator and the Air Force Secretary for their joint consideration.

B. Function

The Committee will conduct a continuing review of the STS program and will recommend steps to achieve the objectives of a system that meets DOD and NASA requirements. Specifically, the Committee will review and make recommendations to the Administrator of NASA and to the Secretary of the Air Force on the establishment and assessment of program objectives, operational applications, and development plans. This will include, but not be limited to: Development and operational aspects, technology status and needs, resource considerations, and interagency relationships.

THOMAS O. PAINE,
Administrator, NASA.
ROBERT C. SEAMANS, Jr.
Secretary of the Air Force.

Dated: February 17, 1970.

COST OF SPACE SHUTTLE

Mr. EVINS. We have learned that the Skylab will cost $2.1 billion. What will be the cost of the space shuttle in 1971 and each year for the next 5 years?

Dr. PAINE. The space shuttle project for the fiscal year 1971 is restricted of course only to the study phase, the estimate being $110 million with the space station. Beyond that, we would have to have a decision to proceed with the development of the project.

One of the things that we are trying to do in this definition study this year is to come up with these cost estimates to lay before you in our appearance next year, Mr. Chairman.

MISSION PROFILE

Mr. EVINS. Dr. von Braun, would you enlighten us on how the space shuttle will launch, orbit, and return to earth.

There is a chart on page RD 2–19. Tell us about it.

Dr. VON BRAUN. The shuttle is going to take off vertically, just like our present rockets. The booster will push the combined two-stage vehicle up to approximately six times the speed of sound, which would be reached at an altitude in the order of 40 miles. At this point the booster stage will be completed and separated from the orbiting unit. The orbiting unit would be ignited at this point. The booster will now perform an 180-degree turn-around maneuver while descending into the dense atmosphere; it will fire up air-breathing cruise engines that will enable it to fly back to the launch site.

LAND LIKE AIRPLANE

This is quite feasible because by now the booster is very light compared to its take-off weight. All its propellant being gone, it is actually an empty shell returning to the launch site. It will land airplane-fashion on the runway at the launch site.

The orbiting unit will continue on into orbit. The trajectory is tilted into a horizontal flight path which will be reached at an altitude of about 100 nautical miles.

From this point on, the cut-off point, the unit will coast unpowered halfway around the earth in the Hohmann transfer into orbit, which will again be on the order of 250 to 300 nautical miles up. In this final orbit, the shuttle can remain up to 7 days longer in orbit. It has life support equipment and enough consumables for the crews and the passengers to stay that long in orbit.

Many scientific missions can be conducted during this week or so in orbit, by the payload of the shuttle, itself.

Let me come back to what happens in orbit after I explain the return flight to earth.

RETURN FROM ORBIT

After completion of the mission in orbit, the orbiting unit applies a short deceleration maneuver in orbit, using its rocket engine as a brake. This will put it into an elipse, which, after half a flight around the earth, again will reenter the atmosphere. The orbiting unit now

performs a glide from an initial very high speed, superorbital speed down to subsonic speed, at which point the normal glide landing to the launch site can begin.

The timing of departure from orbit and the return flight must be synchronized with the rotational movement of the earth so that the launch area moves into the footprint area of the returning orbiter at the point of the entry of the orbiting unit into the atmosphere and the ensuing glide.

In this fashion the orbiting unit can join the booster unit again, both units now carefully checked out, joined together again, refueled and can fly again.

100 FLIGHTS ENVISIONED

It is hoped that structures can be built that will enable both the orbiting and the boost unit to perform such a flight profile at least 100 times. In this way very substantial savings in launch costs to orbit are possible.

Our present estimates indicate that whereas at the moment it costs anywhere between $500 and $1,000 to orbit 1 pound of payload, this cost can be reduced to something like $50 per pound in orbit.

Mr. EVINS. Will the booster exhaust itself or will it be reusable?

Dr. VON BRAUN. The booster is also reusable, yes, sir.

Mr. EVINS. The orbiter will carry the man, won't it?

Dr. VON BRAUN. The orbiter carries the man, but there will also be a crew in the booster, a two-man crew that flies the booster back.

Mr. EVINS. The orbiter will be piggy-back of the booster, is that correct?

Dr. VON BRAUN. That is correct.

10,000 VS. 50,000 POUND PAYLOAD

Mr. EVINS. Why was the 50,000-pound payload arrived at instead of a 10,000-pound payload?

Dr. VON BRAUN. The main reason was the following: We studied the most likely traffic situation, the traffic profile that we can expect and we found that about 50 percent of all attractive payloads will require rather high speeds, either in synchronous orbits or orbits that would require additional speed applications, additional acceleration periods after arrival in low orbit.

The synchronous orbit is a good illustration of what I am talking about.

ADVANTAGES OF SYNCHRONOUS ORBIT

All communications satellites in synchronous orbit have the inherent advantage that they will be in continuous line of sight with several points on earth, they will never set on the horizon because the period of revolution becomes equal to the period of revolution of the earth itself. So a satellite in synchronous orbit appears stationary over any one point on the equator into which it has been brought. The synchronous orbit, for instance, sitting over the equatorial regions of the Atlantic Ocean and will be in simultaneous line of sight of Europe, all of Africa, all of North America and all of Latin America, and can, as a result, serve as a continuous communications relay for television, phone calls, serving all four continents.

It is often that such synchronous orbits offer advantages that lower orbits do not have, because the period of revolution will be so fast that an orbiting satellite would rise and set several times a day for any one station.

Mr. EVINS. How high up are the satellites in synchronous orbit?

Dr. VON BRAUN. They are about 1,900 nautical miles up. Five and a half earth radii away.

Mr. EVINS. The bigger they are, the better, is that right?

Dr. VON BRAUN. They have to be bigger at these higher orbits in order to carry enough power to serve as effective communications satellites. I mention the synchronous orbit because the basic two-stage shuttle vehicle can climb only to a low orbit.

Mr. EVINS. Do they have to be bigger to carry the power?

Dr. VON BRAUN. No. We have to carry a propulsive stage as payload in the orbiting stage which can now carry a satellite into a synchronous orbit with an extra power maneuver. If you want to have something like a 10,000-pound satellite in synchronous orbit, the departure in low earth orbit must be in the order of 50,000 pounds, and that is the configuration-driver for the size of the shuttle.

This is why we need such a heavy payload. If we were to build a shuttle that can carry only 10,000 pounds into a low orbit, it could practically carry no payload at all in a synchronous orbit and we would lose the entire synchronous orbit market for the shuttle.

Mr. EVINS. Is there going to be much of a market?

Dr. VON BRAUN. This has been studied quite carefully and it is believed, with the market that can be identified both for NASA and for the Department of Defense, that such a space shuttle that can take care of good payloads in the synchronous orbit also will indeed pay for itself.

Mr. EVINS. We will have to take your word, you are the expert, but there has been quite a debate as to why you chose the 50,000-pound payload rather than a lighter one.

DISADVANTAGE OF SMALL SHUTTLE

Dr. VON BRAUN. This is the reason. If we build a much smaller shuttle, we would have to continue the several discardable types of launch vehicles now in the stable just because we cannot take care of the synchronous orbit payloads.

By making the shuttle big enough, it can do both.

Mr. MCDADE. What functions do you envision the shuttle will perform as it gets to the synchronous orbit?

Dr. VON BRAUN. It will be essentially a means of transportation of a propulsive stage with a synchronous orbit satellite into a low earth orbit from which the propulsive unit can then carry the satellite up into synchronous orbit.

NUMBER OF PASSENGERS

Mr. EVINS. How many passengers do you propose to carry on this 50,000-pound-payload space shuttle?

Dr. VON BRAUN. The present plan is that a nominal cargo capsule would accommodate 12 passengers which will be in addition to the flight crew of two in the cockpit. There will be, in addition to that

cargo, space for equipment and also for consumables to supply the space station. But there is no reason why, if more people have to be carried, special payload compartments could not be built to accommodate more people. There could also be special capsules where there are no passengers at all and only unmanned cargo is carried.

COST OF DEFINITION CONTRACTS

Mr. EVINS. During 1970, NASA plans to award two sets of definition contracts for the space shuttle. Will these be funded out of fiscal year 1970 funds?

Mr. PAINE. That will start in 1970, but will be funded primarily in the 1971 budget.

Mr. EVINS. What is the cost of the definition contracts?

Mr. MYERS. The cost of the definition contracts will be $8 million each.

Mr. EVINS. $16 million?

Mr. MYERS. Depending on the responses from the industry, if there is a show of great imagination or innovation in their approach to the contracts, we would award three contracts for the shuttle air frame and three for the shuttle engines.

MANUFACTURING IN SPACE

Mr. EVINS. What do you expect to manufacture in space, Dr. von Braun?

Dr. VON BRAUN. We believe many interesting manufacturing processes can be worked out in space that cannot be performed at all on the ground because they would require zero gravity.

Let me give you this one illustration and explain the underlying thought here.

Suppose you melt a mixture of small metal spheres, like shot, together with other organic material which, when heated, gives off a gas. If such a mixture, metal and organic pellets, is molten, the organic particles will give off gas which will create gas cavities in the melt.

DENSITY OF METALS AND ALLOYS

Depending on the mixture ratio of the melt and organic materials, you can then make a metal foam of any desired density.

For example, you can make a steel that is so light that it would float in the water. You can specify the density that you want.

Now this need not be limited to pure metals. It can be also alloys. Metal mixtures which cannot be alloyed at all beyond a certain mixture ratio because of the differences in densities of the metals, can also be mixed and alloyed under zero gravity.

This has all kinds of potential.

For instance, if you have a particularly sensitive structure, let us say a turbine blade, where you are interested in having the blade material very light at the outer tip in order to reduce centrifugal force, but you want to very strong in the foot of the turbine blade in order take care of the centrifugal forces, you can, by slowly spinning the mold, even program the density of the material along the longitudinal axis of the blade.

Why would such a thing be conceivably important?

BENEFITS FOR JET ENGINES

I can only say if we had a material today that would enable us to run, for example, all our jet engines in airliners at a temperature of 200° hotter than what they can take today, a tremendous saving would accrue because of better economy of the engines which can be translated into more range, more payload of these engines.

So there are limited markets for material where even the cost of material processed in orbit is entirely acceptable.

MANUFACTURE OF DRUGS

Just very recently we had very interesting discussions with the pharmaceutical industry on the manufacture of certain drugs under zero gravity conditions.

Very small quantities are involved. If some medical effects can be produced by using manufacturing methods at zero gravity, this could really lead to a breakthrough.

This laboratory here, which would be attached to the space station, is designed to experiment in this area to determine what manufacturing at zero gravity can do.

ADVANCED MISSIONS

Mr. EVINS. Very good. Mr. Reporter place in the record the "Advanced missions" section.

(The pages follow:)

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1971 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT — ADVANCED MISSIONS PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The objectives of the Advanced Missions programs include examining advanced manned space flight program concepts and developing the requirements for future systems. The studies conducted provide both guidance for the research and technology effort required to support these systems and technical information upon which to base future program decisions.

SUMMARY OF RESOURCES REQUIREMENTS:

	1969	1970	1971
Advanced missions studies.....	$2,500,000	$2,500,000	$2,500,000
Total.....	$2,500,000	$2,500,000	$2,500,000
Distribution of Program Amount by Installation:			
John F. Kennedy Space Center, NASA.....	---	---	$100,000
Manned Spacecraft Center.....	$465,000	$1,000,000	1,000,000
Marshall Space Flight Center....	810,000	800,000	1,000,000
Langley Research Center.....	125,000	---	---
NASA Headquarters.....	1,100,000	700,000	400,000

BASIS OF FUND REQUIREMENTS:

	Advanced Missions Studies		
Advanced studies.....	$2,500,000	$2,500,000	$2,500,000
Total.....	$2,500,000	$2,500,000	$2,500,000

Advanced studies enable this country to efficiently direct future manned space flight program planning. The studies use the capabilities of industry to perform conceptual designs and provide comparative technical data to supplement in-house activities. During FY 1970, emphasis is being reoriented to study the elements of the integrated program endorsed by the President's Space Task Group. Studies during this fiscal year include: requirements associated with future manned missions, focusing on applying hardware to be developed for the Space Station, Space Base, and future lunar missions; prescribing the desired characteristics of nuclear stages and chemical stages

for use in transporting men and payloads to and from synchronous orbit, lunar orbit, the lunar surface, the planets, and between various low earth orbits; examining methods for conducting manned exploration of the moon after completion of Apollo; evaluating the effect of introducing various degrees of self-support in conducting future manned space flight missions; and reviewing critical aspects of proposed future missions, to promote their operational safety.

Funding in FY 1971 will continue to concentrate on the future activities included in the integrated program:

(a) Escape and rescue systems studies will be conducted to establish the best methods and techniques for performing escape and rescue missions from low earth and synchronous orbit space stations and bases, from lunar orbit, and from the lunar surface.

(b) Integrated mission management and operations planning studies will be performed to develop a concept that supports all missions, and develop its evolution through the next decade.

(c) Space base studies will be directed toward the support requirements for major space operations, including the erection of large structures in earth orbit, geosynchronous missions, lunar missions and possible planetary missions. Also to be investigated is the practicality of using the space base for support of a refueling station, as a personnel and cargo staging platform, and as a hardware assembly area. Examination of the performance and operational characteristics of a reuseable vehicle, such as a space tug for manuevering men, equipment and modules in space will be conducted.

(d) Advanced lunar studies will be undertaken to determine the characteristics of a lunar orbit station and a lunar surface base as the integral part of an advanced lunar exploration and exploitation program. An assessment of the compatability of the proposed mission mode with the objectives of this future lunar program will include: personnel and equipment transfer mechanisms between the lunar surface, lunar orbit, and earth orbit; crew sizings for orbital operations; the commonality of a lunar orbit station with earth orbit space station modules; the modification of space station systems for use in a lunar surface base; and the design and operational characteristics of a reuseable lunar landing vehicle.

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Mr. EVINS. Tell us about the advanced missions program.

Mr. MYER. One of the things we would like to continue is the escape and rescue missions. We have to continue to look at them as far as rescue from lower orbit missions. We want to look at the types of alternate space transport activities that we could look at here. The shuttle looks like the best way to get this low-cost transportation in space.

ESCAPE SYSTEM

Mr. EVINS. Has any escape or rescue system ever been tested and found to work?

Dr. GILRUTH. The only case I know of is in the case of the Mercury program, where the Atlas that was the booster rocket failed to program over, but went straight up, instead of downrange. This was an unmanned spacecraft.

When the Atlas was destroyed, that fired the escape tower which was a device to save the astronauts in the manned program. The escape tower pulled the capsule up and to one side and came down and landed off the shore a few hundred yards.

We actually used that spacecraft again for the next flight. So that was a rescue device which we still carry on Apollo which we did get a chance to use and demonstrate it.

Mr. EVINS. Have you ever had to use the big escape tunnel for the astronauts at Cape Kennedy?

Mr. MYERS. We have used them for practice only.

SHUTTLE RESUPPLY CAPABILITY

Mr. EVINS. Will food, medical supplies, and so forth be supplied to space stations with the space shuttle?

Mr. MYERS. With the shuttle, we will have a very fine capability of resupply of the space station, food, water, supplies of all types, including changes of experiments, and the ability to bring the results of the experiments back to the ground very easily.

AUTHORIZATION FOR ADVANCED MISSIONS

Mr. EVINS. We understand that the authorizing committee authorized $1 million for advanced missions and you are proposing to spend $2.5 million.

How can you go above the authorized amount?

Mr. MYERS. We had proposed $2.5 million. I understand it is being cut below that.

Mr. EVINS. What was recommended by the committee?

Mr. LILLY. The House report, the report to the full House will contain a recommendation for $1 million instead of $2.5 million. What it will end up with, we do not know.

Mr. EVINS. Any other questions, gentlemen?

Gentlemen, I suggest we suspend until 10 o'clock in the morning and we will begin with the space science and applications programs.

WEDNESDAY, MARCH 25, 1970.

Mr. EVINS. The committee will come to order.

When the hearing concluded yesterday, we were discussing the manned space flight programs.

SPACE SHUTTLE AND STATION PROGRAM

COST BREAKDOWN

We feel that we need a little more detail on the space shuttle and station. This program jumps up from $18.5 million in 1970 to $110 million in 1971. How do you propose to spend this $110 million? There is not much breakdown.

Mr. MYERS. The breakdown at $110 million covers some experiment definitions of the space station and here is a case where we have done quite a lot of work for the Skylab and need to better understand the ideas of the separate modules we might be able to use for future space station activities where we can mount a complete experiment in a module to be carried up by the shuttle, and either attached to the space station or free-floated alongside the space station in conditions where you want to have the experiment separated from the space station. So we have $12 million for definition phases this year that would cover that kind of activity.

There is $48.5 million for the shuttle engine definition and design. In this case we would be going out for contracts for the development of designs of the engine for the shuttle now. This is a high-pressure topping-cycle engine that would give us the highest level of technology in terms of the efficiency of the engine that we could possibly get for application to the shuttle program. There is $48.5 million breaking down into $16 million for definition and $32 million for——

Mr. EVINS. Didn't you just go over the $12 million for definition?

Mr. MYERS. That was for the space station experiments.

Under the shuttle engine now, there is $48.5 million breaking down into $16 million for definition of the engine; this would be design studies of the details of the topping-cycle type of engine which gives us the high efficiency we need for the shuttle. And $32.5 million for design activities which would allow us to do some laboratory investigation of the critical parts of that engine system. This would be a program where we would expect to have three contractors doing this design definition work and those same three contractors doing some design activity and some testing activity in the laboratories with the idea of having what amounts to something like the old concept of a flyoff where you have a demonstraton test of the three different contractors' engines and by that means actually pick the best engine, even under demonstrator conditions.

Mr. EVINS. You expect to have three contractors working on the program, each with some design and testing activities; is that correct?

Mr. MYERS. But not of a full engine. Testing of components.

Mr. EVINS. There will be some testing of components for the engine in three separate contracts, is that correct?

Mr. MYERS. Yes, sir. This was to get maximum competition in this engine development so we could get the best approach by their management and engineering to low-cost development and manufacturing of that engine.

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SHUTTLE AIRFRAME DEFINITION

Mr. EVINS. Tell us about the shuttle airframe definition program.

Mr. MYERS. The shuttle airframe definition is the $22.5 million which, as we testified yesterday, is the completion of the definition phase for up to three contractors on the airframe of the shuttle. This is the study that will look at two specific designs, one for low cross-range and one for high cross-range, during this 1971 time period, and will give us enough depth in that design study to define the weights and the technology areas that need additional work and the costs in a much better fashion as far as the shuttle airframe is concerned.

Mr. JONAS. Will this be the wrap-up cost for definition?

Mr. MYERS. Yes, sir, this should be the wrap-up cost.

Mr. EVINS. Of all of the components?

Mr. MYERS. Yes. I will have to hesitate on this point. We believe this will give us a good solid definition of the design and good answers on the cost of the program. However, if in this phase we actually find problems in technology, we may find that we want to move for another 6 months of additional definition or perhaps longer if we don't solve these definition technologies to the point where we can move forward on the program. We don't want to enter into the program until we understand it sufficiently to know we are going to have a good, viable development program where we are not going to stumble as we go.

The definition phase is the thing that gives us this opportunity to understand the technology and to understand how that fits into the design so that we can move forward then in the following years.

I could finish this definition phase and find we are ready to move forward into what we call phase C, which would be design, or perhaps would need an extended period in definition before we are ready to move forward.

NOT A CRASH PROGRAM

Dr. PAINE. It is a point of basic policy that we might highlight here. We do not regard this as a crash program that has to be accomplished by a certain date. We would like to do the definition work sufficiently thoroughly so that we don't spend money later on making hardware parts that are not correct where actually in this less expensive part of the work we can understand the problems we may encounter later before we move to the next phase.

Mr. EVINS. You spent money in 1969 for station definition.

Mr. LILLY. In the Apollo applications program in fiscal 1969, there was work toward an eventual space station. We are showing this amount of $8.8 million as the actual amount spent in the Apollo application program.

Mr. EVINS. You are adding another $6 million for that in your budget for 1971, is that correct?

Dr. PAINE. That is correct.

DESIGN VERIFICATION

Mr. EVINS. Tell us about the $21 million for preliminary design verification.

Mr. MYERS. $21 million will be money we would use for experimental work to give us a clear understanding of certain specific structural design or thermal protection systems that come out of the design by the manufacturers.

We had this definition phase going on. Say contractor A comes up with a certain structure for the wing of the shuttle and contractor B comes up with a different way and they both look like they have promise, but in different directions.

We would like to be able to build parts of that wing. Sections 2 or 3 feet in each direction, and test them under temperature conditions and load conditions we would expect to encounter in flight.

Mr. EVINS. Where would this be tested?

Mr. MYERS. This would be done by the manufacturers.

MONITORING OF CONTRACTS

Mr. EVINS. In other words, you are going to contract with the manufacturers to do this work and you will contract with them again to verify the work. You are not going to do the verification with your own in-house capabilities?

Mr. MYERS. We would be monitoring that work. We will use facilities wherever we have those facilities.

Mr. EVINS. That appears to be another layer on the already existing contracts.

Mr. MYERS. It would be additional work to the contractors to build parts which we would verify——

Mr. EVINS. Can't you write it in the language when you give them the contracts, to come up with solid and checked-out proposals? Why do you have to have another contract to verify that which has already been done?

Mr. MYERS. We have design studies in the definition phase and during that phase we want to be able to understand those technologies that we want more work done on. So then we want to be able to add those contracts.

Mr. EVINS. I could understand verification in your own laboratories with your own in-house capability but I don't quite see why you would let another contract to verify what has done.

Mr. MYERS. We would like to use their manufacturing and fabrication techniques to build the piece of hardware we want to test, so we have actually utilized his capabilities in manufacturing activities to build the part.

WORK VERIFICATION

Mr. EVINS. Has it been a common practice in the past to let the manufacturer verify his own work?

Mr. MYERS. When we say verifies his own work, his tests will indicate whether the results are good and final tests may be done in our facilities.

Mr. EVINS. This is a $21 million add-on.

Mr. MYERS. It is a very important add-on, sir, in terms of the output that we get because one of the elements of this thing is developing the technology of fabrication that will be used in building the structure of the vehicle.

Mr. EVINS. Do you think this $110 million will be the wrap-up cost of the space shuttle and station design, definition, and verification?

Mr. MYERS. We have high confidence it will give us the answers we need to move forward at the end of the year.

ADD-ON AUTHORIZATION COMMITTEE

Mr. EVINS. What would be provided with the $80 million proposed to be added by the House authorization? Some of the members had a view in addition to NASA.

Mr. MYERS. This was to do additional verification work. In the definition of the shuttle, we have new structures, we are using new materials and new structural concepts, and we are working at temperatures of 1,500 degrees or so on the surface of the shuttle, so we certainly could use additional dollars in this effort, but we believe that the amount shown in this budget request will do the job.

Mr. EVINS. This will be to verify the verification?

Mr. MYERS. That would be deeper and broader verification, I am sure, if additional funds were added for that kind of activity.

COMMENTS ON ADDITIONAL VIEWS

Mr. EVINS. Seven members of the House Authorizing Committee gave additional views against this space shuttle station program. They say that you have developed the Saturn V vehicle, spent a lot of money on it and now you are going to discontinue it. It is like developing the Ford car, I suppose, the universal car, and then you turn around and develop a Cadillac. You don't use the one you developed for long. They are decrying abandonment of Saturn V and picking up a new concept which they say will cost billions of dollars. Do you have any comments on these additional views?

Dr. PAINE. The Saturn V has served the Nation well. It was designed to do a specific job. It brought us very far along technologically, in addition to performing successfully the lunar mission but, as we look down the road, the continuation of this particular technology as our basic launch capability, which is a very expensive capability, does not fit the conditions we will be facing in the perinod of the 1980's. The shuttle-space station development is a development aimed at reducing by a factor of 10, costs associated with space flight using Saturn V kinds of techniques. I think it is extremely important for the future pace of the Nation.

Mr. EVINS. Place in the record pages 161 and 162 of House Report 91–929.

(The pages follow:)

ADDITIONAL VIEWS OF HON. JOSEPH E. KARTH

The administration requested authorization for $110 million for design and definition of the space shuttle station. The Science and Astronautics Committee increased this amount by $80 million, for a total of $190 million for fiscal year 1971.

These funds represent the first large increment for the space shuttle station, a development program which ultimately will cost the Nation many billions of

dollars. In order to make resources available for this new project during fiscal year 1971, several noteworthy policy decisions were made by NASA. Among the most significant were the following:

The launch schedule for the Viking project was delayed 2 years, from 1973 to 1975.

The applications technology satellite F and G project was delayed for 6 to 12 months.

The production of Saturn V launch vehicles will be discontinued after vehicle No. 515.

In my judgment, these decisions were unwise, the three affected programs are justified on their individual merits, and work on them should not be delayed or discontinued in order to accommodate a major new start in the manned space flight program, or for that matter, any other.

The Viking project will significantly advance our knowledge of the planet Mars, with particular emphasis being placed on obtaining biological, chemical, and environmental data relative to the possible existence of extraterrestrial life. The objectives of Viking have been given the highest priority by the scientific community. It is especially regrettable that the launch of the Viking spacecraft will be delayed until the 1975 opportunity, since the relative positions of Earth and Mars during the 1973 opportunity would make for a much less demanding mission in terms of complexity of both equipment and operations. Moreover, the 2-year delay will increase total project costs by some $150 million.

The applications technology satellite F and G project will test advanced communications concepts, including a 30-foot diameter erectable antenna and superior pointing controls. These spacecraft will be precursors to direct broadcast satellites of the future. The capability for direct broadcast from orbit could revolutionize world communications, and the potential benefits to mankind growing out of research and development projects such as applications technology satellites are immeasurable.

Finally, the United States has an enoromous investment in Saturn V/Apollo hardware. For the purpose of continuity and for reasons of economy, the Nation should make the most effective possible use of this proven hardware now. These existing systems can be utilized for a variety of meaningful manned missions in the 1970's, in addition to those proposed by NASA.

More to the point, the huge costs involved in suspension and subsequent restart to production of Saturn V launch vehicles, estimated by Dr. Werner von Braun to be hundreds of millions of dollars, can be avoided if additional resources are applied to Saturn V during fiscal year 1971, and production is continued. In this connection, testimony was received to the effect that NASA intends to resume Saturn V production in 1976 or 1977 in order to support future manned missions, and for the testing of the NERVA nuclear stage. That being the case, it seems both inefficient and unwise to discontinue production of Saturn V launch vehicles with vehicle No. 515.

NASA should defer large-scale expenditures on the space shuttle station until after necessary basic research can be accomplished on the many technical problems that must be resolved before hardware development can be undertaken effectively. In addition, it would seem advisable that cost effectiveness studies be conducted comparing operation of the space shuttle with the continued use of existing expendable launch vehicles before sizable amounts of money are applied to the shuttle development project.

It is important to note that testimony was received to the effect that the Office of Advanced Research and Technology will spend between $30 and $40 million on basic research in support of the space shuttle station during fiscal year 1971. I fully support the research to be done by OART in this regard; but I oppose rushing into development of expensive space shuttle station hardware during these years of declining space budgets. I consider it extremely unwise to commit the Nation to development of costly hardware before the necessary fundamental research has been completed. I consider it extremely unwise, also, to cancel or stretch out on-going projects at enormous additional cost so as to accommodate, prematurely, a new project start.

JOSEPH E. KARTH.
KEN HECHLER.
THOMAS N. DOWNING.
MARIO BIAGGI.
THOMAS M. PELLY.
GUY VANDER JAGT.
JERRY L. PETTIS.

Mr. JONAS. It says in these comments, "I consider it extremely unwise to commit the Nation to develop this costly hardware before the necessary fundamental research has been completed."

Dr. PAINE. I don't know what particular context that is taken from. What are they commenting on?

ADVANCED RESEARCH FUNDING

Mr. JONAS. They are talking about the $30 or $40 million relative for advance research and technology which will be spent in support of the shuttle station during 1971.

Dr. PAINE. This whole question of design verification and definition that we have been discussing this morning is designed——

Mr. JONAS. Is this provided in the program for 1971?

Mr. LILLY. The $30 or $40 million is the amount of work carried out in the Office of Advanced Research and Technology. It is not in these funds.

Mr. JONAS. It is in addition to these funds?

Mr. LILLY. It is work in this kind of advanced research which they say has applicability to the space shuttle and space station effort.

Mr. JONAS. These members seem to be saying that they think it is a mistake to spend this money until the research has been completed, the definition work.

Dr. PAINE. The point here is that we regard it of prime importance to both proceed with this definition and the verification studies here which will tell us the status of our technology and at the same time to be moving ahead in those critical areas of technology which we know are of long-range importance, both for these programs and other programs, for things like life support systems, guidance and navigation. There are many different fields, structures, materials. We will be carrying on research in parallel with this definition study.

Mr. JONAS. It turns out now that this $110 million is not the wrap-up cost. It is not all of the costs involved. The Office of Advanced Research and Technology is going to be spending $30 or $40 million and that would increase the cost of the preliminary work, wouldn't it?

APPLICABILITY OF OART RESEARCH

Dr. LOW. In the Office of Advanced Research and Technology there is about $30 to $40 million worth of work which is also applicable to the shuttle and the space station, but it applies to many other things as well; engines for airplanes, supersonic transports. In other words, in looking at the work in the Office of Advanced Research and Technology, looking at all of the tasks that are going on there, we find that many of these jobs apply to multiple facets of our operation including the shuttle and the space station and this is the work that's referred to here in the House report.

Dr. PAINE. A specific example is high temperature materials. For the reentry of this shuttle vehicle to be successful, we have to have materials on the bottoms of the wings and the fuselage that will withstand the high temperatures of reentry, but clearly the high-temperature material work which will help that will also help jet engine turbine

buckets, so what we have done in the other cases is identify the area of things like high temperature material development which will also apply to the shuttle development although they are not specific to it. The specific things are identified here. The others are general research programs which will also have application here.

Mr. BOLAND. So the statement really is not quite correct wherein it says that the OART will spend between $30 and $40 million on basic research in support of the space shuttle station during fiscal year 1971. It is not all going for these Space Shuttle/Stations?

Dr. PAINE. The question is correct, but it is not all-inclusive. In addition, that work will support other things.

DIFFERENT VIEWS ON PACE OF PROGRAM

Mr. EVINS. Part of the statement is applicable. The authorizing committee thought that you should have $80 million more, so there are various views as to how much should be spent.

Dr. PAINE. Yes. I think, Mr. Chairman, you will recognize that essentially reflects a view on their part that we should be moving ahead more rapidly. The proposal we are presenting here is for a somewhat slower pace.

Mr. EVINS. Will you provide, Mr. Administrator, a detailed listing of the RFP's currently planned and projected with the $110 million requested for the space shuttle and station.

Dr. PAINE. Yes; we will provide that.

(The information follows:)

Two contracts for phase B studies on the space station were let to North American Rockwell and McDonnell-Douglas in September 1969, to run for 11 months. At the end of these contracts, six 1-month options are available. The present plan is to exercise these options, in addition, eighteen RFP's have been or will be issued for experiment definition during fiscal year 1970.

The RFP for phase B on the space shuttle engine was issued on February 18, 1970, and it is expected that up to three contracts will be let on or about June 1, 1970. If there are three contracts let, each contract will be worth approximately $7 million to be funded out of fiscal year 1970 and fiscal year 1971 funds.

The RFP for phase B on the space shuttle airframe was issued on February 20, 1970, and it is expected that up to three contracts will be let on or about June 22, 1970, for up to $10 million each to be funded out of fiscal year 1970 and fiscal year 1971 funds.

Based on current planning for fiscal year 1971 approximately 35 RFP's are projected for space station experiments, one RFP for the experiment module, eight RFP's for design verification and one RFP is projected for the shuttle engine activity. The other space shuttle and station activity is a continuation of the effort initiated in fiscal year 1970.

The 18 RFP's being issued for experiment definition in fiscal year 1970 will be in the following areas of study: Systems definition, physics and astronomy, life sciences, human factors.

The estimated costs of these 18 RFP's is approximately $6 million.

Preliminary planning for allocation of fiscal year 1971 space station funding calls for approximately $12 million applied to experiment definition and approximately $12 million allocated to design verification. It is envisioned that as many as 43 separate study activities may be required. The requirements for these studies are in the process of definition and have not been sufficiently identified to provide a proposed RFP listing. The following are typical disciplinarian areas of study identified as high priority and it is expected that several RFP's will be issued in each category in fiscal year 1971.

SCIENCE, APPLICATIONS AND TECHNOLOGY, SPACE STATION, SPACE SHUTTLE, SPACE BASE (PLANNED FUNDING TOTAL $12 MILLION)

Thirty-five studies contemplated: Astronomy, Earth applications, space physics, aerospace medicine, bioscience, engineering and technology, space base, space shuttle science.

DESIGN VERIFICATION

Eight studies contemplated (planned funding total $12 million).
The funding for these individual RFP's is still under review and no precise estimates are available at this time as the configurations and the system characteristics of the space station are being studied by our phase B contractors.

SATURN V PRODUCTION

Mr. JONAS. I notice Dr. von Braun is not here. He commented on this yesterday, but another comment made by these seven legislative committee members I think needs to be answered. If you don't think it was adequately answered, will you comment on it? He talks about hundreds of millions of dollars involved in starting up again the production of the Saturn V launch vehicles after putting them in mothballs until the midseventies.

Dr. PAINE. Yes; this is one of these cases, Mr. Jonas, where we are faced with the decision of postponing costs now which would be involved with keeping up production—say two Saturn V's a year—which we would produce and put into storage—the costs associated with that versus the costs of suspending production now, laying off the people and eventually, later on, being faced with higher startup costs and the judgment we have made is that we would prefer to reduce the costs now and incur higher costs later on rather than have higher costs on a continuing basis.

VIKING AND APPLICATIONS TECHNOLOGY SATELLITE F AND G PROJECT

Mr. JONAS. These seven members are opposed to your postponing the Viking project and the Applications Technology Satellite F and G project. They think you ought to do that rather than embark on this shuttle and station program. There is where you get a horserace.

Dr. PAINE. I think that is exactly right. We have tried to come up with a balance here between the ongoing programs we have and the new programs because we certainly don't want to give up our future activity. We must continue to keep NASA in the forefront which the shuttle/space station program does while we continue with our present systems. We believe the number of flights scheduled to go to the moon will keep our current technology active and will keep the astronauts and the tremendous number of people we have trained at the gate carrying out the work that will allow us at any time we feel that the time has come to reinstitute Saturn V production. We will have the back-up for that.

PRESENT STATUS OF PROGRAM

Mr. EVINS. There are many individual views about the space program in this Committee and in the country. We can say for the record that the President's Space Task Group has studied this matter and the Vice President has come up with a report. The Bureau of the Budget

has made decisions and recommendations, as has NASA and the President has approved this plan. It has been authorized by the authorizing committee of the House with a suggestion by the majority that they go even further. There are a lot of views, but the prevailing view is that we launch upon this new program at this time.

Dr. PAINE. I think, Mr. Chairman, that is an excellent statement of the situation we face and I think it is clear to everyone that in the process of coming to these decisions, NASA has been faced with the necessity of making very hard choices indeed, and I think the closing of our Electronics Research Center was certainly one of the bitterest decisions with which we were faced in this extremely major cut in NASA funding, but we believe on balance the decisions we have made are the correct ones.

COST OF LAST TWO APOLLO FLIGHTS

Mr. EVINS. Maybe this Committee might help you make a decision to cut out the last two of the Apollo flights.

How much is included in the 1971 budget for the last two Apollo flights in 1974, including all the additional experimental gear associated with the manned landing?

Mr. LILLY. Mr. Evins, I will supply a precise figure later. There is very little money in for those last two vehicles. We made a specific decision when they were scheduled that far in advance that we would not need to fund any of the experiments and equipment for them. The primary thing that would be involved in the cost right now is the vehicles that are going to be used. These are in their final stages of production and as Dr. Paine said, yesterday, will be finished by September of this year, so there is a small amount in finishing those up.

Mr. EVINS. Supply that for the record.

(The information follows:)

As you are aware, NASA did not contract for the manned space vehicles and scientific payloads on a per mission basis. The launch vehicles and spacecraft for the last two missions are essentially through the production process. It is estimated that approximately $25 million will be required in fiscal year 1971 for work on the lunar landing modules for the two lunar missions planned for fiscal year 1974. Effort on the scientific payloads for these two missions will be limited to study and defintion work and is estimated to be approximately $1 million. If a decision were made to cancel these two lunar missions, the portion of the $26 million no longer needed would depend on the timing of the decision and the ultimate determination of the contract termination liability.

Mr. BOLAND. About the only cost will be for the launching.

Mr. LILLY. And that wouldn't be in the 1971 program.

SPACE SCIENCE AND APPLICATIONS PROGRAM

Mr. EVINS. We will proceed to Space Science and Applications and place in the record summary page SSA–1.

(The page follows:)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION—RESEARCH AND DEVELOPMENT BUDGET PLAN FOR SPACE SCIENCE AND APPLICATIONS PROGRAMS

[Fiscal year 1971 estimates]

Program	Fiscal year—		
	1969	1970	1971
Physics and astronomy	$128,850,000	$111,835,000	$116,000,000
Lunar and planetary exploration	87,923,000	151,013,000	144,900,000
Bioscience	37,900,000	19,670,000	12,900,000
Space applications	98,665,000	128,400,000	167,000,000
Launch vehicle procurement	99,900,000	108,800,000	124,900,000
Total	453,238,000	519,718,000	565,700,000

Mr. EVINS. Tell us what you are proposing in this program.

Dr. PAINE. Dr. Naugle can speak to this.

EMPHASIS ON APPLICATIONS

Dr. NAUGLE. Mr. Chairman, the President, as Dr. Paine testified yesterday, stated three basic purposes for NASA exploration, science, and applications. The Office of Space Science and Applications is heavily involved in all three of those. As you noted yourself, in looking at the summary breakout yesterday, we are increasing our emphasis on the practical applications of space at this time. We are increasing the budget for the spacecraft and supporting research associated with that effort from $98 million in fiscal year 1969 to $167 million in the fiscal year 1971 budget that you have before you.

I might say a word about the approach that we are taking in applying this. We are not just saying, "Here is some hardware we have developed, let's go see who we can sell it to," but, rather, we are working very closely with the user agencies such as Interior, Agriculture, and universities that have expertise in this area. We are also bringing on board some new people such as Dr. John De Noyer, who comes originally from the university community. He spent some time in the Institute for Defense Analysis, IDA, but most recently was Director of Research for the Department of the Interior. We have also added Dr. Archibald Park, formerly of the Department of Agriculture, to one staff. So the approach we are taking in NASA as we look to the future here, is to understand what we call the ecological problems of the planet earth.

UNDERSTANDING OF ECOLOGICAL PROBLEMS

That is just another way of saying that we want to understand the interactions between the humans on the earth and the earth itself—its natural resources, its atmosphere, water supply, and so on. When we understand what the problems are, we will use our knowledge of space, the techniques, the measurements, the sensors, and apply those to help solve those problems.

TIROS–M

We have worked closely with the Environmental Science Services Administration, ESSA, to develop prototypes of the Meteorological satellite systems that then become operational. In January we launched Tiros–M, which is the prototype of the next generation of operational meteorological satellites. With that satellite, we will be able to really combine two satellites into one. That is, the functions that used to take two satellites will now be done with a single satellite and in addition to that we will be able to get photographs of the cloud cover at night.

I have here some photographs taken by the two cameras that are working in the same satellite, at the same time. On the right is a picture taken in the visible light channel, the conventional technique that we have been using which only gives us cloud cover photographs in daylight. With this new technique that we have developed, you are able to take cloud cover pictures at night.

What you see is a pass in which the satellite is coming down under the South Pole, if you will, and up over South America. What you see is the coast of South America. As the satellite came over the South Pole this region was in darkness so, as you can see, with the visible light camera we were unable to get cloud cover pictures. With the infrared camera, we get very good cloud cover pictures. So now we will be able to really maintain continuous, both daytime and nighttime, cloud coverage with the satellite.

Earlier, I mentioned two techniques, or the techniques that require two satellites. One of those was the process I described by which we collect global cloud cover pictures on a worldwide basis; that took one satellite. It took another satellite to carry what we call the automatic picture transmission system. This gives a capability for a station, say in Nebraska, or any place around the world for that matter, to interrogate a satellite and it will send down a picture of the local area weather patterns.

With this new satellite, we have combined both of those functions on one satellite. The satellite is up and working perfectly.

PHYSICS AND ASTRONOMY PROGRAM

Mr. EVINS. Let's turn to your "Physics and astronomy program" and place pages RD 4–1 through RD 4–13 in the record.

(The pages follow:)

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1971 ESTIMATES

OFFICE OF SPACE SCIENCE AND APPLICATIONS — PHYSICS AND ASTRONOMY PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The Physics and Astronomy program, when viewed in the framework of broad scientific and technological efforts, has the following objectives: to understand the origin and continuing evolution of the earth, our solar system, the stars, galaxies, and the universe. We are exploring our space environment in order to understand its nature and the physical processes that shape it. In doing so, we are increasing our knowledge of the fundamental laws and principles of nature.

To attain this goal, a variety of techniques are used to gather information. These include theoretical and laboratory research; aircraft, balloon and sounding rocket flights; as well as observations using small and large automated spacecraft and manned systems. The latter category covers manned earth orbital flights (AAP) as well as observations conducted from the lunar surface under the Apollo program. Research groups participating in this effort are distributed all over the US and the free world. Groups are located at most of the NASA centers, at several other Government laboratories, and at many universities and industrial laboratories. Foreign participation is arranged through the science ministry of each of the participating countries.

The technology developed and data gathered in this Program are made available to the scientific and technical community in order to contribute to future scientific research, education, and the advancement of the technology of our country.

SUMMARY OF RESOURCES REQUIREMENTS:

	1969	1970	1971
Supporting research and technology/ advanced studies	$22,497,000	$17,500,000	$17,500,000
Airborne research	1,000,000	1,600,000	3,000,000
Data analysis	3,412,000	3,000,000	3,000,000
Sounding rockets	19,234,000	18,500,000	18,500,000
Solar observatories	13,812,000	14,700,000	16,100,000
Astronomical observatories	36,392,000	31,600,000	27,100,000
Geophysical observatories	13,072,000	6,000,000	5,200,000
Explorers	19,431,000	18,935,000	25,600,000
Total	$128,850,000	$111,835,000	$116,000,000

Distribution of Program Amount by Installation:

	1969	1970	1971
Kennedy Space Center	$60,000	---	---
Manned Spacecraft Center	666,000	$490,000	$450,000
Marshall Space Flight Center	777,000	1,214,000	1,500,000
Goddard Space Flight Center	99,422,000	83,700,000	86,800,000
Jet Propulsion Laboratory	537,000	920,000	650,000
Wallops Station	838,000	734,000	860,000
Ames Research Center	2,017,000	3,094,000	4,910,000
Electronics Research Center	47,000	40,000	---
Langley Research Center	886,000	773,000	740,000
NASA Headquarters	23,600,000	20,870,000	20,090,000

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology/Advanced Studies

Space physics	$10,300,000	$7,300,000	$7,300,000
Astronomy	12,197,000	10,200,000	10,200,000
Total	$22,497,000	$17,500,000	$17,500,000

The Supporting Research and Technology/Advanced Studies programs enhance the overall scientific and technological return from NASA flight projects and help assure continued excellence and viability of the future research program in space science. The objectives can be stated in the following three broad categories: (1) enhancement of the value of current space missions by a full supplement of simultaneous ground-based and balloon observations; (2) development of theories to explain observed phenomena and predict new ones; and (3) optimization of the return expected from future missions by problem definition, development of advanced experiments and concepts, and the careful definition of proposed new missions.

These funds provide partial support for the Goddard Institute for Space Studies, the Space Science Board, and the Research Associate Program. About 250 research tasks are carried out by universities, nonprofit and industrial research institutions, NASA centers, and other Government agencies. The following specific areas of research are being supported:

Space Physics

The work is largely devoted to support of research related to physics of the earth's environment. It includes study of the sun-earth environmental factors as well as extra solar factors such as cosmic rays. In general, these tasks may be categorized in the traditional disciplines of particles and fields, ionospheres, and interplanetary dust.

Particles and fields tasks include research in magnetodynamics and plasma physics, studies of the solar wind and magnetosphere, and magnetometer and plasma detector development. Research in cosmic rays and the radiation belt are carried out under this area. Special efforts are being made to develop detectors for the study of ultrahigh energy cosmic rays. Advanced studies are being performed of combined satellite V systems and of a spacecraft to assess conditions in interplanetary space.

Tasks included in the ionospheres area cover ionospheric theory, plasma physics, radio propagation, electromagnetic waves, ionospheric electron content, electron density and electron temperature, ion mass spectrometers, plasma and langmuir probe observations, antenna impedance, solar terrestrial relations, and ionospheric and magnetic storms and disturbances.

Under the category of interplanetary dust are included the study of meteorites and micrometeorites, micrometeorite simulation, development of instrumentation, theoretical studies, interplanetary gas and dust, noctilucent clouds, cometary physics, and physical and chemical analyses of dust particles. Also included in this area are problems relating to chemical releases, Zero-G physical phenomena, airglow, and zodiacal light observations.

Astronomy

Research supported in this area involves the study of the sun and other stars and objects outside the solar system. Research tasks include studies of the sun and the solar spectrum, influence of the sun on interplanetary and planetary environments, instrument development, and laboratory and theoretical studies of basic physical processes peculiar to the sun. Also included are solar radio and radar astronomy.

Research tasks related to objects outside of the solar system include observation by ground-based and balloon-borne telescopes, radar and radio astronomy, and instrument development. Theoretical studies of stars, galaxies, interstellar and intergalactic matter, and advanced development work on experimental tests of the validity of Einstein's Theory of Relativity are also supported in this area.

Advanced studies are being performed of systems that will lead to the development of large space astronomy facilities, such as, a 120 inch optical telescope, large X-ray and gamma ray observatories, and low frequency radio astronomy antennas.

Airborne Research

	1969	1970	1971
Airborne research.....	$1,000,000	$1,600,000	$3,000,000
Total.....	$1,000,000	$1,600,000	$3,000,000

Research with instrumented aircraft has been an integral part of the NASA program since 1965. This Airborne program has helped bridge the gap between ground-based experiments and those which require the higher costs and complexities of rockets and space vehicles. In the past, this program has supported auroral and airglow research, observations of the solar corona during total eclipses, and infrared astronomy.

Funding includes that planned for the acquisition of a C-141 airplane and for the continuation of the development of a 36 inch infrared telescope. The C-141 airplane and 36 inch telescope will provide us with a unique and cost effective airborne astronomical observatory. It will be used to explore an essentially unobserved part of our universe in that portion of the infrared spectrum that is blocked from our view due to water vapor in the lower atmosphere.

Data Analysis

	1969	1970	1971
Space physics	$3,162,000	$2,650,000	$2,600,000
Astronomy	250,000	350,000	400,000
Total	$3,412,000	$3,000,000	$3,000,000

The operation of the National Space Science Data Center (NSSDC) and correlative studies utilizing space data are supported under this project. Following the successful launch of a spacecraft, the investigators are funded to perform the primary analysis of the data. As soon as definitive reduced data tapes have been produced, the investigators make them available to other interested scientists by placing reduced data records in the NSSDC.

The NSSDC, located at the Goddard Space Flight Center, was established to serve as a central repository and clearinghouse of reduced scientific data resulting from space investigations. The amount of data to be handled has increased steadily each year. Although the proposed budget will not permit the originally planned buildup in NSSDC capabilities, it is considered adequate for supporting the most essential activities.

In general, flight projects support the primary analysis of data by principal investigators. If required, further support of primary analysis of data acquired from major long-lived experiments has been provided by this project. The primary purpose of the Data Analysis project is to support correlative studies from several separate investigations, as well as new approaches to the analysis of available data. All proposals for research are competitively evaluated and support is provided for those efforts that are expected to contribute most to the total advancement of knowledge.

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Sounding Rockets

	1969	1970	1971
Space physics	$9,200,000	$8,200,000	$8,000,000
Astronomy	10,034,000	10,300,000	10,500,000
Total	$19,234,000	$18,500,000	$18,500,000

Sounding rockets provide a flexible, timely, and cost-effective means of providing space flight opportunities and, as such, constitute an invaluable component of a balanced program in space research.

A flexible stable of relatively inexpensive vehicles is utilized to carry a wide variety of scientific instruments developed for studies in the disciplines of aeronomy, energetic particles and fields, ionospheres and radio physics, galactic and radio astronomy, and solar physics.

Sounding rockets provide timely and relatively low cost flight opportunities for: (1) conducting test flights of instrumentation being developed for spacecraft; (2) providing unique opportunities to study scientific phenomena; and (3) cooperative projects with scientific groups in foreign countries.

Sounding rockets are currently being utilized to conduct measurements of the wide variety of constituents in the earth's upper atmosphere, their variation with altitude, longitude, latitude, time-of-year, etc., and their reaction to incoming radiation and energetic particles. The nature and behavior of the earth's electric and magnetic fields is being studied by a variety of instruments and ionizing chemical clouds released at high altitudes.

Recoverable rocket payloads continue to provide the unique means of collecting samples of micrometeorites, interplanetary dust, noctilucent cloud particles, and upper atmosphere trace gases for study and analysis. The study of cosmic radiation and energetic particle influx and their relationship to such phenomena as aurora and airglow are being continued at a reduced level due to budget constraints. Our knowledge and understanding of the nature, characteristics, and dynamics of heterogeneous layers of the ionosphere is being enhanced with rocket-borne measurements of electron and ion concentrations, altitude distributions, and mass spectra from a variety of launch sites around the world. Studies of the atmospheres, emissions and dynamics of the planets, sun, and stars continue to be made over a complete range of wavelengths of the energy spectrum. Particular effort has concentrated on the study of stellar X-ray and ultraviolet sources, active areas of the sun and its corona, and the atmospheric constituents of the inner planets. Major advances in our ability to conduct these studies have resulted from increased utilization of our recently developed stellar and solar pointing controls that are able to hold scientific instruments pointing at their celestial target within approximately $\pm$ 1.0 arc second, allowing discrimination of very localized regions of interest for study.

The program has made major contributions through test flights of instruments being developed for the Orbiting Solar Observatory and the Apollo Telescope Mount (ATM), as well as providing the in-flight calibration of instruments in orbit on board the Orbiting Observatories and Explorer spacecraft. Special note should be made that a series of approximately 30 rockets will be launched from Wallops Island during a total solar eclipse on March 7, 1970 carrying scientific instruments designed to conduct complementary experiments to study the sun, its radiation, and its effect on the earth's ionosphere and atmosphere during the eclipse.

Responsibility for flight support activities has been assigned to the Goddard Space Flight Center, which also has resident experimental scientific groups in all disciplines. NASA Headquarters has responsibility for experiments developed by scientists at universities, in industry, at other agencies, and in other countries. The Ames Research Center has responsibility for high accuracy solar pointing control systems. Responsibility for flight support activities for certain special projects is assigned to Wallops Station.

Over 80 Physics and Astronomy sounding rockets, primarily of the Nike Cajun/Apache/Tomahawk, Aerobee, and Javelin types were launched during Calendar Year 1969 from sites in the United States Canada Brazil, India, Sweden, and Norway.

NASA plans to continue the sounding rocket flight program in FY 1971 at the current level. Forty to fifty scientific teams will be supported by this program effort.

Solar Observatories

	1969	1970	1971
Orbiting Solar Observatory (OSO):			
Spacecraft	$6,815,000	$8,570,000	$8,220,000
Experiments	6,997,000	6,130,000	7,880,000
Subtotal OSO	$13,812,000	$14,700,000	$16,100,000
Delta (Launch Vehicle Procurement Program)	($2,400,000)	($1,300,000)	(---)
Total (including Launch Vehicles)	($16,212,000)	($16,000,000)	($16,100,000)

The Orbiting Solar Observatory (OSO) program is an observational and scientific program designed to obtain new knowledge of the sun, the earth's atmosphere, and the stars over a broad range of electromagnetic spectrum not available to ground-based observatories. OSO obtains scientific information of changes on the sun which may be very slow, with periods of the order of 11 or 22 years, the periods of the solar cycle, or changes on the order of a month and of changes on the order of seconds, as in the case of short-lived,

unpredictable activities, such as solar flares. Operational OSO's have provided a new observational model of solar flares, with precursive activity in the ultraviolet and X-ray spectral regions. Also, the concept of a "quiet" sun is losing validity, as the OSO data shows.

The OSO is a specialized spin-stabilized space observing platform. The spacecraft consists of a sail, upon which is mounted solar pointing and scanning experiment instruments and which, during the daylight portion of the orbit, points continuously at the sun, and a rotating wheel which houses solar terrestrial and celestial scanning experiment instruments.

Six OSO's have been launched and operated successfully between 1962 and 1969. Two of these, OSO-V and OSO-VI, are continuing to operate and perform valuable observations in support of our solar physics research objectives. Four additional approved missions are scheduled for launch through the mid-1970's to provide the increased spectral, temporal, and spatial resolution necessary to further advance our understanding of the sun. A flight payload of seven experiments was recently selected for one of these missions from a total of 30 proposals submitted by three foreign countries, eight universities, two U.S. Government agencies, and three commercial institutions.

The FY 1971 funds will provide for: (1) the continued operation of OSO-V and VI and for analysis and publication of associated data; (2) the development, testing, launch, and initial operation of the OSO-H mission; and (3) the OSO-I, J, and K scientific instrument and spacecraft development and test to be continued. The next four OSO missions will provide major contributions to the understanding of the physics of particular regions of the sun. OSO-H will concentrate on the solar corona and OSO-I will emphasize the interface between the corona and the chromosphere.

Astronomical Observatories

	1969	1970	1971
Orbiting Astronomical Observatory (OAO):			
Spacecraft	$28,027,000	$21,280,000	$19,710,000
Experiments	8,365,000	10,320,000	7,390,000
Subtotal OAO	$36,392,000	$31,600,000	$27,100,000
Centaur (Launch Vehicle Procurement Program)	($8,800,000)	($5,600,000)	($1,500,000)
Total (including Launch Vehicles)	($45,192,000)	($37,200,000)	($28,600,000)

The Orbiting Astronomical Observatory-II (OAO-II) is now providing detailed information required by astronomers in their search for understanding of the universe. Only by establishing an observatory for investigating the ultra-

violet region of the spectrum outside the earth's atmosphere are scientists able to study these emissions for extended periods of time. As in any exploration, OAO is now accomplishing a sky-mapping operation as a first objective. At the same time, spectral energy distribution data on selected celestial objects in the ultraviolet range are being gathered.

During the first year's observations, the Smithsonian Celescope has taken almost 6,000 ultraviolet pictures of the celestial sphere. Important results of these observations are: (1) many giant stars are fainter in the ultraviolet than predicted, (2) the earth's hydrogen corona is more extensive than appreciated and (3) the Orion nebulosity was observed in detail. The Wisconsin experiment has made observations of 762 celestial objects and obtained data that indicate: (1) young stars are hotter than estimated, (2) most nearby galaxies are generally brighter in the ultraviolet than previously theorized, (3) dark nebulae are bright in the ultraviolet apparently due to the characteristics of the interstellar particles for which OAO has obtained a great deal of fascinating data and (4) preliminary determination of abundance of ozone in the Martian atmosphere.

The next two OAO missions will build on the OAO-II results by providing moderate resolution spectrometer data of stars down to the tenth magnitude and carry out high resolution ultraviolet spectral analysis of fainter celestial objects, respectively.

The successful OAO-II mission has demonstrated a major advance in the state of the art essential to realizing the potential of space astronomy. The OAO project required the development of spaceborne hardware and operational capability which meet the most advanced scientific and technical requirements of the space program. The OAO spacecraft is designed to point in any direction with an accuracy of one-tenth second of arc, and to hold that attitude for extended periods of time. With this operational capability, astronomers can obtain observations of celestial objects and phenomena in those regions of the electromagnetic spectrum that are inaccessible to ground-based instrumentation.

The third OAO (OAO-B), to be launched in 1970, will carry the Goddard Space Flight Center (GSFC) 36-inch telescope to obtain absolute spectrophotometry data on stars, nebulae, and the brighter galaxies. This mission will be the first to include the Inertial Reference Unit (IRU) developed by the Massachusetts Institute of Technology (MIT).

The fourth OAO (OAO-C), scheduled for launch in 1971, will carry a major experiment for Princeton University and a small piggyback experiment for the University College London. The Princeton Experiment Package (PEP) is a 36-inch Cassegrainian reflecting telescope with a concave grating spectrometer. Studies will be made of spectra of interstellar gas and of composition and physical characteristics of interstellar gas and dust, as well as stars. The London experiment consists of three telescopes with paraboloidal reflectors, photon detectors, and gas counters to study X-ray emissions and to search for interstellar absorption.

Although the OAO observatory is, to a large extent, automated, the successful operation of the mission requires closely integrated support from ground facilities to meet the objectives of the scientific investigators.

Extensive ground facilities in the United States and in four other countries (Ecuador, Chile, Australia, and Malagasy) are provided for control of the mission in orbit, and to receive telemetry for transmission to the OAO Control Center at GSFC.

Development of the OAO spacecraft was initiated in 1960. Funding prior to FY 1970 provided for the complete design, fabrication, integration, and test of the observatory for the OAO-I and II missions, and for the prelaunch, launch, and post-launch support of these missions. During this period, an IRU was developed at MIT to augment the star trackers in the stabilization and control subsystem of OAO-B and OAO-C. In addition, the OAO-B spacecraft was fabricated and delivered to GSFC for acceptance test.

Major requirements for FY 1970 funds include: OAO-II operation and data processing; integration of equipment and test of the OAO-B spacecraft; acceptance test and calibration of the Goddard Experiment Package; prelaunch support of the OAO-B mission; and equipment development and qualification for the OAO-C mission, including the PEP.

In FY 1971, the funding will provide for continued analysis and publication of data from OAO-II; launch support, operation, and data processing for the OAO-B mission; completion of subsystems integration and test for the OAO-C spacecraft; acceptance test and calibration of the OAO-C experiment instruments; and assembly and test of the OAO-C observatory system in preparation for a late 1971 launch.

Geophysical Observatories

	1969	1970	1971
Orbiting Geophysical Observatory (OGO):			
Spacecraft	$6,411,000	$730,000	$100,000
Experiments	6,661,000	5,270,000	5,100,000
Subtotal OGO	$13,072,000	$6,000,000	$5,200,000
Thor-Agena (Launch Vehicle Procurement Program)	($233,000)	(---)	(---)
Total (including Launch Vehicles)	($13,305,000)	($6,000,000)	($5,200,000)

The Orbiting Geophysical Observatory (OGO) project has as a primary objective the accomplishment of a series of coordinated scientific studies of the earth's environment and the effect of solar activity on that environment.

Six OGO missions, each including 20 or more experiments, have been launched at the rate of one each year starting in 1964. The last mission in this project (OGO-VI) was launched in June 1969 and has successfully accomplished its initial objectives. These six missions have alternated between high altitude, low-inclination orbits for magnetospheric and interplanetary studies, and low altitude, nearly polar orbits for global studies of atmospheric and related phenomena, and have provided good coverage from solar minimum through solar maximum.

The scientific accomplishments of the OGO project have had a significant impact on our understanding of the earth's space environment. In particular, the results disseminated in over 300 papers and published reports have indicated the complex, dynamic nature of this environment. The knowledge obtained provides a firm basis for the next phase of earth environment studies: that of specific research leading to an understanding of the physics of observed phenomenalistic processes.

The development of a large, complex laboratory system like OGO for space studies and the proven long life of these systems under strenuous conditions, is a major technical and engineering achievement. This experience has benefited other space programs and has provided a technology base for the development of advanced space laboratory concepts.

In November 1969, routine data acquisition for OGO-I and III was discontinued and these observatories were placed in a standby mode. Operation of OGO-II and IV was terminated in November 1967 and October 1969, respectively.

The OGO-V and VI missions continue to perform well and are providing, from a stabilized platform, data for approximately 40 investigations. In 1969, through a series of special operations, experiment instrumentation aboard OGO-V was used successfully to obtain, for the first time, a virtually complete sky survey of hydrogen Lyman-alpha radiation emitted by our galaxy. Also, as part of the 1969 Airborne Auroral Expedition, OGO-VI data acquisition in the northern polar regions was coordinated with flights of the CV-990 airplane and with the geostationary satellite, Applications Technology Satellite-V. We plan to continue to exploit the national investment in OGO flight systems and the data bank acquired through extended operations. This will be accomplished through selective investigations which make use of instrumentation in orbit or available data.

Management of the OGO project is the responsibility of GSFC. Development of the spacecraft system and fabrication and testing of flight observatories was accomplished under contract to TRW Systems, California.

Funds in FY 1971 will provide for operational support of OGO-V and VI, special operation of earlier OGO's as appropriate, and continuation of data analysis.

Explorers

	1969	1970	1971
Space physics	$12,018,000	$10,715,000	$12,820,000
Astronomy	7,413,000	8,220,000	12,780,000
Subtotal Explorers	$19,431,000	$18,935,000	$25,600,000
Scout (Launch Vehicle Procurement Program)	($2,300,000)	($4,400,000)	($3,900,000)
Delta (Launch Vehicle Procurement Program)	($2,700,000)	($6,400,000)	($6,200,000)
Total (including Launch Vehicles)	($24,431,000)	($29,735,000)	($35,700,000)

The Explorer program utilizes classes of relatively small spacecraft consistent with Scout and Delta launch vehicle capabilities for coordinated research on the environment of the earth, earth-sun relationships, the nature of the interplanetary medium, and astronomical observations. These spacecraft are designed and configured especially for the requirements of the particular mission. The program also provides for cooperative satellite projects with other Government agencies and with foreign governments.

During 1969 three Explorer missions were launched, including two cooperative satellites. The International Satellite for Ionospheric Studies-I (ISIS-I), the fourth cooperative mission with Canada, launched in January 1969, continues the ionospheric studies begun in 1962 with Alouette I. The seventh Interplanetary Monitoring Platform (Explorer 41) was launched in June 1969. This spacecraft supported the Apollo 12 mission by monitoring emergetic particle radiations from the sun, and is expected to perform a similar service during manned missions in 1970. The first German satellite, AZUR, was successfully launched in November 1969, for studies of trapped radiations, aurorae, and solar particles.

Fiscal Year 1971 funds will be used to support missions that will be launched over the next several years. These Explorer spacecraft will be used to obtain data for investigations in X-ray and radio astronomy, atmospheric and ionospheric physics, the radiation belts and magnetospheric boundary, and interplanetary space. Activities to be funded will include the development of the spacecraft and instruments, the pre-flight testing, launch, and the analysis of data from operating satellites.

The first Radio Astronomy Explorer (RAE-I) discovered a variety of phenomena. It observed extraterrestrial sources and thousands of solar radio bursts in the 0.2 to 10 Mhz frequency range, and measured both steady and sporadic radio emissions from the earth's radiation belts. RAE-B is being prepared to continue the observation of extraterrestrial sources.

It will be placed into a far earth or lunar orbit to minimize the interference from the radio background of the earth.

X-ray astronomy constitutes one of the most promising areas of science. With a limited Sounding Rocket program we have discovered numerous sources, proved that the intensity of these sources varies with time, and that the X-ray emission from at least one pulsar is modulated just like the radio and optical signals. Two Small Astronomy Satellites (SAS-A and C) are being prepared to follow up on these discoveries. In addition, NASA plans a cooperative program with the United Kingdom (UK) and the Netherlands in this area. Other astronomy Explorer missions include a gamma ray satellite, SAS-B, and a solar ultraviolet monitor (Solrad-C) that will be launched under a cooperative agreement by the Naval Research Laboratory.

Investigations of the upper atmosphere and ionosphere continue to be most fruitful. A theoretical model has been developed that explains the spatial distribution of electrons and various ions in a gravitational and magnetic field. One consequence is a helium bulge near the equator where the ions are magnetically confined, and an escape of hydrogen and helium from the polar ionosphere where the magnetic field is open. The international cooperative program continues to play a major role in this research. The third Italian satellite, San Marco-C, is planned for the study of atmospheric density variations. The fourth UK satellite (UK-4) and ISIS-B will study the properties of the upper ionosphere, and a second German satellite is just being started for both ionospheric and atmospheric studies.

Because atmospheric drag causes rapid decay of satellite orbits, an altitude regime of the greatest interest has not been explored on a global basis. Investigations with sounding rockets have shown that most of the incoming solar radiation is absorbed below 150 miles; this region controls, therefore, the behavior of much of the upper atmosphere and ionosphere. Atmospheric Explorer spacecraft will be built with on-board propulsion to overcome the atmospheric drag. Detailed design studies and initial development of the spacecraft and scientific payload are underway. The scientific payload assigned to these missions will help us gain an understanding of the global processes in the thermosphere that control parameters in the upper atmosphere.

The radiations present in the outer magnetosphere have been identified. Of particular interest, are low energy protons (less than 50 keV) that are found in the outer radiation belt during geomagnetic storms. The Small Scientific Satellite-A (SSS-A) constitutes our primary attempt to understand the behavior of the low energy protons and to find the mechanism that produces them. These observations will be supplemented with data to be taken in a different part of the magnetosphere under our cooperative program with the Air Force Cambridge Research Laboratories (AFCRL-A). Electric fields in the outer radiation belts will be studied with a release of barium ions to be performed as part of our cooperative program with Germany.

The Interplanetary Monitoring Platform (IMP-H, I, and J) missions will continue, during the declining part of the solar cycle, the investigations of the magnetospheric boundary, the geomagnetic tail, and interplanetary space. Studies will be conducted with more diverse and greatly improved instruments. The latter of these missions also will provide the near earth reference data that will be required to interpret many of the measurements to be performed with Pioneers F and G. In addition, the IMP satellites will continue to provide radiation monitoring in support of manned missions.

Mr. EVINS. We notice in your summary of the physics and astronomy program that most of the items are funded at approximately the same level as last year and the year before except airborne research, solar observatories, and Explorers. Would you tell us about those increases?

Dr. NAUGLE. Yes, Mr. Chairman. The increases in funding for Explorer satellites are primarily associated with what we call the Atmospheric Explorer, which is an Explorer to study the interaction of solar radiation with the upper regions of the atmosphere.

Another is the Radio Astronomy Explorer which is a satellite that has an X-shaped antenna, which extends as far as the Empire State Building is tall, and is used to study the low-frequency radio noise that is emitted by the planets, by Jupiter for instance, by the sun, and by other astronomical objects. The low-frequency radio noise cannot come through the ionosphere which effectively excludes it. So, by taking a satellite up beyond the ionosphere, we can study this portion of the electromagnetic spectrum. We intend to place the satellite in orbit about the moon and then use the moon like a shutter, so that we can precisely pinpoint sources of this electromagnetic radiation.

We are continually attempting to improve our observing capabilities for weather phenomena. The primary purposes of this capability are the observation and prediction of weather. It may also be used to support weather modification experiments.

APOLLO TELESCOPE MOUNT

Mr. EVINS. How much is in the manned space flight program funds for physics and astronomy experiments?

Dr. NAUGLE. For "Physics and astronomy," the Apollo telescope mount is a part of the astronomy program of OSSA and funding for that is included.

Mr. EVINS. How much add-on would that be to your program?

Mr. MYERS. $13.6 million.

GODDARD INSTITUTE

Mr. EVINS. What is the total budgeted for the Goddard office in New York?

Dr. NAUGLE. This total budget for the Goddard office in New York is $2.3 million.

Mr. EVINS. How many jobs in 1969, 1970, and 1971?

Dr. NAUGLE. That supports a civil service force of 33. I might mention, Mr. Chairman, they are a group of some of the most competent theoretical physicists in the country. We are using that group as a part of the global atmospheric research program.

One of the major problems that you have in studying weather patterns on a worldwide basis is the modeling, the developing of mathematical models of the atmosphere so that you can feed the data into a computer in an intelligible way so the computer can then come out with——

NEW YORK LOCATION

Mr. EVINS. What are they doing in New York that they couldn't do down here at Goddard?

Dr. NAUGLE. Mr. Chairman, the reason they are located in New York is because of the academic-intellectual community that is there. There are 33 civil service people there, but there are a number of other high caliber scientists in the universities in the New York region who work very closely with this group. If the group were located at Goddard, it would be much more difficult to involve those people in the NASA program.

We want their intelligence; we want their graduate students involved in it. We are really doing, in a sense, two things. Those people, by staying in New York, are also contributing to the production of future generations of scientists by teaching and conducting research which, if they moved down to Goddard, they would not be able to do.

Mr. EVINS. They have plenty of room at Oak Ridge.

GISS OFFICE SPACE

What is the purpose of the transferring to GSA $474,000 in 1970 for office space in New York? How much are you expanding up there? Do you have to get them better quarters?

Mr. LILLY. This is a matter of the space that GSA normally picks up in their budget. They lease space when they have an opportunity to budget for it. This is a special kind of space that they do not pick up until they are able to budget for it and we transfer the money to them.

Dr. PAINE. These are reasonably spartan quarters, Mr. Chairman.

Mr. EVINS. $474,000, is that spartan?

Dr. PAINE. Yes, sir. The office spaces there are rather small——

Mr. EVINS. Where were they before they moved into these spartan quarters?

Dr. NAUGLE. They have always been in the same place.

Mr. BOLAND. Where are they up there?

Dr. PAINE. It is a building that we lease up near Columbia University, Mr. Boland.

TOTAL PERSONNEL AT GISS

Mr. BOLAND. How many people are involved in addition to the 33 civil servants that you mentioned?

Dr. NAUGLE. There are 33 civil service people, 56 contractor people and 80 other people, which includes the National Academy of Science Associates, part-time university faculty, student associates, post-doctoral resident associates, and visiting experts and consultants.

Mr. EVINS. You closed down the electronics center in Boston but you beef up the office in New York. You make it more concentrated in the metropolitan area. This is not a wise policy.

Dr. NAUGLE. The total manpower has stayed the same in 1970—it has actually gone down by one, from 170 to 169 in the total of those figures.

Dr. PAINE. We are not increasing.

Mr. EVINS. The costs increase.

AIRBORNE RESEARCH

The funding for Airborne Research includes the acquisition of a C–141 airplane and for continuation of the development of a 36-inch

infrared telescope. The C-141 airplane and 36-inch telescope will provide you with a unique airborne astronomical observatory.

What type of aircraft is this and what will be the cost? It involves only one plane, doesn't it?

Dr. NAUGLE. It involves but one plane, Mr. Chairman. I would like to note here that we have taken a careful look at this branch of astronomy and found that you can do this type of research by carrying your telescope up above the water vapor in the earth's atmosphere and you can do this with the Lockheed C-141, which is a four-engine Air Force plane that we are buying.

Mr. EVINS. Where will it be based?

Dr. NAUGLE. At the Ames Research Center.

SOUNDING ROCKETS

Mr. EVINS. You plan to continue the sounding rockets program in 1971 at the current level of $18.5 million.

Dr. NAUGLE. Mr. Chairman, could I take just 1 minute to mention one of the more exciting activities that we have been involved in recently? The total solar eclipse that took place on March 7 actually passed over Wallops Island. The path of totality which is about 60 miles wide passed between North and South America and then totality passed right over Wallops Island. As a part of that event we fired a total of 33 rockets in a 3-day period. We fired 28 on the day of the 7th and actually fired 14 rockets in just the few minutes of totality at Wallops Station.

Here is a photograph of the spectacular eclipse. We have the ring and the corona that you see here——

Mr. EVINS. These are good pictures. We saw them on the front page of the newspapers. Did the newspapers get those from NASA or did they ferret them out themselves?

Dr. NAUGLE. This was actually taken by an amateur photographer friend of mine who was there.

Mr. EVINS. Why do you need $18,500,000 for this when an amateur photographer can take these exemplary photographs?

Dr. NAUGLE. These are the kinds of data, Mr. Chairman, that you get. Now, in order to get these data, we used an Aerobee sounding rocket, a pointing system that pointed a telescope and a grating——

Mr. EVINS. This is the rocket that went off and this is the picture taken by an amateur photographer. This is the payoff right here.

Dr. PAINE. This was taken by the rocket. You can see the difference.

Dr. NAUGLE. What this does is take the light emitted from the corona and spread it out into its various wave length bands. By looking at the intensities of these bands you can tell what the composition of the corona is and you can tell what the temperature of it is. It is these scientific measurements that you can make with a sounding rocket that make the rocket program such a productive part of our program.

Dr. PAINE. Mr. McDade of this subcommittee went down to Wallops and was present during the eclipse there and observed these experiments.

PICTURE OF ECLIPSE FROM ATS-3

Dr. NAUGLE. Now, this was a total effort that involved some 100 scientists. The National Science Foundation coordinated the whole

effort. Another spectacular part of this was the fact that we maneuvered the applications technology satellite 3, that is up in synchronous orbit, into a position so it could take a picture of the shadow of the eclipse on the Earth.

This is how the Earth looks from 22,300 nautical miles. We mentioned this yesterday. I show this partly to show the eclipse shadow here, but also to illustrate what a potent meteorological technique we have in the sense that this satellite will stay in one position and give a picture of the clouds once every 25 minutes. You can track a hurricane or watch a squall line building up in Kansas that will give you tornadoes. In our budget in the space applications program we are asking for funds for a project that was authorized and appropriated last year, the synchronous meteorological satellite, to develop an operational meteorological satellite that will sit at the geostationary or parking orbit, do this sort of thing, and have the data incorporated routinely into weather predictions.

Mr. EVINS. You propose a $16.1 million program for your solar observatories and a $28.6 million program for your astronomical observatories.

GEOPHYSICAL OBSERVATORIES

In the Geophysical Observatories section you state that six more OGO missions, including 20 or more experiments, have been launched at the rate of one each year starting in 1964, and these result in dissemination of over 300 papers? What have been the achievements? Have we secured enough?

Dr. NAUGLE. No, sir. We have not completed our investigation of the sun. We fly Orbiting Solar Observatories to make measurements of the sun with a particular set of instruments. With these flights we have gained new insight into the sun. At the same time new questions are raised which make you go back to make additional measurements.

The accomplishments that have come out of OSO's are many. We save shown that associated with solar flares on the sun are extra bursts and that these are confined to very narrow filamentary threads which are probably associated with magnetic field lines. One of the major puzzles about a solar flare is that we do not understand the mechanism by which such a tremendous amount of energy is released in such a short time. A solar flare on the sun will flare up and emit a burst of X-rays. You are probably familiar with the disturbance of communications when this takes place. The work that we are doing with OSO is contributing to help understand the basic processes that take place there.

ORBITING SOLAR OBSERVATORIES VERSUS APOLLO TELESCOPE MOUNT

Mr. EVINS. What can the orbiting solar observatories do that the Apollo telescope mount cannot do, and vice versa?

Dr. NAUGLE. Mr. Evins, I would like to submit this information for the record.

(The information follows:)

The ATM provides the opportunity to use large scientific instruments to make observatons of solar phenomena with high spatial resolution, moderately good wavelength coverage, good time resolution, and good spectral resolution. Through

the use of photographic film on four experiments, we will obtain an amount of scientific data much greater than can be obtained through the use of telemetry.

The ATM will permit the use of man's capabilities to handle complicated instruments and to vary observational programs as might be indicated by the scientific data.

The astronauts flying with the ATM instruments will be able to point these in real time at solar phenomena that represent "targets of opportunity."

The ATM instruments are scheduled to be launched in late 1972 and will provide a time coverage of solar phenomena until about the middle of 1973. The four future OSO's will provide time coverage from 1971 through 1975. Time coverage of solar phenomena is very important as the behavior and characteristics of the sun, our most important star, change over 11- and 22-year cycles. The OSO's will provide observations in the white light, ultraviolet, soft and hard X-ray, and gamma ray regions of the spectrum, giving a very wide wavelength coverage. In the ultraviolet and soft X-ray regions, OSO-borne instruments will provide a very high spectral resolution not available except on rockets.

EXPLORER PROGRAM

Mr. EVINS. With respect to your explorer program, I have been asked even if the program is a complete success, how will the average man and woman benefit from this expenditure of $36 million? Shouldn't the taxpayers be given some idea about what the returns will be for their money?

Dr. NAUGLE. I would like to say a word about that, Mr. Chairman.

If you look at the history of astronomy and extrapolate that into the future, you can certainly assure yourself that the man in the street will get his benefit from the money that we are spending because out of astronomy has come the whole science of measurement—the very accurate geodesy—the very accurate measurement of time. The work of astronomers trying to understand the source of energy of the sun and the stars and of physicists working in the laboratories understanding nuclear physics, has led to the development of nuclear energy. These same kind of people are puzzled today by the tremendous amounts of energy that we see coming from pulsars and quasars. There seems to be general agreement that we are seeing a new process developing energy in these objects that is as much more powerful than nuclear energy, as nuclear energy was above the chemical flame we were familiar with before 1945. This is an area in which I think it is absolutely crucial that this country maintain a strong, vigorous astronomy program, both ground-based and space-based.

LUNAR AND PLANETARY EXPLORATION

Mr. EVINS. We will place in the record the "Lunar and planetary exploration program," pages RD 5–1 through RD 5–11.

(The pages follow:)

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1971 ESTIMATES

OFFICE OF SPACE SCIENCE AND APPLICATIONS

LUNAR AND PLANETARY EXPLORATION PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The objective of the Lunar and Planetary Exploration program is the scientific exploration of our solar system utilizing manned and automated spacecraft, supported by earth based observations and laboratory research. Its achievement is the acquisition of new and more detailed data and knowledge of the origin, history and dynamics of our solar system with particular emphasis on understanding the evolution of our earth and the processes that control its environment. The current program has two major thrusts: the further manned exploration of the moon, and automated investigation of the planets and interplanetary medium.

Earlier unmanned programs have already considerably advanced our knowledge of the moon and provided a wealth of data. The Ranger project provided the first closeup detail of the moon's surface through vidicon pictures transmitted to earth. The subsequent Lunar Orbiter project provided large scale, detailed photographs of the moon that were required for the selection and certification of sites for the Apollo manned lunar landing missions and improved coverage of the moon by exposing new areas of the moon's near and far side surface to view. The Surveyor project, by demonstrating the soft landing capability of a complex spacecraft, increased confidence in the ability of Apollo to land on the lunar surface. In addition Surveyor cameras took hundreds of high resolution photographs of the lunar terrain, instruments measured the lunar surface bearing strength, and rudimentary chemical analysis was performed on lunar surface materials.

Manned exploration began with the Apollo program. Funds provided under this program finance the basic scientific research and planning essential to the design of experiments and missions of the Apollo Manned Space Flight program. It also supports the subsequent data analysis efforts, the real payoff of each mission.

The planetary and interplanetary programs have experienced a high degree of success beginning with the Mariner II flyby of Venus in 1962 and continuing with the most recent successful launchings of Mariner VI and VII this past summer. The Mariner II mission provided new data on the magnetic and atmospheric characteristics of Venus. Mariner IV, in 1965, provided the first closeup pictures of Mar's cratered surface and showed that its atmospheric density was very low compared to the earth. Mariner V, launched in June 1967, made more precise measurements of Venus' ionosphere, magnetosphere and atmosphere. Pioneer IX in November of 1968 marked the last in the preliminary series of missions to measure the interplanetary medium. These

early flights provided much insight into understanding how solar disturbances are propagated through space, the effect of these disturbances on terrestrial phenomena, and the relationship between solar activity and solar and cosmic rays.

SUMMARY OF RESOURCES REQUIREMENTS:

	1969	1970	1971
Supporting research and technology/ advanced studies	$18,571,000	$17,980,000	$17,400,000
Planetary astronomy	3,700,000	3,800,000	4,800,000
Data analysis	2,337,000	2,600,000	3,900,000
Pioneer	4,700,000	20,800,000	32,900,000
Mariner Mars 1969	26,130,000	4,491,000	200,000
Mariner Mars 1971	20,058,000	60,342,000	29,600,000
Mariner Mercury 1973	---	1,000,000	21,100,000
Viking	12,427,000	40,000,000	35,000,000
Total	$87,923,000	$151,013,000	$144,900,000
Distribution of Program Amount by Installation:			
Kennedy Space Center	$3,000	---	$100,000
Manned Spacecraft Center	246,000	$1,096,000	680,000
Marshall Space Flight Center	615,000	115,000	250,000
Goddard Space Flight Center	3,554,000	4,632,000	3,550,000
Jet Propulsion Laboratory	56,412,000	86,221,000	69,475,000
Ames Research Center	5,158,000	19,774,000	29,320,000
Electronics Research Center	25,000	25,000	---
Langley Research Center	10,487,000	22,343,000	25,100,000
NASA Headquarters	11,423,000	16,807,000	16,425,000

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology/Advanced Studies			
Lunar science	$5,602,000	$6,580,000	$6,000,000
Planetary science	5,269,000	4,200,000	4,200,000
Planetary advanced technical development	6,000,000	6,000,000	6,000,000
Planetary advanced studies	1,700,000	1,200,000	1,200,000
Total	$18,571,000	$17,980,000	$17,400,000

Supporting Research and Technology and Advanced Studies programs are the research activities which provide support to the flight missions by providing the base for defining the scientific objectives of future missions, and establishing the scientific and engineering capabilities essential to the performance of these missions.

The activities of the Lunar Science program are devoted to increasing our scientific knowledge of the moon by continuing laboratory investigations, and theoretical studies, and by, drawing on basic data derived from ground based research and Ranger, Surveyor, and Orbiter missions, and previous Apollo missions. Apollo lunar missions have demonstrated dramatically a growing capability for useful scientific accomplishments in orbit and on the lunar surface. Initial surface exploration, in mare areas in the equatorial belt, has provided basic new data of great scientific value on the surface rock composition (rock analysis), subsurface structure (passive seismic measurements), and environmental factors such as solar radiation effects and magnetic field strength. Continuing these experiments and expanding the data base is vital if the Nation is to take full advantage of the Apollo capability to explore the moon, and exploit the discoveries made in the earlier phases of lunar exploration. Success to date is just a beginning, as we await new discoveries related to environmental factors, rocks and history at later landing sites at high latitudes and in older highland areas that will be attainable with increased EVA time and new equipment.

The FY 1971 lunar science effort will include: continued production of geologic maps of landing sites; plotting traverse routes; selection of future landing sites; and the investigation of instrument concepts for remote physical and chemical analysis. FY 1971 will also see the Lunar Science Institute fully operational at the Manned Spacecraft Center in Houston, Texas.

The Planetary Atmospheres program funds research in atmospheric phenomena including that of the earth and the planets, and the gaseous phenomena associated with comets. In FY 1971, research will be conducted into the design of experiments, and the development and modification of instruments for use in the exploration of the outer planets. Direct measurement experiments and instrumentation for the exploration of the lower atmosphere of Venus will also be stressed.

A third area financed under Planetary Supporting Research and Technology is the Planetology program which supports research in the increasingly important field of planetary geology. As the planetary program progresses from earth based observational data to flyby and orbiter data, and in 1975 to data from landers, planetology research will play a more important role in determining the nature and properties of the planets. In FY 1969 and 1970 research toward the development of scientific instruments for project Viking was one of the major goals of the Planetology program. In FY 1971 the emphasis will be on the development of instrumentation for geochemical and geophysical studies of Mars to be used on future lander missions.

In the area of engineering technology, the Advanced Technical Development (ATD) program supports the development of new and improved design of spacecraft hardware to: (1) extend the nominal lifetime of the systems for long duration missions such as a Jupiter flyby, with approximately 1 1/2 years of spacecraft transit, and the Grand Tour missions which may be up to 12 years in duration; (2) develop power sources which use nuclear energy and allow a spacecraft to operate for extended periods without dependence on solar

energy; (3) develop instruments and subsystems which will survive in hostile environments; (4) develop the ability to communicate up to three billion miles; and (5) perfect the techniques and subsystems for swingby trajectories which require great precision in spacecraft control and tracking. In FY 1971, research in the ATD program will continue work in these areas, with somewhat more emphasis on the critical technologies for Venus probes and buoyant Venus stations and advanced Mars exploration.

In the Planetary Advanced Studies program surveys of potential future scientific missions are made, and an up to date catalogue of mission opportunities, their general system requirements and their value in fulfilling established goals and objectives of NASA are defined. Alternate mission approaches, including the utilization of existing systems are evaluated, resource requirements determined, and advanced technology requirements examined. In FY 1969 and 1970, studies were continued on: (1) multiple planet Grand Tour and other outer planet flybys; (2) surface sample return from Mars; (3) buoyant stations and atmospheric probes of Venus; (4) Jupiter orbiters; (5) comet flybys; and (6) asteroid belt surveys. In FY 1971 it is planned to continue the investigation of the more promising missions and to initiate additional studies such as: (1) orbiters of Saturn and other outer planets; (2) atmospheric probes of Jupiter; (3) comet rendezvous; and (4) Mars rovers.

Planetary Astronomy

	1969	1970	1971
Planetary astronomy.....	$3,700,000	$3,800,000	$4,800,000
Total.....	$3,700,000	$3,800,000	$4,800,000

One approach to the scientific exploration of the solar system is to observe the planets and associated bodies from the vicinity of the earth. Although astronomers have studied the planets for well over 100 years, a very large amount of information can still be obtained from observations made from the vicinity of the earth. New instrumentation and observing techniques combined with the use of airplanes, balloons, rockets, and earth orbiting satellites as observing platforms in addition to ground based observatories have increased the possibilities of astronomical observations far beyond those considered feasible a few years ago.

The application of radar observations in planetary studies illustrates the great potential value of using new observation techniques. Radar observations of the planets have, within the last eight years, resulted in the determination of accurate rotation periods for the planets Venus and Mercury. They have also determined precise distance values for the nearer planets as well as giving information on the size of Mars and Venus. Topographic variations on the surface of Mars have also been obtained for limited regions of that planet. With improvements to one or more of the largest existing radar systems, it will be possible to map the entire cloud covered surface of Venus

at sufficient resolutions to observe in detail features such as mountains, craters, etc. And it is important to realize that almost all of the information determined thus far from radar observations could not be determined from any of the presently planned planetary spacecraft.

In the case of radar observations and many other types of observations, the data obtainable from the vicinity of the earth complements the scientific return from the presently planned planetary flight program. In fact, a combination of the two methods is required to achieve program objectives in the most economical way. Earth based observations are extremely cost effective compared to planetary missions, and require relatively short turn around times for instrumentation changes. They are also repeatable, when necessary, over long periods of time.

To assist with the interpretation and analysis of the observations, simultaneous programs in laboratory and theoretical studies are also supported. Existing instrumentation such as telescopes, radio and radar systems, spectrographs, etc., are used as much as possible. However, when new instruments such as large telescopes or relatively smaller items such as photometers, are required to obtain data, the development and construction of such instruments are also supported through this program. The increase of one million dollars in funding in FY 1971 is to start on the construction of one much needed major instrument.

Data Analysis

	1969	1970	1971
Lunar data analysis.....	$1,887,000	$2,000,000	$2,000,000
Planetary data analysis.....	450,000	600,000	1,900,000
Total.....	$2,337,000	$2,600,000	$3,900,000

The primary purpose of lunar and interplanetary missions is to conduct experimental investigations which will advance our knowledge and understanding. Data are obtained by scientific instruments aboard the spacecraft and are transmitted to earth for analysis by the scientists conducting the experiments. The initial data reduction and analysis is funded by the flight project as a part of is project responsibilities. Usually, the time required to reduce and thoroughly analyze the data extracting the full scientific value and then publish the results is longer than the period of support provided by the project. The Data Analysis project will provide for reduction of data from the Mariner V, VI and VII planetary missions, the Pioneer missions to interplanetary space and missions pertinent to scientific exploration of the earth's upper atmosphere.

In addition, analysis of lunar data from several flight programs continues, with attention centering on Surveyor (nearing completion), Orbiter, and now the Apollo program. Initial emphasis has been given to photo analysis of Orbiter data bearing on selection of safe Apollo landing sites, and orbit

analysis (gravity anomalies) bearing on Apollo landing trajectories. Attention will continue to be given to these analyses but the major effort will be directed to scientific problems in these and other areas of the moon. For these studies the Orbiter data are supplemented by a wealth of new high resolution Apollo photography, much of it in color, of selected parts of the lunar equatorial zone. This information will then be correlated with that obtained from the lunar samples and geologic exploration of the Apollo landing sites by the astronauts. This analysis of Apollo scientific data, other than that done initially by the principal investigators, will be a significant part of the FY 1971 Data Analysis program.

Pioneer

	1969	1970	1971
Spacecraft and support	$2,860,000	$13,287,000	$25,266,000
Experiments	1,840,000	7,513,000	7,634,000
Subtotal, Pioneer	$4,700,000	$20,800,000	$32,900,000
Delta (Launch Vehicle Procurement Program)	($1,152,000)	(---)	(---)
Centaur (Launch Vehicle Procurement Program)	(1,265,000)	($4,600,000)	($15,900,000)
Subtotal, launch vehicles	($2,417,000)	($4,600,000)	($15,900,000)
Total (including launch vehicles)	($7,117,000)	($25,400,000)	($48,800,000)

The objectives of the Pioneer project are: to obtain scientific information at widely separated points in interplanetary space; to supply interplanetary environmental data on a continuing basis; and to conduct, during the 1972 and 1973 Jovian opportunities, exploratory investigations of the interplanetary medium, the nature of the asteroid belt and the environmental and atmospheric characteristics of the planet Jupiter.

The project is responsible for three series of missions, Pioneers VI-IX, Pioneers F and G and Helios A and B. The first series of spacecraft weighed about 140 pounds each and were launched in 1965, 1966, 1967 and 1968, by the Thrust-Augmented Improved Delta. A fifth spacecraft, Pioneer E, was lost during launch in 1969 when the launch vehicle failed. The four Pioneers now in solar orbit are all functioning and Pioneer VI has operated longer in interplanetary space than any other spacecraft. These interplanetary outposts are essential elements of our network of deep space "weather stations." The instruments on these Pioneers are designed to measure the solar wind flow, magnetic fields, the electron density in space, and to observe the energy spectra, fluxes, and direction of solar and galactic cosmic rays. The opportunity to obtain such measurements at widely separated positions in deep space is providing unique and valuable scientific information about the sun and its

influence on the solar system. The combination of these measurements from the four widely separated stations enables us to detect and estimate the paths of solar storms. Such information helps forecasters to provide advance warning of radiation dangers to spacecraft and of variations in the protective magnetic envelope of the earth which affects the long range radio communication of the world.

The development of Pioneers F and G was initiated in FY 1969. These spacecraft are to be launched into trajectories permitting the exploration of interplanetary space between one and five Astronomical Units (AU) from the sun including the asteroid belt and Jupiter. (One AU is equal to the mean Earth-to-Sun distance, 92,000,000 miles.) With this trajectory, we should be able to study the possibly hazardous region of the asteroid belt, to measure the gradient of the sun's influence on interplanetary space and the penetration of galactic cosmic radiation into the solar system. While the spacecraft passes in the vicinity of Jupiter, instruments will measure the properties of charged particles, magnetic fields, and electromagnetic emissions associated with the planet. Data from these measurements will be used to study the composition and dynamics of the atmosphere surrounding the planet and its interaction with the interplanetary medium. It will also be used to analyze the thermal balance of Jupiter and the source of energy which the planet seems to have. These missions will require new features on the Pioneer spacecraft to compensate for the lessening of solar radiation as a power source and the more demanding communications and thermal conditions. For example, Radioisotope Thermoelectric Generators (RTG's), rather than the more conventional solar cells, will be utilized to provide electrical power to the spacecraft. New experiment instrumentation will also be required to make measurements in the asteroid belt and near Jupiter.

In FY 1969, NASA also initiated its largest international cooperative project as part of the Pioneer program. The objective of this project, called Helios, is to investigate the properties of and processes in interplanetary space in the direction of and close to the sun (about 0.3 AU) by developing, launching, and operating an automated spacecraft. The spacecraft will be developed in West Germany with about one-third of the scientific experiments supplied by NASA.

FY 1971 funds will be used for design and development work on the Pioneer F and G spacecraft and its selected experiments. Operational support for the four active Pioneer spacecraft and for data analysis will continue. Development of U.S. experiments for Helios will continue.

Mariner

	1969	1970	1971
Mariner Mars 1969	$26,130,000	$4,491,000	$200,000
Mariner Mars 1971	20,058,000	60,342,000	29,600,000
Mariner Mercury 1973	---	1,000,000	21,100,000
Total Spacecraft and Support	$46,188,000	$65,833,000	$50,900,000
Atlas Centaur (Launch Vehicles Procurement Program)	($11,039,000)	($9,800,000)	($4,300,000)
Total (including launch vehicles)	($57,227,000)	($75,633,000)	($55,200,000)

Over the past six years, the Mariner spacecraft has evolved from the 450 pound Mariner II used for man's first successful mission to another planet to the 2,200 pound (including 900 pounds of propellant) Mariner 1971 to be used for our first orbiting mission of another planet. The Mariner spacecraft represents a major tool in the planetary program for remote observations, from an attitude controlled spacecraft, of the other planets in the solar system.

The Mariner II, flyby of Venus in 1962, provided the first direct temperature and magnetic field measurements from near the planet. This was followed by the Mariner IV flight past Mars on July 14, 1965 which conducted initial closeup scientific observations of Mars and its environment. Pictures of the planet showed a cratered surface similar to that of the moon. Valuable information on the planet's atmosphere and ionosphere was also acquired. On October 19, 1967, Mariner V flew past Venus some 2,600 miles from the planet's surface and made measurements to determine the properties of the Venusian atmosphere and the interaction between the planet and interplanetary medium, improving and significantly augmenting the data acquired five years earlier by Mariner II. Scientists are still analyzing data telemetered back by Mariner V. According to Mariner V, Venus is a hot planet with a thick lower atmosphere--mostly carbon dioxide. The heavy atmosphere is surrounded by a sphere of hydrogen analogous to that of earth.

On July 31 and August 5, 1969, Mariner VI and VII passed within 2,000 miles of the Martian surface completing the most ambitious and successful planetary reconnaissance ever attempted. The scientific data returned greatly exceeded the minimum requirements of the mission including more than 200 pictures of the planet taken by the spacecraft on their approach trajectories. Mariner VII, which flew over the south polar cap region, found the polar cap to be composed of carbon dioxide and heavily cratered in the same fashion as the land surfaces. The possibility of life on Mars remains one of the major unanswered scientific questions, and the combined spectroscopic and imaging data from Mariner VII provided interesting and likely regions for future missions to concentrate their efforts in pursuit of this question.

The scientific investigation of Mars using orbiting spacecraft will begin in 1971. The Mars 1971 spacecraft, which will use many of the proven subsystems of the Mariner IV and Mariner 1969 exploratory flyby missions, will begin detailed studies of the atmosphere and environment of the planet and provide a closeup look at large areas of the surface. This 1971 mission will provide broad topographic and thermal coverage, record seasonal variations in the atmosphere and on the surface, and major other long term dynamic observations.

Although some of the scientific instruments for the Mariner-Mars 1971 missions will be improved versions of those carried on the earlier Mariner-Mars 1969 flyby, the scientific data return will be increased significantly. This increase in data return results from the spacecraft being in orbit about the planet allowing multiple measurements and observations over a period of several months. From orbit, it will observe approximately 70% of the planet's surface including the wave of darkening, cloud movements and any other dynamic and seasonal changes in the planet atmosphere and on the planet's surface. In addition, the low point of the orbit will be about 1,200 miles as compared with the nominal 1,800 mile closest approach distance of the Mariner-Mars 1969 flyby. This closer distance to the surface will allow higher resolution measurements from all instruments, and will increase the value of the occultation and celestial mechanics experiments.

The Mariner-Mars 1971 orbiter design is based on existing Mariner technology which resulted in successful planetary investigations of Venus during 1962 and 1967, and of Mars during 1965, and was used to develop the spacecraft which will be launched to Mars in early 1969. The actual hardware to be used for the 1971 orbital missions will make extensive use of spare hardware and test equipment from the Mariner-Mars 1969 project.

A single modified Mariner spacecraft will be used to study both Venus and Mercury in 1973. Although the similarities between Mars, Venus and Earth make the study of these planets important to our knowledge of earth and its place in the solar system, the knowledge of other planetary bodies can also make a significant contribution. During the 1973 opportunity, using the same rocket required to go to Venus, a spacecraft can be accelerated by Venus' gravity and orbital velocity so that it can also swing by Mercury and begin the exploration of this, the closest planet to the sun. The Mariner spacecraft, which will be launched by an Atlas/Centaur, will return both ultraviolet and visual television pictures, atmosphere and ionosphere data, as well as thermal maps from both Venus and Mercury. In addition, it will monitor the space environment in the unexplored regions between Venus and Mercury.

The Office of Space Science and Applications, NASA Headquarters, is responsible for overall management of the Mariner program. The responsibility for project management has been assigned to the Jet Propulsion Laboratory, which will perform the systems integration function of the prime contractor for the Mariners under development; subcontracting will be for complete subsystems. The Lewis Research Center is responsible for the launch vehicles.

The funds requested for FY 1971 will support post launch operations for the Mariner Mars 1969 spacecraft and continued analysis of scientific and engineering data. FY 1971 funds requested for Mariner Mars 1971 will be used for spacecraft systems testing, launch operations and the initial portion of mission operations. FY 1971 funds will also be used to prepare functional specifications for the Mariner Mercury 1973 spacecraft in order to permit initial flight hardware procurement activities. A systems contractor will be selected during the year.

Viking

	1969	1970	1971
Orbiter - spacecraft and experiments	$2,300,000	$17,000,000	$10,000,000
Lander - spacecraft and experiments	10,127,000	23,000,000	25,000,000
Total	$12,427,000	$40,000,000	$35,000,000

The exploration of Mars initiated in 1965 by the Mariner series of spacecraft will be extended to surface exploration with a Viking landing in 1975, rescheduled from the previously planned 1973 opportunity. While these prior missions were to study the planet from orbital or flyby distances, the 1975 mission will be the first opportunity to obtain data from direct measurements in the Mars atmosphere and on its surface.

The objectives established for the Viking project are to significantly advance our knowledge of the planet Mars by means of observations from Martian orbit and direct measurements in the atmosphere and on the surface during the 1975 opportunity. Particular emphasis will be placed on obtaining biological, chemical and environmental factors relevant to the existence of life on the planet at this time, at some time in the past, or the possibility of life existing at a future date.

The lander to be used for this mission will be a soft lander similar to those used in the Surveyor program. Technology developed for Surveyor and the Apollo Lunar Module will be directly applicable to the Viking lander. This lander will be mated with a modified Mariner 1971 orbiter, which will have the capability to insert the lander into orbit prior to landing. This will permit orbital entry for the lander which has the advantage of smaller surface dispersions, lower entry velocities, and better control of entry angles. The launch vehicle to be used will be a Titan/Centaur.

The Office of Space Science and Applications, NASA Headquarters, is responsible for overall management of the Viking project. The responsibility for project management is assigned to the Langley Research Center (LaRC). LaRC will also be responsible for the lander system. The Jet Propulsion Laboratory, which has had responsibility for all Mariner projects, will be responsible for the Mariner class orbiter. FY 1970 funds are being used to initiate preliminary design activities on the orbiter and lander subsystems.

In FY 1971 funds will be used to continue the development of critical long lead items, such as the landing radar system, the landing propulsion system and many of the science instruments. Design effort will continue. Funds will further provide for scientific investigation support.

MARINER PROGRAM

Mr. EVINS. You state on page RD 5–10 that the funds requested for 1971 will support post-launch operations for the Mariner Mars 1969 spacecraft and continued analysis of scientific and engineering data. fiscal year 1971 funds requested for Mariner Mars 1971 will be used for spacecraft system testing, launch operations and the initial portion of mission operations. The 1971 funds will also be used to prepare functional specifications for the Mariner Mercury 1973 spacecraft in order to permit initial flight hardware procurement activities.

How much will the Mariner Mercury cost?

Dr. NAUGLE. The Mariner Mercury will cost between $95 and about $120 million.

Mr. EVINS. That is to fly around Mars?

Dr. NAUGLE. This is a single spacecraft which we will send to Venus to give us pictures of the cloudy atmosphere of that planet. We will use what we call a billiard ball deflection, of gravity assist, as it goes by Venus to carry it on in to fly by Mercury and we will study two planets with a single spacecraft in that Mariner-Mercury mission.

SAMPLES FROM MARS

Mr. EVINS. What would it cost to return samples from Mars with an unmanned mission?

Dr. NAUGLE. I don't have a figure for that, Mr. Chairman.

Mr. EVINS. You make reference to it on page RD 5–4. "In 1969 and 1970, studies were continued on: (1) multiple planet grand tour and other outer planet flybys; (2) surface sample return from Mars; —." What is the estimated cost for returning samples from Mars?

Dr. NAUGLE. These are very low cost studies of the order of $100,000 to $200,000, in which we examine the feasibility of this type of thing to come up with a concept of how you would recover or return a sample from Mars. It is not until we would go beyond that conceptual phase that we would have a good, reliable or even a parametric cost estimate of what that would cost.

Mr. EVINS. Are new systems necessary for landing on each new planet? Can you develop a successful device that could be used repeatedly?

Dr. NAUGLE. The landing device, Viking, that we are developing for Mars, can certainly be used for repetitive landing on Mars. It is not clear we could use that same system for landing on Venus or the other planets.

We would be able to use many of the same systems that places it into orbit; we would be able to use many of those same techniques, but you will recall that Dr. Paine yesterday noted that Mars has an atmosphere which is less than one one-hundredth the atmosphere of the earth and the surface pressure on Mars is equivalent to the atmospheric pressure at over 100,000 feet on the earth.

On the other hand, Venus has a very heavy atmosphere and a very hot atmosphere and to land there takes a different technique.

In the case of Venus, when we begin to probe there, we will probably send probes or systems that will float in the atmosphere because the atmosphere is so dense that you can do that.

HELIOS PROJECT

Mr. EVINS. On page RD 5–7 you have indicated that West Germany will develop one-third of the scientific experiments supplied by NASA. Is this a cooperative project?

Dr. NAUGLE. Mr. Chairman, I believe you are referring there to the Helios, which is a cooperative project with Germany. This is a case where they will develop the spacecraft and also part of the experiments—three of the experiments will be built in the United States and integrated by Germany into the spacecraft and then we will furnish the launch vehicle for that. That is a cooperative project.

VIKING PROGRAM

Mr. BOLAND. With respect to the Viking program, you have pushed back the landing date to 1975. What would it have cost you if you kept to the previous schedule of landing in 1973?

Dr. NAUGLE. Mr. Boland, last fall when we were putting the fiscal year 1971 budget together, we took a close look at Viking and what it would cost at that time for a 1973 launch. We set a target at that time of $650 million. That includes all the costs that we could identify at that time. We said, based on our previous experience with planetary programs, that we would encounter probably 10 to 15 percent increases due to mandatory, unexpected problems that would come up during the development. So we testified before both houses of the Congress last fall that we were setting a target of $650 million for Viking; but that we thought it would probably grow to $750 million. That is a 15 percent contingency that was in there.

When we had to slip it fom 1973 to 1975, our best estimate at this time is that it will cost us an additional $100 million to $150 million for the total project.

ADDITIONAL COSTS DUE TO SLIPPAGE

Mr. BOLAND. In slipping this project from 1973 to 1975 you have indicated, and the minority views in the authorization committee indicate, that the added cost will be $150 million because of setting it back to 1975. Is it because of budgetary restrictions that you decided to——

Mr. LILLY. The amount that would have been required in fiscal year 1971 to carry out the 1973 launch would have been $250 million.

Mr. EVINS. With a budget of $3.3 billion, if we are going to save $150 million by landing on the original date of 1973, I don't see why we shouldn't do it instead of spending the extra $150 million to land in 1975.

Dr. PAINE. It is a case of balancing off expenditures now against future expenditures.

Mr. EVINS. The budget situation could be worse off in the future.

Dr. PAINE. That could well be, but our best judgment was, looking at the economies that had to be made, that slipping there was the best solution.

BIOSCIENCE PROGRAM

Mr. EVINS. Place in the record the "Bioscience Program," pages RD 6–1 through RD 6–10.

(The pages follow:)

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1971 ESTIMATES

OFFICE OF SPACE SCIENCE AND APPLICATIONS — BIOSCIENCE PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The Bioscience program has three principal objectives: (1) the attainment of a thorough understanding of the effects of the space flight environment on terrestrial organisms; (2) the search for extraterrestrial life and life related molecules, with the primary emphasis directed initially to the moon and nearest planets; and (3) prevention of the unintentional transfer of terrestrial organisms to the planets, so that studies of extraterrestrial life will not be complicated or voided.

The first objective has three areas of effort: (a) to study the effects of space environmental factors on living earth organisms, especially, weightlessness and effective dissociation from factors related to the earth's rotation; (b) to exploit the unique space environment to analyze organism-environment relationships, especially the role environment plays in establishing and maintaining normal organization in living systems; and (c) to study the physiological, behavioral, and genetic responses and adaptations of living organisms to the space environment.

The biological effects of the space flight environment are being studied in the Biosatellite project. During flights of Biosatellite I and II the engineering design and integrated operation of the spacecraft systems were thoroughly checked out. The Biosatellite II experiment results showed that there was an interaction between radiation and weightlessness and other factors encountered in space flight. This interaction varied between greatly increasing the effects of radiation-induced damage, to decreasing the effect significantly depending upon the type of organism studied. The plant experiments studying the biological effects of weightlessness showed a close correspondence to results obtained by rotation on the horizontal clinostat. Post-flight laboratory control studies, in addition to those performed before and during flight, have been conducted to clarify questionable results such as the contribution of vibration. The contributing biologic mechanisms are still being studied.

The Biosatellite III mission had a 14 pound pig-tailed monkey as an experiment subject. During the mission, the effects of weightlessness upon the central nervous system, the cardiovascular system, and the metabolic function were studied. Particularly significant data were recorded from all instrumentation channels during the 8-1/2 days of flight. Much of the data still remain to be analyzed, but the findings to date reveal many of the physiological effects of weightlessness, and indicate the great value of carefully designed animal experiments in collection of biomedical data relevant to space flight.

The specific aims of the second objective - the search for extraterrestrial life include: (a) physical and chemical evaluation of planetary surfaces as a possible environment for life; (b) determination of whether or not life exists, or has existed; (c) if life in some form exists, determination of its characteristics; and (d) if no life exists, investigation of the pattern of chemical evolution in order to evaluate the probability of its future occurrence either spontaneously or by contamination, and the reason for its present nonexistence.

The development of prototype instrumentation for exobiological studies on the Martian surface is needed as a precursor to flight instrument development for future Mars landers. The life detection and organic analytical techniques developed in various laboratories must now be converted into flight instruments which in turn must be tested and integrated into the payload required to achieve the scientific objectives of the exobiology program. The development of this instrumentation is one of the most important items in the Bioscience Supporting Research and Technology (SR&T) project and is extremely critical to the pursuit of planetary exploration.

The third objective of the Bioscience program (Planetary Quarantine) is shown as a separate line item because of its direct relationship to the planetary flight program. Continuing efforts are being made, before initiation of space flights destined to land on the planets, to assure adequate technology development in the solution of the complex problems related to the planetary quarantine constraints. This item is in direct support of all future planetary missions intended to probe the atmospheres or land on the planets.

SUMMARY OF RESOURCES REQUIREMENTS:

	1969	1970	1971
Supporting research and technology/ advanced studies	$8,900,000	$11,170,000	$9,400,000
Planetary quarantine	1,300,000	2,500,000	2,000,000
Biosatellite	27,700,000	6,000,000	1,500,000
Total	$37,900,000	$19,670,000	$12,900,000

Distribution of Program Amount by Installation:

Manned Spacecraft Center	---	$300,000	$400,000
Marshall Space Flight Center	$135,000	372,000	400,000
Goddard Space Flight Center	86,000	50,000	100,000
Jet Propulsion Laboratory	2,003,000	1,614,000	1,100,000
Wallops Station	80,000	30,000	25,000
Ames Research Center	27,129,000	8,450,000	3,330,000
Langley Research Center	190,000	127,000	100,000
NASA Headquarters	8,277,000	8,727,000	7,445,000

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology/Advanced Studies

	1969	1970	1971
Advanced programs and technology...	$322,000	$2,400,000	$2,000,000
Exobiology.....	3,000,000	3,500,000	3,000,000
Environmental biology.....	1,890,000	1,500,000	1,400,000
Behavioral biology.....	1,241,000	1,450,000	1,400,000
Physical biology.....	1,696,000	1,570,000	1,200,000
Bio-communications.....	751,000	750,000	400,000
Total.....	$8,900,000	$11,170,000	$9,400,000

Advanced Programs and Technology

Emphasis in the area of Advanced Programs and Technology is heavily oriented toward defining the scientific requirements for future biological space flight investigations. This activity, of necessity, begins with determining the scientific character of the experiments to be flown and the space flight situation under which the investigations will be conducted. Among these situations are the options between manned and unmanned flight; automated or man-tended experiments; and earth orbital, lunar orbital or heliocentric flight. Time periods of experimentation vary from a few days in earth orbit in Bioexplorer type spacecraft, to several weeks or months in earth and heliocentric orbits in Bioexplorers and Biopioneers. For manned missions the time ranges from 28 days in the initial mission of the Apollo Applications program (AAP) through several years (possibly including successive generations of animals) in a space station.

The classes of biological specimens under consideration fall into the following broad categories: primates; microorganisms; cells and tissue cultures; semi-microscopic animals and plants; small vertebrate animals; plants; and invertebrate animals. Since several years are required to bring an investigator's hypothesis to flight in the space environment, it is necessary to establish experiment feasibility early to assure readiness to meet the various launch opportunities.

For manned flight systems it is currently considered desirable to maintain a clean separation between the life support systems for man-inhabited portions of the spacecraft and the bioscience experiments. In certain experiments it is also necessary to keep the experimental specimens physically isolated from contact with man. Therefore, a modular approach for environment control and maintenance is required. In efficient utilization of man in a space station laboratory, it is also necessary to define and develop new equipment and techniques which are workable in this environment. Logistics requirements for transporting test specimens, expendable supplies, and experiment rotation as well as the return of specimens to earth must be worked out. These studies and developments require close coordination with

space station design and operation planning to ensure compatibility. Studies are now being initiated on such areas as optimum groupings of experiments, and spacecraft interface requirements. These will be continuing efforts until a satisfactorily operating manned space laboratory has been achieved.

Future automated spacecraft missions are required to satisfy requirements of short term experiments with simple measurement requirements and for those experiments to be flown in heliocentric orbit or other deep space trajectory. The Bioexplorer and Biopioneer systems would satisfy these requirements. Studies have been completed which indicate the feasibility of satisfying many of the needs for automated systems with the Scout launch capability. Additional study and preliminary design activities for such systems are included in the FY 1970 and FY 1971 Bioscience Advanced Mission Study category.

Exobiology

An integral and perhaps inevitable event in the origin and evolution of the universe was the origin of life. An understanding of the controlling factors in the origin of life and determination of the uniqueness of life on the earth are the primary objectives of the Exobiology project. The research areas considered basic to the project area are:

(1) Chemical Evolution - study of the chemical events on the primitive earth or on any primitive planet with a similar history which preceded and led to the origin of life. There are two approaches to chemical evolution: (a) by the application of energy (electrical discharge, ultra violet radiation, heat, etc.) to the simple components (methane, ammonia, water) of the primitive atmosphere, and (b) organic geochemistry which includes analysis of ancient rocks and sediments of the earth, moon and other planets, for fossils (both chemical and biological), providing a record of the events taking place at the time of the origin of life. Extraterrestrial analysis can be done in situ or on returned samples.

(2) Biological Adaptation - a study of the response of terrestrial organisms (primarily microorganisms) to extremes of environment (temperature, radiation, pressure, atmospheric composition, water availability, etc.) likely to be characteristic of extraterrestrial environments. Two basic problems are being explored - survival and growth. Are terrestrial organisms accidently landed on an extraterrestrial surface likely to survive and be detected inadvertently by our life detection experiments and are terrestrial organisms likely to grow and destroy indigenous life forms? What are the limits of environmental extremes which carbon-based life can tolerate, so that we may estimate the likelihood of life on any given planet? Are there other chemistries which could produce a "living" system capable of tolerating quite different environments than we ordinarily consider?

(3) Life Detection - the development of techniques which will allow us to determine the presence or absence of past, present, or potential life elsewhere in the universe. The emphasis is on automated systems performing

relevant environmental measurements and chemical analyses early in the program. These evolve to more complex payloads making more integrated and sophisticated measurements and ultimately to unmanned and even manned laboratories. The most likely techniques seek the more basic attributes of terrestrial life - organic chemical, metabolic, and growth analyses, as well as imaging systems for visual detection and morphology. Ultimately, data on all of these basic attributes will be acquired hopefully on a single sample. The development of prototype instrumentation for the above studies, is included here.

(4) Flight Experiments and Return Sample Analyses - lunar samples are available for analyses in FY 1970 and FY 1971. They are being studied for evidence of biologically significant organic matter and for evidence of all living or fossil biota. Preliminary studies of Apollo 11 samples are suggestive of the presence of organic matter, but the data from contaminated samples are difficult to interpret.

Environmental Biology

Living organisms, from microbial forms to man, are extremely responsive to their environment. Life forms have successfully adapted their life forms and life cycles to an inconceivable variety of biologic environments. The space environment provides still another variety of unique environmental factors to which living earth systems are being exposed.

Earth-based studies deal with the known space flight factors that may exert effects in biological systems. Information is being accumulated on the effects of acceleration, vibration, magnetism, radiation and simulated weightlessness, individually and in combination. Emphasis is placed on a thorough investigation of genetic, cellular, biochemical and physiologic components of life.

Experience to date, in plants and animals (Biosatellites) and humans, indicates that space flight induces a variety of changes in life processes. The specific causes of these transient or permanent alterations, and the mechanisms by which they are brought about are unknown and must be verified experimentally. We must recognize and understand factors which directly or indirectly influence cellular function, either at the molecular level of interaction, or in the process of some more integrated function such as cell development.

Many effects of a physiologic nature were observed when plant species were exposed to lunar materials. Most of these were beneficial as shown by more vigorous growth and quality in plants exposed to lunar material. Thus, a new area of biologic research is being developed to determine what factors in the lunar material are compatible with life and how it is affected.

Earth life with which we are familiar generally requires sufficient quantities of water, warmth, atmosphere, mineral and organic nutrient, and energy. Looking beyond our familiar habitat and into the world of extremes

takes us into an area of biologic exceptions. This minority of living systems that exists under extreme ranges of the physical and chemical environments permitting growth, reproduction and other physiologic processes of earth organisms is under study to determine absolute limitations of life by the environment and the mechanisms by which normal levels of metabolic function are maintained within these limits.

Behavioral Biology

The role of behavioral biology in space bioscience is twofold: (1) to explore the ways in which the extreme conditions of space flight affect the behavior of organisms, and (2) to use the unique features of the space environment to advance the analysis of behavior. In addition to weightlessness, which represents the principal unique factor in space, important effects upon behavior include drastic reductions in familiar modes of sensory stimulation, the removal or alteration of ordinary day-night cycles and, particularly for higher forms, a rather severe kind of social isolation.

A major area of endeavor is the border region between perception and control of movement. The origin and maintenance of eye-hand coordination is an extremely promising topic for current research in behavioral biology. The various feed-back and feed-forward mechanisms involved in manipulatory behavior have become susceptible to laboratory experimentation. If there is any deterioration in the performance of high level motor skills it is important to learn about this from the standpoints of astronaut safety and a deeper understanding of mechanisms in sensorimotor coordination.

Orientation in space is engaging the attention of investigators interested in understanding and controlling those functions which are essential to extravehicular activity and those other maneuvers in space which require complex behavior. Both ground based and in-flight studies on the sensation of gravity, such as the determination of thresholds for angular and linear acceleration and responsiveness of the otoliths, semicircular canals, and other gravi-receptors to both transient and prolonged stimulation will contribute to this understanding.

Absence of the day-night cycle and other periodic aspects of the earth environment make space an ideal laboratory for learning about the origin and nature of circadian rhythms. Interest in this subject extends to a concern for behavioral and other biological events, observed by man, with a periodicity of approximately twenty-four hours, exemplified by the cycle of sleep and wakefulness. Studies of various stages of sleep, particularly those dealing with neurophysiological and biochemical changes during that stage associated with rapid eye movement promises new knowledge equally relevant to man in space and his normal environment. The relationships between the requirements for sleep, the process of fatigue, and the effects of gravity remain almost totally unexplored.

Physical Biology

Broad experimental and theoretical research provides a strong background of knowledge for planning and development of experiments for space flight. This includes comparative physiology, bioinstrumentation and biophysics, and molecular biology, including theoretical biology.

Biorhythmicity and oscillatory phenomena in physiological activity has long been recognized.

All living organisms demonstrate some degree of biological periodicity. These persistent rhythms can be accounted for by either the hypothesis that they are timed by an autonomous, endogenous oscillator system, or the hypothesis that these are dependent for their timing on an exogenous rhythmic input. The ultimate goals for studying these phenomena are the understanding of basic life processes and the monitoring and evaluating the physical condition and well-being of animal and man during space flight missions.

Crucial to conducting successful biological experiments in space is the need for advanced instrumentation and methods for measuring and analyzing behavioral and physiological reactions. Recent advances in solid state technology and theory have created a unique opportunity to develop new and especially miniaturized methods for obtaining biological information. Accordingly, basic research and preliminary development of experiments are sponsored for the acquisition of devices and techniques unique for the special problems arising out of space flight activities. These devices and methods are sought on the basis of their potential and/or immediate use to the Bioscience program.

Coincident with biological experimentation in space environments and with the search for extraterrestrial life is the need for an understanding of the form and function of cells, their relationship to one another, and of their constituents. This also includes an understanding of the evolutionary relationship of cells and their parts, and of cellular phenomena. Both experimental and theoretical studies are supported in order to develop an insight into the kind of response living organisms will have during space flight and also for the kind of life and/or life-related chemistry and physiology that might be found and should be sought on other planets.

Earth orbital satellites with space monitoring and position locating systems present a unique opportunity to study and monitor the earth's ecology and especially the earth's wildlife. Studies are being initiated to determine the feasibility of using or developing various systems for monitoring the behavior and physiology of wildlife and the interrelationship of the total bioecology of earth. Crucial to these studies are ground-based research efforts in optical bio-telemetric and physiological instrumentation and in microminiaturization of bio-instrumentation as well as in animal behavior in migration, navigation and orientation of living forms, in sensory systems; and in the development of theoretical models and concepts to interpret and use data as they are generated.

Bio-Communications

The Bio-Communications project was established to improve communication and understanding among scientists engaged in activities related to space biology. As the body of scientific knowledge expands in size as well as scope, it becomes increasingly difficult for a scientist to keep abreast of knowledge in his own field, and pertinent advances outside his field. The goal is to make the scientist more aware of advances in his own specialty, and open the door for a greater exchange of ideas and dissemination of information between and among scientific disciplines.

The Bio-Communications project provides:

(1) Partial support of the Space Science Board of the National Academy of Sciences and its subcommittees,

(2) Training of scientists through research associates and summer institutes,

(3) Consultation to administrative program scientists,

(4) Cross-disciplinary communication between physical and biological sciences,

(5) Research literature, report analyses, current status reports, and

(6) Conferences, symposia, and informal meetings.

Planetary Quarantine

	1969	1970	1971
Planetary quarantine.....	$1,300,000	$2,500,000	$2,000,000
Total.....	$1,300,000	$2,500,000	$2,000,000

The absolute prerequisite in the search for extraterrestrial life is that all possible measures be taken to prevent the transfer of any biological or organic earth forms to the planets and to maintain them free of such terrestrial contamination until the question of existence of planetary life is answered. The knowledge of environmental factors gained by both Venus flybys in 1967 has permitted a reassessment of the possibility of contaminating that planet. Flybys of Mars are assisting in the design of more effective planetary quarantine measures. Missions preliminary to later landing probes to date have neither confirmed nor denied the possibility of the existence of life in the outer atmosphere of Venus and on Mars.

Major launching nations subscribed to the objective that there must not be more than one chance in a thousand of contaminating a planet during the

period of biological exploration. This level of safety has required new technology development of decontaminating procedures during manufacture and sterilization of space vehicles by dry heat and other methods before launch and the protection of the sterile vehicle from recontamination during and after launch. These requirements impact the design of the spacecraft as well as procedures for trajectory control, assembly, testing and checkout during the preflight period. Research results now assure that we can obtain reliable mission hardware performance together with positive sterilization. Investigations in FY 1971 are directed toward further simplifying the sterilization requirements and implementing effective operational procedures.

In the operational area all lunar flights have been monitored to provide an inventory of the microorganisms landed on the moon. These operations have been extended to Apollo in order that any life detection results on the returned lunar samples may be more quickly interpreted to prevent prolonged unnecessary quarantine of returned astronauts and investigators making later life detection analyses of the lunar samples.

Biosatellite

	1969	1970	1971
Spacecraft	$21,166,000	$4,700,000	$1,200,000
Experiments	6,334,000	1,100,000	300,000
Operations	200,000	200,000	---
Total Spacecraft Operations	$27,700,000	$6,000,000	$1,500,000
Thor-Delta (Launch Vehicle Procurement program)	($1,200,000)	(---)	(---)
Total (including launch vehicles)	($28,900,000)	($6,000,000)	($1,500,000)

The Biosatellite has been the only automated spacecraft devoted to biological research. Management responsiblity for the Biosatellite project has been assigned to the Ames Research Center. Spacecraft development and fabrication is under contract to the General Electric Company, Re-enty and Environmental Systems Division, located at Philadelphia, Pennsylvania.

Thirteen experiments were orbited on Biosatellite II for two days using specially selected plant cells, animals and simple forms of life to study the effects of the space environment upon biochemical processes in cells, their development and growth, the transmission of hereditary characteristics and the structure of living tissues. Positive effects of the space environment (weightlessness and/or radiation) were observed on cell division and differentiation, growth and development, chromosome aberrations and mechanics, mutations, biochemical processes and population dynamics. A definite interaction between weightlessness and radiation was noticed; in some cases this resulted in an enhancement of development, in some cases there was an

impairment. The greatest effects of this environment of space were observed in: (1) young and actively dividing cells and tissues; (2) rapidly dividing cells with a high metabolic rate; cells such as sperm and egg after meiosis. Mature cells were least affected. The detailed results have been presented at national and international scientific meetings and in a number of scientific journals.

On June 28, 1969, the first of the two planned primate missions, Biosatellite III, was flown. The second of these two missions, Biosatellite F, was cancelled on July 11, 1969, as a result of an amendment to the FY 1970 Budget which reduced Biosatellite funds that year by $12.0 million.

The specific goals of the Biosatellite III flight were to study cycles of sleep and wakefulness; states of attention, including levels of alertness accompanying the performance of two tasks; continuous measurement of blood pressure; pre- and post-flight studies of whole body metabolism to reveal changes in fluid distribution in body tissues and blood; to estimate urinary excretion of calcium, creatine, and creatinine; to evaluate changes in bone density attributable to calcium loss; and to study effects of prolonged weightlessness on the reproductive system.

From a preliminary examination of the data from the Biosatellite III flight, it is apparent that there was a disturbance in the normal 24 hour sleep-wakefulness cycle. Also, for the first time, the occurrence of rapid eye movement sleep (associated with dreaming in man's normal sleep on earth) was confirmed. There was a pronounced loss of body fluid, which in the opinion of the experimenters was a consequence of weightlessness. The detailed analysis of nervous and cardiovascular system data will continue for several months. Data on the animal's metabolism is still undergoing analysis; however, initial estimates by the experimenter point to a considerable loss of calcium from the bones of the monkey.

Funding for FY 1970 provides for the orbital operations and recovery of Biosatellite III, the reduction and analysis of data by the spacecraft contractor and the experimenters, and the submission of their written reports.

Also it will provide for spacecraft contract termination activities (inventory location, identification and disposition), subcontract claims, scrap disposition, reports and administrative processes.

Funding for FY 1971 will provide for the continued analysis of Biosatellite III data by the experimenters and any claim resulting from the spacecraft contract close-out and termination that could not be settled in FY 1970.

No funds will be required for Biosatellite subsequent to FY 1971.

Mr. EVINS. The Bioscience program is reduced from $37,900,000 in 1969, to $19,670,000 in 1970, and to $12.9 million in 1971. We are not going to argue with you too much. On page RD 6–3 you state that you have several options, one of which is between manned and unmanned flights for these advanced programs and technology. What is your present thinking?

FUTURE BIOSCIENCE FLIGHTS

Dr. NAUGLE. We have not made that decision yet, Mr. Chairman. We are trying to determine this year what will be the best approach. At the present time it would appear the most desirable way, the way in which you get the most bioscience done, is to fly these experiments as a part of manned missions. That is, as a part of Skylab and a later space station.

Mr. EVINS. With respect to your planetary flybys, you state that missions preliminary to later landing probes to date have neither confirmed nor denied the possibility of the existence of life in the outer atmosphere of Venus and Mars. What is the significance of this? We have spent a lot of money and we haven't confirmed or denied anything.

Dr. NAUGLE. Mr. Chairman, we have not made a definitive experiment yet to search for life on Mars and cannot until we land there. We are fairly confident life does not exist there in the forms that it exists on the Earth, but, on the other hand, the planet Mars is the planet that has the most hospitable environment, we think, for life as we know it.

We would like to go there and see if there are primitive forms of life such as existed several hundred million years ago on the Earth, or whether perhaps life existed there in the past and has vanished, or whether Mars has no prelife forms at all and there are chemistry reactions taking place there which might lead to the forming of living systems.

SPACE APPLICATIONS PROGRAM

Mr. EVINS. Let's turn to the "Space applications program" and place pages RD 7–1 through RD 7–17 in the record.

(The pages follow:)

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1971 ESTIMATES

OFFICE OF SPACE SCIENCE AND APPLICATIONS SPACE APPLICATIONS PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The objectives of the Space Applications programs are to: (1) expand the knowledge of atmospheric and space phenomena; (2) conduct a broad program of research and technical development oriented toward the application of space techniques for the benefit of mankind; (3) develop and test procedures, instruments, subsystems, spacecraft, and interpretive techniques for the various applications; (4) fulfill NASA's responsibilities under the Communications Satellite Act of 1962; (5) develop and implement for the Environmental Science Services Administration (ESSA), Department of Commerce, the operational meteorological satellite system; (6) cooperate with the user government agencies, such as the Departments of Agriculture, Commerce, Interior, and Navy, through the Earth Resources Survey Program Review Committee to achieve practical benefits to mankind in earth resources; and (7) cooperate to the extent possible with foreign countries in the general advancement of space applications.

Within the Space Applications program objectives, a number of current goals have been established which should be achieved in the near term. One or more goals have been established in each major disciplinary area.

In Communications the endeavors are to: (1) study the factors which affect efficient space use of the frequency spectrum, such as extension of use into the millimeter wave region and ultimately to optical wavelengths; (2) study factors influencing allocation of positions in the geosynchronous orbit so as to minimize mutual interference between terrestrial and space communications systems sharing the same frequencies; (3) develop and test improved technology for accurate stabilization and pointing of the large space erectable antennas which will be required on spacecraft; (4) develop efficient satellite techniques for collecting data from many remote, unattended platforms; (5) study the requirements, technical approaches, and cost factors involved in the potential use of satellites for television transmission to low-cost ground terminals for community TV and direct TV to home receivers; and (6) cooperate with Alaska and India on their potential TV experimentation by utilizing ATS-I and ATS-F satellites.

In the area of Earth Resources Survey from space three goals have been established: (1) to establish the relative roles of aircraft and spacecraft for operational remote sensing of the earth's resources; (2) to provide systematically and simultaneously acquired data from a number of sensors on a single experimental spacecraft which will permit the user scientists to determine the utility of earth resources data obtained from space; and (3) to develop efficient techniques for data processing, analysis, storage, and dissemination.

In Geodesy the aim is to contribute to the National Geodetic Satellite Program in: (1) the accurate determination of the shape of the earth and anomalies in its gravitational field; (2) exploring the utility of geodetic satellite technology and techniques to the solid earth sciences and oceanography; and (3) determining and understanding the wobble of the earth's axis of rotation.

In Meteorology the goals are: (1) to use infrared and microwave sounding techniques for global measurement of the vertical structure of the atmosphere via satellites, and (2) to develop, based on our successful experimentation with the Applications Technology Satellites (ATS), a first generation prototype operational Synchronous Meteorological Satellite (SMS) to permit continuous viewing of the global atmosphere and weather conditions. Achievement of the first goal will start to provide the three-dimensional meteorological data which are needed for the fuller understanding of meteorological processes which can ultimately lead to long-term forecasting based on atmospheric models simulated numerically by computers. Achievement of the second goal will permit the continuous monitoring of cloud patterns associated with short-term severe atmospheric disturbances such as thunderstorms and tornadoes; monitoring the tropics to detect hurricane development; and estimation of wind velocities by short-term tracking of small scale clouds.

In Navigation the goals are to understand: (1) the various needs for better navigation, communications, traffic control, aircraft and ship position determination, and collision avoidance; (2) the technical requirements necessary to achieve the various needs; and (3) the various satellite designs and cost factors which would best meet the requirements of the maritime and aviation community.

SUMMARY OF RESOURCES REQUIREMENTS:

	1969	1970	1971
Supporting research and technology/advanced studies...	$19,600,000	$24,900,000	$25,900,000
TIROS/TOS improvements.....	5,800,000	3,700,000	3,200,000
Nimbus.....	31,800,000	27,300,000	28,000,000
Synchronous meteorological satellite.....	---	2,700,000	15,600,000
Meteorological soundings.....	3,000,000	3,000,000	3,100,000
Cooperative applications satellite.....	100,000	100,000	100,000
Global atmospheric research program (studies).....	---	---	1,000,000

	1969	1970	1971
Applications technology satellites	$24,700,000	$39,000,000	$31,100,000
Geodetic satellites	2,465,000	1,700,000	3,500,000
Navigation/traffic control satellites studies	---	---	3,000,000
Earth resources survey	(11,200,000)	(26,000,000)	(52,500,000)
Aircraft program	8,900,000	11,000,000	11,000,000
Earth resources technology satellite	2,300,000	15,000,000	41,500,000
Total	$98,665,000	$128,400,000	$167,000,000

Distribution of Program Amount by Installation:

Kennedy Space Center	$58,000	---	---
Manned Spacecraft Center	9,949,000	$12,530,000	$12,500,000
Marshall Space Flight Center	447,000	150,000	200,000
Goddard Space Flight Center	72,193,000	91,622,000	131,400,000
Jet Propulsion Laboratory	2,029,000	1,858,000	1,500,000
Wallops Station	529,000	644,000	200,000
Ames Research Center	100,000	175,000	200,000
Electronics Research Center	2,124,000	1,825,000	---
Langley Research Center	980,000	4,170,000	4,300,000
Lewis Research Center	1,125,000	1,095,000	1,700,000
NASA Headquarters	9,131,000	14,331,000	15,000,000

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology/Advanced Studies

Applications technology	$974,000	$925,000	$950,000
Communications	3,113,000	2,985,000	3,950,000
Earth resources	7,060,000	9,022,000	9,000,000
Geodesy	1,530,000	1,230,000	1,250,000
Meteorology	4,800,000	5,412,000	5,400,000
Navigation	1,173,000	1,285,000	1,300,000
Interdisciplinary applications	950,000	4,041,000	4,050,000
Total	$19,600,000	$24,900,000	$25,900,000

Nearly every technique and space system in Space Applications must be preceded by Supporting Research and Technology (SR&T) effort. This effort includes supporting activities in all disciplines (Applications Technology, Communications, Earth Resources, Geodesy, Meteorology, and Navigation/Traffic Control), and a number of interdisciplinary activities. The SR&T emphasizes activity in four major areas: (1) theoretical and

applied research, (2) sensor and instrumentation development, (3) spacecraft technology, and (4) data processing and management.

The largest area is theoretical and applied research. Here, the main activity is in examining the feasibility of applications of space, through studies such as investigations of ERS signatures and development of inversion techniques of radiation measurements in meteorology. In sensors and instrumentation development, effort is on potential future spacecraft remote sensors, such as microwave radiometer and multispectral scanners. In spacecraft technology, work continues on subsystems for support functions, such as advanced tape recorders and phased array antennas. In data processing and management, effort continues in improving techniques for processing and analyzing space acquired data and their integration with data obtained from other sources. Such efforts include studies in multispectral correlation of images and indexing and storage of sensors and associated data.

The plan is to continue these efforts in each of the discipline areas as listed below:

In Applications Technology, effort continues in control systems directed at stabilization of spacecraft into orbit; spacecraft equipment developments to improve amplification and antenna system capabilities; and increasing the reliability and useful lifetime of satellite components.

In Communications, effort consists of system comparison and trade-off studies to determine the merits of advanced concepts; techniques applicable to small, terminal multiple access communications; evaluation and development of components and subsystems required for high power communications; propagation studies and component development in the frequency region 10 to 100 GHz where frequencies are more available for space communications; studies in the data relay satellite systems area and in antenna beam widths; and frequency analysis and prediction methods needed for developing sharing criteria. In FY 1971 additional emphasis will be put on the study of radio interference and propagation. This involves the investigation of methods for improving use of the radio spectrum and studying frequency sharing criteria as related to greater density of satellites and earth terminals, and to explore the use of frequency bands at higher regions of the spectrum. Efforts on information networks will be also receive additional emphasis.

The Earth Resources program is unique both in the wide variety of potential users interested in the information that will be the outcome of the spacecraft program and in the vast quantities of data to be handled, even during the experimental phases of the program. The study, research, and technology development program for FY 1971 will be more specifically focused on preparing for the advent of spacecraft dedicated to the Earth Resources objectives. Theoretical, laboratory, ground and aircraft studies

and field investigations will be extended in cooperation with the user agencies such as the Departments of Agriculture, Interior, Commerce and Navy, to further define the requirements of the users for spacecraft data collection, processing and distribution and the capability of spacecraft sensors to meet these requirements. Spatial, spectral and time-varying characteristics of the data must be considered. The current experience in the discipline fields of agriculture, forestry, geography, cartography, geology, hydrology, and oceanography is planned to be extended to include transportation, census, earthquake monitoring, and pollution control. An important aspect of the program is the mutually supporting roles of aircraft and spacecraft as remote sensing platforms. Studies will be directed at qualitative and quantitative analyses of the capabilities of the several methods available for remote sensing of the environment, supported by experience in the ERS aircraft flight program, to assist in planning the relative roles of these methods in programs of the future. Studies, software development and data management systems development will be directed toward meeting the difficult problems of structuring spacecraft data into that most useful for experimental analysis and eventual application to national problems. The experimental analysis and investigation program, to which the ERS aircraft flight program provides essential support, will be extended in the direction of development of broader sensor instrumentation capability and an integrated aircraft and spacecraft data management system and facility. A program for developing centers with special competences in processing and analyzing data automatically both analog and digital techniques will be extended. In addition, advanced studies will be continued to improve the understanding of total Earth Resources Survey systems and the benefits which can be anticipated therefrom.

In Geodesy, emphasis is placed on conducting: (1) conceptual studies, feasibility analysis and configuration definition of geodetic spacecraft, (2) analysis of geodetic requirements by various disciplines in terms of spacecraft mission, (3) analysis of feasibility and effectiveness of geodetically optimized ground based spacecraft observation systems, and (4) research into geodetic effectiveness and feasibility of advanced observations systems and techniques, to provide more precise and densified measurement of geodetic data, and to calibrate geodetic observation methods intended for extraterrestrial use.

In Meteorology, effort is concentrated on: (1) the development and evaluation of components for potential meteorological satellite system application; (2) investigation of scientific techniques and tools for the systematic observation, analysis and subsequent interpretation of meteorological atmospheric phenomena; and (3) optimization system analysis.

In Navigation/Traffic Control, studies and experiment development will be conducted on data and voice transmission and position determination techniques via satellite to ships, aircraft, and other mobile platforms;

future navigation and traffic control satellite concepts; search and rescue and collision prevention techniques; and the collection and retrieval of data from fixed and moving platforms such as balloons, buoys, and animals.

The purpose of the Interdisciplinary Applications is to conduct studies and research relating to several of the applications disciplines, in addition to the development and support of multidisciplinary centers such as the University of Wisconsin and the Goddard Institute of Space Sciences. Also included within this program is the conduct of selected advanced missions studies which will define the requirements of future space applications flight missions.

TIROS/TOS Improvements

	1969	1970	1971
TIROS-M spacecraft.....	$4,300,000	$1,900,000	$700,000
TOS improvements.....	1,500,000	1,800,000	2,500,000
Total Spacecraft and Support	$5,800,000	$3,700,000	$3,200,000
Delta (Launch Vehicle Procurement Program).....	($1,400,000)	($200,000)	(---)
Total (including launch vehicles).....	($7,200,000)	($3,900,000)	($3,200,000)

The objectives of this project are to: (1) provide research and development toward advanced operational meteorological satellite systems, particularly in support of the TOS program and future satellite systems of the National Operational Meteorological Satellite System (NOMSS), (2) provide maximum interim operational data for use in weather analysis and forecasting, (3) measure emitted infrared and reflected solar radiation in selected spectral regions, (4) observe cloud patterns and cloud cover, (5) measure the earth-atmosphere heat balance, and (6) develop system concepts and basic configurations which will maximize success and minimize costs when subsequently used in operational systems.

Ten TIROS research and development spacecraft, of which nine were funded by NASA and one, TIROS-X, by ESSA, have been successfully launched since April 1960, providing cloud cover and other meteorological data for research and operational use. TIROS-IX, as a research and development satellite in a wheel configuration, was essentially the prototype spacecraft for the TIROS Operational Satellite (TOS) system.

The development of the TOS system has been one of the main objectives of the NASA meteorological satellite program. This system has represented a significant improvement over its predecessor, the R&D TIROS spacecraft. Nine TOS spacecraft (ESSA-I through ESSA-IX) have been successfully launched.

TIROS-M, which is the operational prototype of the second-generation operational satellite series, the Improved TIROS Operational Satellite (ITOS), is scheduled for launch from the Western Test Range during January 1970. The mission of the ITOS series of spacecraft is to expand the operational capability of the basic TOS system for use in day-to-day, realtime weather analyses. The mission will use a three-axis stabilized, earth-oriented satellite in a circular. near-polar, sun-synchronous orbit to obtain meteorological observations of the earth's cloud cover. Complete global coverage will be provided on a daily basis. Daytime coverage will be furnished by a system of television cameras comprised of two Automatic Picture Transmission (APT) cameras and two Advanced Vidicon Camera Subsystems (AVCS). The APT cameras will provide the direct readout capability by which about 500 worldwide receiving stations will be able to obtain local cloud cover information. The AVCS sensors will provide the stored data capability whereby the ESSA Command and Data Acquisition (CDA) stations at Goose Creek, Alaska, and Wallops Island, Virginia, will acquire global cloud cover data for central analysis at the National Environmental Satellite Center, Suitland, Maryland. Also carried by the ITOS-series spacecraft as part of the primary sensor complement are two infrared scanning radiometer (SR) subsystems, which will obtain nighttime cloud cover pictures for both direct readout to the APT stations and stored data playback to the CDA stations.

The secondary sensor subsystem is designed to gather earth heat-balance data and to identify proton flux levels at spacecraft altitude. The subsystem consists of a solar proton monitor (SPM) and a flat plate radiometer (FPR).

Under the TIROS/TOS Improvements program initiated in FY 1965, effort will be continued in the development of advanced sensors and subsystems such as high resolution radiometers and attitude determination systems which will be incorporated into future operational spacecraft. In FY 1971, the effort initiated in FY 1970 to define a third-generation, polar-orbiting operational satellite system will be continued. Continuation of this work is necessary in FY 1971 in order to permit the proper time phasing of system developments forming the technology base for global coverage in the post-ITOS time-frame.

The Office of Space Science and Applications is responsible for the overall management of this effort, and project management responsibilities are fulfilled by the Goddard Space Flight Center. The major spacecraft contractor is the Astro Electronics Division of Radio Corporation of America.

FY 1970 funds are being utilized to complete the TIROS-M spacecraft and sensors, spacecraft integration, test, and launch work, initial data acquisition, and for continued development of sensors under TOS Improvements.

FY 1971 funds are required for TIROS-M's post-launch support and data acquisition and handling efforts, for continued sensor and subsystems development for TOS Improvements, and for in-depth studies for future operational satellite systems.

Nimbus

	1969	1970	1971
Spacecraft	$22,826,000	$17,100,000	$15,500,000
Experiments	7,489,000	7,900,000	11,300,000
Ground operations and support	1,485,000	2,300,000	1,200,000
Total	$31,800,000	$27,300,000	$28,000,000
TAT - Agena and Delta (Launch Vehicle Procurement Program)	($5,743,000)	($2,801,000)	($1,500,000)
Total (including launch vehicles)	($37,543,000)	($30,101,000)	($29,500,000)

The objectives of this project are to develop a significantly improved meteorological satellite to provide data on atmospheric parameters for use by the scientific community; to carry out flight tests to prove the applicability of the instrumentation; to fulfill special data requirements of the atmospheric sciences research community which can be provided uniquely by this instrumentation functioning as a space meteorological observatory; and to provide the basis for further significant technological advances in meteorological satellites for operational as well as scientific uses. These objectives will be extended in the Nimbus E and F missions to develop an applications observatory in polar orbit at low to medium altitude that will flight test technology and experiments for meteorology and other applications disciplines.

This project includes development, launch, and operation of a series of meteorological satellites exhibiting evolutionary advances in operating characteristics, and testing in orbit of sophisticated experiments for atmospheric research and operational demonstration. The satellite serves as a flexible space observatory on which a variety of advanced concepts for measuring atmospheric parameters can be tested. The satellite consists of three major subsystems: power, stabilization, and a sensory ring which can accomodate a number of sensors.

The first two spacecraft in the planned series of seven Nimbus satellites were Nimbus I, launched on August 28, 1964, and Nimbus II, launched on May 15, 1966. Nimbus B, a third spacecraft launched May 18, 1968, was lost due to a launch vehicle failure. In June 1968, NASA approved launch of a replacement spacecraft which largely used flight spares or

updated prototype subsystems and experiments. This mission, identical to the Nimbus B configuration, was designated B-2 prior to launch. It was successfully launched April 14, 1969, whereupon it was designated Nimbus III. This replacement was necessary in order not to delay the flight test of that group of selected experiments and technological advances vital to the meteorological research and development program and required for long range weather forecasting. Nimbus III successfully flight tested experiments to determine the vertical temperature structure of the atmosphere, remote sensors to measure radiation reflected and emitted by the earth and its atmosphere, an improved cloud cover imaging system, and a worldwide data collection system. The successful measurement from satellite of temperatures in the atmosphere has been termed "as significant to the advancement of meteorology as the launching of the first satellite." In addition, Nimbus D is scheduled to be launched in Calendar Year 1970, Nimbus E in 1972, and Nimbus F in 1973. Nimbus D, using the same basic spacecraft design as Nimbus III, will test an advanced control system, advanced experiments for determining the vertical temperature structure, and additional experiments such as a temperature/humidity infrared radiometer, a monitor of the water content of the atmosphere, and a more refined worldwide data collection system that will include the first meaningful spacecraft wind measurement experiment. Nimbus E and F will test advanced infrared radiometric and spectrometric and microwave experiments designed to allow penetration of cloud layers for the global determination of the vertical structure of the atmosphere.

The Office of Space Science and Applications is responsible for overall management of this program. Responsibility for project management is assigned to the Goddard Space Flight Center. The major contractor for spacecraft structure and integration and test of spacecraft is the General Electric Company; the Radio Corporation of America is responsible for power and data storage subsystems.

FY 1970 funds are being used for continued acquisition and analyses of data from Nimbus III, for completion of the development, test, and launch of Nimbus D, and for continued development of the Nimbus E and F spacecraft and selected experiments. These funds will also be used for acquisition and analysis of data from Nimbus D subsequent to its launch this fiscal year.

FY 1971 funds are required for continued acquisition and analysis of the data from the Nimbus D spacecraft in orbit and to further continue the development of the Nimbus E and F spacecraft and selected experiments.

Synchronous Meteorological Satellite

	1969	1970	1971
Spacecraft	---	$2,000,000	$10,200,000
Experiments	---	700,000	2,200,000
Ground operations	---	---	3,200,000
Total	---	$2,700,000	$15,600,000
Delta (Launch Vehicle Procurement Program)	---	($1,100,000)	($2,600,000)
Total (including launch vehicles)	---	($3,800,000)	($18,200,000)

The objectives of the Synchronous Meteorological Satellite (SMS) are to demonstrate a prototype operational system which will meet the requirements of the ESSA to: (1) permit continuous observation of major weather systems routinely, thus enhancing the ability to predict and locate severe short-lived storms, (2) derive important wind field data over large areas and in much less time than heretofore possible, and (3) provide capability for rapid dissemination of processed meteorological data to local meteorologists.

A feasibility study and a project definition study were completed by GSFC in-house in FY 1968. In FY 1970 a Phase B system design study was completed by NASA which permitted contractual effort to be initiated for the procurement of a day/night sensor and the SMS-A and B spacecraft.

FY 1970 funds were used for initiating the design and development of the two SMS spacecraft and sensors. FY 1971 funds will be used to initiate procurement of SMS A and B.

Meteorological Soundings

	1969	1970	1971
Large research sounding rockets	$2,050,000	$2,050,000	$2,150,000
Small sounding rocket systems	730,000	730,000	730,000
Field experiment support	220,000	220,000	220,000
Total	$3,000,000	$3,000,000	$3,100,000

The objectives of this project are to determine the structure and characteristics of the atmosphere in the 30 to about 100 km region through the use of research and development sounding rockets and to develop a meteorological sounding rocket system amenable to research, range support, and routine operational requirements.

Three areas of effort are involved:

(a) Large research sounding rockets to explore the characteristics and phenomena of the atmosphere between 30 and about 100 km. This region is important to meteorological science, and cannot be reached except by sounding rocket. Nike Apache and occasionally Tomahawk class rockets are used to explore the relations and mechanisms operating between and within the various regions of the atmosphere, and the effects of solar energy and its variations upon the structure and circulation in the atmosphere.

(b) Small sounding rocket systems are utilized to obtain measurements in the region of approximately 30 to 60 kilometers above the earth. Included in this effort is the development of an inexpensive operational meteorological sounding rocket system capable of reliable launches amenable to the requirements for range support, research and network operations.

(c) The sounding rocket field experiment support, which through cooperation with other countries, provides for the establishment of self-sustaining capabilities for coordinated meteorological sounding rocket launches from sites that will contribute mutually valuable data.

The Office of Space Science and Applications is responsible for the overall management of the project. Project management for large research rockets is assigned to Goddard Space Flight Center, for small sounding rocket system development to Langley Research Center, and for field experiment support to Goddard Space Flight Center and Wallops Station.

FY 1970 and prior years funds were utilized to launch large research and small developmental sounding rockets, develop and improve sounding rocket systems, and for continuation, extension, and development of field experiment projects in cooperation with countries in South America, Europe, and Asia. FY 1971 funds are required to procure additional large research and small developmental rockets, flight test various payload experiments, improve rocket performance and to continue field experiment projects with other cooperating countries to obtain additional atmospheric research data.

Cooperative Applications Satellite

	1969	1970	1971
Spacecraft and support	$100,000	$100,000	$100,000
Scout (Launch Vehicle Procurement Program)	(---)	(---)	(1,100,000)
Total (including launch vehicles)	($100,000)	($100,000)	($1,200,000)

This project is being carried out jointly by NASA and France. The effort consists of developing instrumented balloon techniques to be utilized in conjunction with an earth-orbiting satellite for the purpose of obtaining the characteristics of air masses, especially in-situ measurements of speed and wind direction at various altitudes. The data obtained will be used by U. S. and French scientists to assist in the understanding of the structure of the atmosphere and extending weather forecasting capabilities. One spacecraft and one backup with instruments will be provided by France. The spacecraft will be launched by NASA in 1970 using a Scout launch vehicle from Wallops Island into a 900-km circular, 50-degree-inclination orbit to gather data from approximately 500 balloons. The instrumented balloons will be developed and launched by France in the Southern Hemisphere. Satellite tracking and data acquisition, reduction, and analysis will be by France. The U. S. will provide the Scout vehicle, and backup if required, launch services, initial satellite tracking, and data analysis along with France of the reduced data.

The Office of Space Science and Applications is responsible for the overall management within NASA. Responsibility for project management is assigned to Goddard Space Flight Center.

This project was initiated in FY 1967. FY 1969 and prior year funding were used for preparation of computer program models, for U. S. scientific investigations and analysis of balloon and spacecraft antennas, and for electronics for general project support. Fiscal year 1970 funds are being used to continue U. S. scientific and technical support. Fiscal year 1971 funds are required to continue technical support and provide launch and post-launch support.

Global Atmospheric Research Program (GARP) Study

	1969	1970	1971
GARP study	---	---	$1,000,000
Total	---	---	$1,000,000

The Global Atmospheric Research program (GARP) is an international cooperative program directed toward obtaining data for increasing understanding of the general circulation of the atmosphere and for laying the mathematical and physical basis for methods of long range weather prediction.

GARP is directed jointly by the governments of interested nations through the World Meteorological Organization (WMO) and the world scientific community through the International Council of Scientific Unions; national and international organizations have been established to plan and execute the program. The major event, a global exercise planned for 1975, is expected to require seven (7) meteorological satellites operating simultaneously for about a year. International commitments to provide these satellites have not been made.

Long term weather forecasting cannot be achieved without first achieving the GARP goals. In FY 1970, NASA initiated studies to determine the nature of its possible support to the GARP experiment. The study planned for FY 1971 will involve detailed study, comparative analysis, and preliminary system design directed toward facilitating the choice of a single project approach for NASA support to GARP. The study will also identify facilities, logistics operations, additional advanced technology, and advanced development tasks required to furnish spacecraft, ground support, and related data management for the global experiment.

Applications Technology Satellites

	1969	1970	1971
Spacecraft	$14,293,000	$14,700,000	$15,600,000
Experiments	9,824,000	19,800,000	14,200,000
Operational support	583,000	4,500,000	1,300,000
Total	$24,700,000	$39,000,000	$31,100,000
Atlas centaur and Titan IIIC (Launch Vehicle Procurement Program)	($3,596,000)	($3,700,000)	($4,700,000)
Total (including launch vehicles)	($28,296,000)	($42,700,000)	($35,800,000)

The objectives of the project are to design, develop, flight test, and evaluate a variety of scientific and technological experiments within the applications disciplines by use of a series of seven spacecraft. Five spacecraft have been launched to date. Because of launch vehicle anomalies, the desired orbits for ATS-II, launched April 6, 1967, and for ATS-IV, launched August 10, 1968, were not achieved, thus limiting the experimental value of these spacecraft. ATS-V, launched August 12, 1969, experienced problems with the active stabilization system prior to planned despinning of the satellite and the deployment of the gravity gradient system. However, many objectives from seven of the twelve experiments flight tested on the mission will be achieved. ATS-I, launched December 7, 1966, and ATS-III, launched November 5, 1967, into synchronous orbits have performed successfully and continue to operate. Two spacecraft, ATS-F and -G, are scheduled for launch in Calendar Years 1973 and 1974, respectively. Utilizing three-axis active spacecraft stabilization, these spacecraft will be launched into synchronous

orbit and will flight test a space-erectable, parabolic antenna (approximately 30 feet in diameter) and demonstrate the high pointing accuracy it requires, and, in addition, will flight test a number of scientific and technology experiments.

The Office of Space Science and Applications is responsible for overall program management. Responsibility for project management is assigned to Goddard Space Flight Center. The major contracts for ATS-I through ATS-V missions were with Hughes Aircraft Company for spacecraft development; General Electric Company for gravity gradient stabilization; and Westinghouse Corporation for integration. The spacecraft development contractor for ATS-F and -G, which will either be the Fairchild-Hiller Corporation or the General Electric Company, will be selected early in 1970.

Fiscal year 1970 funds were used for ATS-V final development, experiments, launch and post-launch support; and for continued procurement of ATS-F and -G long lead time items and will be used for commencement of spacecraft development. Fiscal year 1971 funds will be used for continuation of ATS-F and -G development and experiments and for continued development of promising advanced applications experiments which have been defined but have not been assigned to a specific flight mission.

Geodetic Satellites

	1969	1970	1971
Spacecraft and support.....	$2,465,000	$1,700,000	$3,500,000
Delta (Launch Vehicle Procurement Program).....	(---)	(2,600,000)	(---)
Total (including launch vehicles).....	($2,465,000)	($4,300,000)	($3,500,000)

The purpose of the Geodetic Satellite project is to support the National Geodetic Satellite program (joint NASA/DoD/DoC program) and to develop the technology of geodetic satellites for solid-earth geophysics and oceanography.

Three geodetic satellites have been launched: Pageos-I in June 1966; GEOS-I on November 6, 1965; and GEOS-II on January 11, 1968. GEOS-I and -II contained similar instrumentation, namely, optical beacons, geometric and gravimetric instrumentation, range and range rate transponders, laser retroreflectors, and doppler beacons. GEOS-II also carried two C-band transponders, a radar passive reflector, and a laser detector. Data obtained were utilized for Pageos-I, GEOS-I, and GEOS-II.

The Office of Space Science and Applications is responsible for the overall program. Project management of GEOS-C, previously at Headquarters, will be assigned to Goddard Space Flight Center.

Fiscal year 1970 funds are being used for continued analysis of GEOS-II data and to initiate effort on GEOS-C, which will obtain the additional data required to complete the gravimetric objective of the National Geodetic Satellite program and to demonstrate the feasibility of employing a geodetic satellite radar altimeter to measure the mean sea level of the ocean. Fiscal year 1971 funds will be used to continue the development of GEOS-C spacecraft and experiments.

Navigation/Traffic Control Satellite Studies

	1969	1970	1971
Spacecraft and support.....	---	---	$3,000,000
Total.....	---	---	$3,000,000

The objectives of this project are to study and design spacecraft capable of providing the communication, navigation, and traffic control technology required to demonstrate its application for: (1) improving air traffic control services in the over-ocean areas; (2) providing communication and navigation services to ships and aircraft; and (3) providing the aids in search and rescue operations and collision prevention system operations for marine and aviation vehicles.

Fiscal year 1971 funds are required for detailed design studies.

The Office of Space Science and Applications is responsible for the overall management within NASA. Responsibility for study management will be assigned to the Goddard Space Flight Center.

Earth Resources Survey

	1969	1970	1971
Earth resources technology satellites			
Spacecraft.....	$1,375,000	$3,900,000	$13,000,000
Experiments.....	800,000	10,600,000	20,700,000
Ground operations.....	125,000	500,000	7,800,000
Subtotal.....	$2,300,000	$15,000,000	$41,500,000
Delta (Launch Vehicle Procurement Program).....	(---)	(---)	(3,900,000)
Subtotal (including launch vehicles).....	($2,300,000)	($15,000,000)	($45,400,000)

	1969	1970	1971
Earth resources survey/aircraft			
Operations	$1,300,000	$1,700,000	$2,100,000
Data processing	1,400,000	2,300,000	2,800,000
Sensors	6,200,000	7,000,000	6,100,000
Subtotal	$8,900,000	$11,000,000	$11,000,000
Total, Earth Resources Survey (including launch vehicles)	($11,200,000)	($26,000,000)	($56,400,000)

The objectives of this project are to: (1) assess the practical value of remote sensing of earth resources from space, (2) compare the capabilities in earth resources data acquisition of a space system with and without complementary aircraft coverage, (3) determine whether or not, and in what configuration, an operational space-assisted and user-oriented earth resources survey system could be developed to meet existing requirements, (4) determine which remote sensors are most effective for earth resources surveying, (5) develop and improve data handling procedures, and (6) ensure full understanding of future operational system requirements and costs.

This project consists of two activities in earth resources: (1) a comprehensive program to design, launch, and evaluate experiments on Earth Resources Technology Satellites, and (2) a supporting aircraft program to develop and test remote sensing techniques, sensors, and data handling systems by conducting aircraft flights at altitudes of 500 feet to above 50,000 feet.

The objective of the Earth Resources Technology Satellite project is to design, develop, launch, and test a series of spacecraft to conduct experiments which will lead to a reliable assessment of the utility of space-borne sensors for applications to problems related to natural and cultural resources. This assessment will lead to the capability to design spacecraft and related data handling systems to support these national programs on an operational basis. It will also lead to an evaluation of the complementary roles of aircraft and spacecraft in acquiring data on the earth's resources. This effort is progressing in FY 1970 through the performance of two parallel detailed system design studies that encompass both the first two spacecraft and the related ground data handling system. A selection of the more promising system will be made very early in FY 1971 so that the system can enter into the detailed engineering and fabrication stage in FY 1971. The two satellites, which are planned for sun-synchronous orbit, are designated Earth Resources Technology Satellite (ERTS) A and B and are to be launched successively early in CY 1972 and CY 1973. ERTS-B will serve both as a backup to ERTS-A and as an improved version, capable of incorporating lessons learned in the course of fabricating ERTS-A and also capable of extending the sensitivity of the instruments into the thermal infrared region. These satellites will carry instrumentation that

will meet the requirements of the user community in terms of spatial and spectral resolution as well as repetitive coverage. Both framing and line scanning sensors will be flown in order to assess the advantages of each. The satellite system will also concurrently relay data from remote ground sensors such as rain gauges, stream gauges, and seismometers to assess the value of such a network for complementing the spaceborne sensors.

The Earth Resources Survey aircraft supporting project objective is to conduct tests and experiments with instruments analagous to those being considered for the spacecraft systems to evaluate both the instruments themselves and the potentiality of using such instruments to perform useful tasks from space. The flights also contribute to an understanding of, and solution to, the data management problems that will be a part of the total system operation, including the interfaces with the extensive and diverse user community. This project provides essential flight test support to the earth resources supporting research and technology effort.

In FY 1971 two substantial additions to the aircraft instrumentation capability will be made: a 24-channel line scanner covering a broad visible and infrared spectrum will be installed in the C-130 aircraft at the Manned Spacecraft Center, and a scanning microwave radiometer will be installed in the P3A aircraft. Together with the RB57 high altitude aircraft, assigned to NASA by the Air Force, a much improved capability for experimentation will be available. This capability will be used on a combined mission basis with the ERTS flights so that the aircraft effort in FY 1971 will be directed at providing for aircraft-spacecraft correlated experimental investigations.

Fiscal year 1969 funds were utilized for operation of three aircraft, for sensor procurement, and data handling systems. Fiscal year 1970 funds are being utilized to continue this effort, procure additional sensors, and continue the modification of a high altitude aircraft to obtain a better understanding of atmospheric effects on remote sensing capability.

The Office of Space Science and Applications is responsible for the overall management of this project. Responsibility for execution of the Earth Resources Survey/Aircraft project is assigned to Manned Spacecraft Center. Responsibility for management of the ERTS A&B project is assigned to Goddard Space Flight Center. Effort in the Earth Resources Survey is coordinated with other user agencies through the Earth Resources Survey Program Review Committee which includes representatives from the Departments of Agriculture, Commerce, Interior, and Navy, and is chaired by NASA. Observers from other departments such as Transportation are also frequently present.

Fiscal year 1971 funds are being requested to continue aircraft operations, sensor procurement, and data processing to conduct about 30 flights over 60 test sites, and to initiate spacecraft and sensor hardware procurement for the first two ERTS spacecraft.

INCREASES REQUESTED

Mr. EVINS. You have a substantial increase from $128.4 million in 1970 to $167 million in 1971.

Dr. NAUGLE. The large increases are in Goddard Space Flight Center from $91 million to $131 million.

Mr. EVINS. NASA headquarters goes up from $14.3 million in 1970 to $15 million in 1971. What are these increases for?

Dr. NAUGLE. Mr. Chairman, first of all, let me make it very clear there is no increase in the civil service manpower at Goddard even though the amount of effort at Goddard is increasing. Manpower is staying at 4,412 in 1970 and 1971.

The increases at Goddard are associated with the earth resources technology satellite and the synchronous meteorological satellite. Those are both projects that we described to you last year which were authorized and the initial funding was appropriated. We are now getting heavily into the development of those two missions.

NIMBUS PROGRAM

Mr. EVINS. How many rocketry programs like Nimbus are planned? What have been the accomplishments in your other Nimbus launches?

Dr. NAUGLE. Mr. Chairman, one of the most exciting discoveries and the greatest contribution to meteorology was made with the Nimbus spacecraft that we launched last spring. In this satellite we flew——

Mr. EVINS. How many launches have you had?

Dr. NAUGLE. We have had four. We have had three successful shots and one shot which failed to get into orbit.

Mr. EVINS. You had four and you plan three more, is that right?

Dr. NAUGLE. Yes. At the present time we have Nimbus–D, which is scheduled to go about the first of April and then we have E and F, which are scheduled for later 1972 and 1973.

Mr. EVINS. Who are the manufacturers of these vehicles?

Dr. NAUGLE. General Electric is the principal contractor of Nimbus.

Mr. EVINS. They want you to keep on firing them, don't they?

Dr. NAUGLE. I am sure they do. We also want to keep on firing them. The Nimbus is really a meteorological observatory we use to check out new sensors. I would like to complete the statement I was making about the results from Nimbus because it is exceedingly important.

What we demonstrated with Nimbus 3 was that we could fly sensors in a spacecraft from which we can derive a vertical profile of atmospheric temperature, water vapor and ozone content. An estimated pressure profile can also be computed from the temperature and water vapor data if a reasonable assumption is made of the value of the pressure at the top of the profile.

In the past, in order to do that, we had to fly rockets or balloons up through the atmosphere to make such a measurement.

OTHER USES OF NIMBUS

Mr. EVINS. Is there any payoff in Nimbus other than weather modification and weather reporting?

Mr. NAUGLE. We do not conduct any experiments in weather modification although some of the information we gather may be used by some for that purpose. We are developing techniques for

what we call information retrieval where, for instance, if you have buoys along a river and you want to measure the height of a river say during the rainy season, you can use a satellite as it comes over to interrogate those buoys and then feed that data back into a central data-handling system. You can also do the same thing with ocean buoys and we are using Nimbus as a test bed also to develop that technique.

It is really not only the techniques of interrogation, but also the technique of locating where those buoys or systems are, so if you have buoys floating in the ocean to measure the ocean current, you can, at the same time, measure temperature, salinity and so forth of those ocean currents. Not only can you get that information, but you can also locate the buoy without having to have ships out to track it.

Mr. BOLAND. Is not the Coast Guard engaged in an expensive program called the National Data Buoy System which would use just about what you are talking about.

Dr. NAUGLE. The program that you are describing is one that we are certainly aware of. I would suspect that Nimbus or a later national data gathering satellite would collect the data from those buoys.

Mr. BOLAND. Nimbus is just utilizing this system then, is it not?

NIMBUS TRACKING OF LOST BUOY

Dr. NAUGLE. Yes. It is utilizing them but we are also ——

Dr. PAINE. Vice versa, too. The Coast Guard lost one of their buoys and were unaware of where it had been located for some weeks. We were down by Puerto Rico and we were able to pick up the fact that it had drifted all the way around Puerto Rico, was on the other side of it, and gave them the location to pick it up. So these rather fit together.

Mr. EVINS. Dr. Paine, you could not have found a better man than Dr. Naugle. He knows his subject, he is very informed, very articulate, always has the answers.

EARTH RESOURCES TECHNOLOGY SATELLITE

In the Earth Resources Technology Satellite project you had $2.3 million in 1969, $15 million in 1970, and in 1971 you are asking for $41.5 million. This project shows quite an increase.

Dr. PAINE. This is our principal area of new emphasis. We think it has great applications for bringing the benefits of space right down to people on earth in the very near future.

Mr. EVINS. Tell us about it.

Dr. NAUGLE. This is funding for what we call an earth resources technology satellite. There are two of these to be flown in polar orbit. They will have three television cameras which will look in different parts of the visible spectrum and send information back to observers on the earth, who will then look at those pictures. They will be used for a number of areas, for hydrology, to measure the snow cover, and to allow people who are managing the flow of water through a dam system to better program that flow.

Mr. EVINS. The Corps of Engineers, the Bureau of Reclamation, and TVA are expert in that, they control the floods.

Dr. PAINE. This kind of information will make it easier for them to do a considerably better job and to run more economical systems, Mr. Chairman.

Mr. EVINS. You will have to tell us some more about the project, Doctor. You have gone up from $2.3 million in 1969 to $41.5 million in 1971.

Dr. PAINE. I am sure Dr. Naugle can do that.

Dr. NAUGLE. Mr. Chairman, these are some of the most complex satellites that we have developed. We are having to press the state of the art here in television systems in order to get the spectral and spatical resolution that we want. We have given you a couple of examples of what these satellites can do.

COOPERATION WITH OTHER AGENCIES

Let me make it clear that these are experimental satellites in which we actually will be making the measurements. We are working with Interior, Agriculture, ESSA, and the Navy.

From that experiment we will be in a position to decide whether they are worth making operational. The money that is in here is for flight hardware, not just surveys or studies. We are buying two satellites.

The sensors, the development of the television system, the development of the multispecial scanner, the development of a video tape recorder, is what goes into those satellites.

VIEWS OF AGRICULTURE DEPARTMENT

Mr. EVINS. This information goes to the Department of Agriculture and they like it. We have gotten some good letters from Agriculture saying this program is valuable.

Dr. NAUGLE. We certainly have, which we can make available for the record.

Mr. EVINS. We recognize it has potential value, but I think you had better extend your remarks in the record.

Dr. NAUGLE. We will do that.

(The information follows:)

NASA's Earth Resources Survey program is fully coordinated with the user agencies through the functioning of the Earth Resources Survey Program Review Committee (ERSPRC). This Committee consists of representatives of the Departments of Agriculture, Interior, Commerce, and Navy, and NASA; other agencies participating as active observers include the Bureau of the Budget, the Marine Council, Office of Science and Technology, Department of Transportation, and the Space Council. The planning and execution of the Earth Resources Survey program, and the planning and specifications for the ERTS A. & B. satellite, have been coordinated with and approved by this Committee.

In addition, the member agencies to the ERSPRC have specifically indicated approval and support to these programs by letter, copies of which are attached for the record.

A technical discussion of the Earth Resources Survey program is contained in the statement of Dr. John M. DeNoyer, Director, earth observations programs, Office of Space Science and Applications, which was presented to the Committee on Science and Astronautics. A copy of this statement is attached.

U.S. DEPARTMENT OF THE INTERIOR,
GEOLOGICAL SURVEY,
Washington, D.C., November 17, 1969.

Dr. HOMER E. NEWELL,
Associate Administrator, National Aeronautics and Space Administration, Washington, D.C.

DEAR HOMER: I understand that the Bureau of the Budget has withheld funds for the ERTS program from your 1971 budget because they do not believe that the resolution capability of the proposed system will meet the needs of the user agencies.

We have been consistent in our expressions of requirements since they were first transmitted to NASA in October 1966. These requirements, most recently expressed in the issue paper prepared in defense of our 1970 budget, asked for multicolor, repetitive images having a ground resolution of 100 to 200 feet per resolution element. The attached test data and computed performance characteristics from RCA demonstrate that the system proposed for ERTS will meet our oft stated requirements.

We consider a resolution element to be the equivalent of one TV line in the X and Y directions. The utility of information contained in one TV line is amply demonstrated by results of research in automatic analysis of multispectral scanner data.

Considerable confusion in the discussion of resolution capability has resulted from the use of "line pair convention" for expressing resolution. This convention is useful for equating various imaging systems but is not relevant as a means of evaluating system capability to meet our requirements.

At the onset of cooperative studies between NASA and the Department of the Interior (USDI), preliminary determinations of resolution requirements were derived from experience with traditional aircraft systems. These systems are designed to permit precise measurements of size and shape and recognition of discrete objects. With rare exception, these systems provided one-color, one-time coverages.

Likewise, early emphasis was placed on those applications, such as topographic and geological structure mapping, where aircraft data had been traditionally applied.

Experience with existing systems and focus on traditional applications led to preliminary requests for data having resolutions sufficient for object identifications from one-color, one-time coverages, and for measurement precision in keeping with conventional uses.

As experimentation progressed, it became evident and demonstrable that recognition of objects in the nautral scene could be more effectively and economically achieved through repetitive, multicolor observations than through observations of shape or measurements of size. Further, experiments and studies demonstrated that the major needs for information and hence, the major applications and benefits of "space" observations, lay in regional analyses of dynamic situations such as range conditions and water distributions where aircraft data had not been traditionally applied because aircraft are not suited to the task.

While spatial resolution is important for discriminating objects, the dimensions of spectral and temporal resolution are of even more value for recognizing objects. The spectral resolution (three bands in the visible and solar infrared wavelengths) will enable objects in the natural scene to be recognized with more facility than with a single broad wavelength band, even with highly improved spatial resolution. The ability to recognize changes in the natural scene through time is temporal resolution. Many terrain features that cannot be recognized at one time of year are readily recognizable at another time. Also, dynamically changing features such as snow cover, require temporal resolution for their effective recognition.

Our case rests on engineering tests of the return beam vidicon ERTS camera system and recent experimental evidence derived from (1) time lapse comparison of Gemini and Apollo photographs which show that some terrain features are unrecognizable at certain times of the year, while they are readily recognizable at other times (with the 300–500 foot resolution of the photographs); (2) analysis of ERTS analog multispectral data from the SO–65 experiment of Apollo 9 which showed that terrain features not recognizable in one spectral band are readily recognizable in another spectral band, or a combination of bands; and (3) P. Langley's studies (U.S. Forest Service) which show that the Apollo 9 data can be used in a multistage sampling program for measurement of timber volume

"independent of the quality of the space data;" and (4) from limited, repetitive, low-resolution surveys from aircraft at small selected test sites which shows that aircraft analog data can be used for general thematic mapping of small areas, but that, despite improved resolution, there was no increase in recognizability of features of a size significant in regional studies from the aircraft photos over those obtainable from space.

This evidence is supported by my professional judgment and that of our advisory committee in the National Research Council of the National Academy of Sciences. I wish to take this opportunity to reiterate that data from ERTS–A will be effectively used by the Interior Department and the related public. I firmly believe that efficiencies in resources and land-use surveys will result from this use and that these efficiencies will increase as we move forward toward an operational system.

Sincerely yours,

W. T. PECORA,
Director.

ERTS-A. & B.—RBV CAMERA—TYPICAL TARGET RESOLVING POWER

	Average ground resolution (feet per TV line)[1]		
	Ch. 1	Ch. 2	Ch. 3
Measured performance for high contrast target in laboratory (tube SEB 123)	150	150	165
Calculated performance for typical targets with standard atmosphere:			
Desert sand versus shadow	165	160	190
Average plant versus wet loam	(2)	210	275
Average plant versus dry loam	180	165	275
Average plant versus water	275	275	205

[1] Optical resolution corresponds to 2 TV lines.
[2] Inf.

UNITED STATES DEPARTMENT OF AGRICULTURE,
AGRICULTURAL RESEARCH SERVICE,
Washington, D.C., November 17, 1969.

MR. LEONARD JAFFE,
Deputy Associate Administrator, Office of Space Science and Applications, National Aeronautics and Space Administration, Washington, D.C.

DEAR MR. JAFFE: For more than 35 years the U.S. Department of Agriculture (USDA) has been acquiring high resolution aerial photography for measuration purposes; i.e., the precise measurement of the acreage of parity payment crops. In spite of repeated attempts to develop methods of species identification with this high resolution data, all results were failures.

Since early 1965 with NASA support, USDA has been conducting research on an entirely new concept of species identification and measurement. This has been variously called "tone signature analysis" or "multi-spectral analysis." They are the same and refer to the concept of recording the radiance of the terrain feature instead of the shape. Thus spectral resolution, rather than spatial resolution, becomes the fundamental measurement.

This concept has been under development for many years but only recently (1966) has airborne equipment been sufficiently well calibrated that high quality data can be generated. This equipment is a multispectral scanner and the success of the research sponsored by USDA at Purdue University in the automatic analysis of the scanner data has been widely reported in the scientific and lay journals.

In the case of a multispectral camera approach, this work was in a high state of development prior to the establishment of an earth resources survey program in NASA, but even here the principal investigator under contract to USDA, Prof. Robert N. Colwell of the University of California, has been involved in this development since its inception in the late 1950's and has continued his studies for us since 1965. His most recent multispectral camera research was done on the data from the S–065 experiment on Apollo 9. The spatial resolution on this flight was essentially the same as we expect from ERTS; i.e., 300–350 feet. The principal lines of research conducted by several investigators were:

1. Timber volume analysis.
2. Crop calendar development.
3. Range species composition and density.

The results confirmed our estimate of feasibility for all three which leads to a statement of purpose for ERTS: "As a prime experiment, USDA will conduct agricultural census studies with ERTS data."

Even before these studies were complete the Office of the Secretary of Agriculture wrote to the administrators of the following agencies of the Department:

1. Agricultural Research Service.
2. Forest Service.
3. Agricultural Stabilization and Conservation Service.
4. Soil Conservation Service.
5. Statistical Reporting Service.
6. Economic Research Service.
7. Cooperative State Research Service.
8. Foreign Agricultural Service.

In the letter the existing specifications, including spatial resolution of the image-forming sensors on ERTS, were described. The agencies were asked to determine what interest, if any, they had in participating in the experiment. They were to provide information on—

1. Where (latitude and longitude),
2. When,
3. How often,
4. Objectives of study, and
5. Manpower commitment.

A summary of the replies received to date is provided as an enclosure.

In view of the fact that I personally have worked on a day-to-day basis with the engineers at NASA Houston, NASA Goddard, and NASA headquarters, I have been able to monitor the development of specifications, the determination of feasibility, and the engineering progress of the ERTS payload. Whenever it was determined that there must be a sacrifice of spatial resolution or sensitivity, USDA has always voted to preserve sensitivity at the expense of spatial resolution. This has been going on since phase A and I am utterly amazed that anyone would think that this agency was not a party to every decision made.

I said in direct reply to such a question in Senate testimony that we, the user agencies, "designed" ERTS.

Sincerely,

A. B. PARKS,
Assistant to the Administrator.

U.S. DEPARTMENT OF COMMERCE,
ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION,
November 17, 1969.

Memorandum to: Dr. John E. Naugle,
Chairman, ERSPRC.
From: Administrator.
Subject: Proposed ESSA uses of ERTS data.

As I indicated in my testimony before the Senate Committee on Aeronautical and Space Sciences on May 1 of this year, ESSA expects to derive substantial benefits relating to its mission areas from the NASA earth resources technology satellite program. Our principal areas of application will be in oceanography, for such purposes as reconnaissance hydrography and identification of coastal changes for mapping purposes; and in hydrology for mapping the aerial extent of snow cover as an aid in forecasting water supplies and floods and in observations of the extent of flooded areas to improve the accuracy of flood forecasts. In addition to these direct uses for mission purposes, we anticipate the ERTS will provide an opportunity for us to evaluate the utility of high-resolution multispectral data for all of our mission areas. In meteorology, for example, it is anticipated that these data will have numerous research applications in such areas as the dynamics of severe local storms and the effect of scattered clouds on satellite measurements of surface temperatures. In addition to evaluating the telemetered data from television and scanning sensors on ERTS A and B, ESSA is also very much interested in the film recovery capability proposed for ERTS C and D since these data may be used for geodetic and other mapping mission applications. The sensors proposed for ERTS E and F will similarly be of great interest to us for both oceanographic and hydrologic research purposes. Evaluation of applications of high-resolution multispectral data which are expected from the ERTS program will probably have a major bearing on the sensors that will be carried on future ESSA operational environmental satellites.

We consider that the resolution proposed for the return beam vidicon on ERTS A and B will be adequate for most of these purposes. In particular, based on recent experimentation with aircraft photographs, we consider that resolution of about 200 to 400 feet on the ground (100–200 feet per TV line) should be excellent for snow mapping in the Midwest area and extremely helpful even in mountainous regions. (You might wish to note that my earlier reference to resolution in my testimony to the Senate committee and in my subsequent letter to Senator Anderson was with regard to resolution per TV line and thus this statement is compatible with statements I have made in the past.)

We are in the process of preparing a detailed statement of quantitative and qualitative ESSA requirements for data from ERTS A through F which will be forwarded to you in the near future.

John W. Townsend.
For Robert M. White.

U.S. NAVAL OCEANOGRAPHIC OFFICE,
Washington, D.C., November 17, 1969.

MR. LEONARD JAFFE,
Deputy Associate Administrator for Space Science and Applications (Applications), National Aeronautics and Space Administration, Washington, D.C.

DEAR MR. JAFFE: The development of remote sensors using the visible and near visible regions of the electromagnetic spectrum, such as those to be found on ERTS A and B, will have application to the measurement of certain ocean parameters. The 300- to 1,000-foot resolution, depending on scene contrast and illumination levels, of ERTS A through D are applicable to the measurement of ocean currents, sea radiance, detection of upwelling areas, current channels, sargassum, fresh water effluents, and shoreline configurations. These requirements are documented in table 1 and were generated prior to 1968 (enclosure (1)).

During the past 2 years it has become evident that less resolution may accomplish the measurement of other phenomena. Only two will be cited herein. First, it is known from TV imagery of the Tiros satellites that ice/water interfaces are measurable with several mile resolution and not those resolutions listed in table 1. With resolutions on the order of 500 feet much more can be done in sea ice research. These include deformation features, open-water leads, divergence, freezing, and rafting. Second, Gemini and Apollo photography of coastal areas has shown the data in table 1 with regard to measurement of sediment transport to be in complete error. There is every indication that 500-foot surface resolution is more than adequate for measurement of sediment transport.

ERTS A and B, while not designed for the specific oceanic requirements, will be used for observations important to coastal oceanography. Equally important, efforts are underway to mount an intensive study of the ice motion, deformation and distribution of sea ice features in the Arctic Basin. This tentative project, termed Project AIDJEX (Arctic Ice Deformation Joint Experiment) is being pursued through the efforts of several United States and Canadian Universities and governmental agencies. The project, in brief, will involve the establishment of several manned and unmanned instrumented stations over a wide area on the Arctic Sea ice for the simultaneous collection of air-ice stress data, ice-water stress data, navigation data for deformation of relative distance changes between stations, and airborne remote sensing data to map the ice field deformations for correlation with the atmospheric and oceanographic conditions. ERTS A is a potential research tool to assist in this study.

It is important for us all to realize that there is no substitute for the synoptic view of the world's oceans as observed from space. I am sure that as time proceeds the space sensor needs for oceanography will be modified as we learn from other satellite systems as well as the research aircraft program. I feel the importance of ERTS A is to involve the oceanographic community in space techniques of remote sensing which will assist in the preparation of optimum sensors for specific oceanographic applications.

Sincerely,

F. L. SLATTERY,
Captain, U.S. Navy, Commander.

Enclosure. (1) Spacecraft oceanography project review of NASA earth resources aircraft program and remote sensing experiments, January 1968.

TABLE 1.—OCEANOGRAPHY SUMMARY OF SENSOR REQUIREMENTS AND OBJECTIVES

Application	Phenomenon	Characteristic	Detector	Resolution		Spectral band
				Meters	Degrees centigrade	
Shipping	Sea state	Surface roughness	Microwave imager	300 to 10 km	0.3 to 0.7	6 and 19.4 gc.
			Microwave radiometer	3 to 30 km	0.5 to 2.0	1.46 to 4.29 cm.
			Scatterometer	1 to 7 km		4, 21, 10, 75 cm.
		Sea radiance	Multispectral camera	30 to 1,000		0.6 to 0.9μ.
	Currents	Surface temperature gradient	IR imager	30 to 2,000	0.5	8 to 13μ.
			IR radiometer/spectrometer	30 to 300	0.3 to 0.5	0.8 to 1.5μ.
			Microwave imager	300 to 10 km	0.3 to 0.7	6 and 19.4 gc.
			Microwave radiometer	3 to 100 km	0.5 to 2.0	1.46 to 4.29 cm.
		Sea radiance	Multispectral camera	30 to 50		0.7 to 0.9μ.
		Sea slope	Laser	15 cm to 3 km		0.3 to 0.9μ.
	Shoals	Temperature anomalies	IR imager	30 to 2 km	0.5	8 to 13μ.
			IR radiometer/spectrometer	30 to 300	0.1 to 0.2	0.8 to 1.5μ.
		Water color	Multispectral camera	30 to 50		0.48 to 1.0μ.
		Wave refraction	Metric camera	20 to 30		.6 to .9μ.
			Multispectral camera	30 to 50		0.48 to 1.0μ.
	Ice	Water/ice interface	IR imager	30 to 2,000	0.5	8 to 13.0μ.
			IR radiometer/spectrometer	30 to 300	1.0 to 2.0	0.8 to 1.5μ.
			Metric camera	20 to 30		0.4 to 0.9μ.
			Multispectral camera	30 to 50		0.4 to 0.9μ.
			Microwave imager	300 to 10 km	0.3 to 0.7	6 and 19.4 gc.
			Microwave radiometer	3 to 10 km	1 to 5	1.46 to 4.29 cm.
			Radar imager	30 to 1,000		3.00 to 19.3 cm.
Sea food production	Upwelling	Surface temperature gradient	IR imager	30 to 2,000	0.5	8 to 13 μ.
			IR radiometer/spectrometer	30 to 150	0.3 to 0.8	0.8 to 1.5 μ.
			Microwave imager	300 to 10 Km	0.3 to 0.7	6 and 90.4 Gc.
			Microwave radiometer	3 to 10 Km	0.3 to 1.0	1.46 to 4.29 Cm.

	Currents/eddies	do	IR imager	30 to 2,000	0.5	8 to 13 μ.
			IR radiometer/spectrometer	30 to 300	0.3 to 0.8	0.8 to 1.5 μ.
			Microwave imager	300 to 10 Km	0.3 to 0.7	6 and 19.4 Gc
			Microwave radiometer	300 to 10 km	0.3 to 1.0	1.46 to 4.29 Cm.
		Water color, luminance	Multispectral camera	30 to 50		0.7 to 0.9 μ.
	Oil slicks	Water color	do	30 to 50		0.3 to 1.0 μ.
		Vapor spectra	Absorption spectrometer	70 to 100		0.25 to 0.6 μ and 2.5 to 16 μ.
	Bioluminescence, plankton	Water color, sea radiance	Multispectral camera	30 to 50		0.5 to 0.9 μ.
	Heat flow	Surface temperature gradient	IR imager	30 to 2,000	0.5	8 to 13 μ.
			IR radiometer/spectrometer	30 to 300	0.3 to 0.8	0.3 to 0.5 μ and 0.8 to 1.5 μ.
			Microwave imager	300 to 10 Km	0.3 to 0.7	6 and 19.4 Gc.
			Microwave radiometer	3 to 10 Km	0.3 to 1.0	1.46 to 4.29 Cm.
Ocean charting	Doubtful shoals	Temperature anomalies	IR imager	30 to 2,000	0.5	8 to 13 μ.
			IR radiometer/spectrometer	30 to 300 Km	0.1 to 0.2	0.8 to 1.5 μ.
		Water color	Multispectral camera	30 to 50		0.48 to 0.9 μ.
		Wave refraction	Metric camera	20 to 30		0.6 to 1.0 μ.
			Multispectral camera	30 to 50		0.6 to 0.9 μ.
	Current channels	Surface temperature gradient	IR imager		0.5	8 to 13 μ.
			IR radiometer/spectrometer	30 to 300	0.5 to 0.8	0.8 to 1.5 μ.
			Microwave imager	30 to 10 Km	0.3 to 0.7	6 & 19.4 Gc.
			Microwave radiometer	300 to 100 Km	0.5 to 2.0	1.46 to 4.25 Cm.
		Water color	Multispectral camera	20 to 50		0.3 to 0.9 μ.
		Luminance variations	Metric camera	20 to 000		0.3 to 1.0 μ.
	Archipelago	Relative positions	do	20 to 30		0.4 to 0.9 μ.
			Multispectral camera	20 to 50		0.5 to 0.9 μ.
		Shoreline configuration	Radar imager	30 to 1,000		3.00 to 19.3 Cm.
	Sargassom, kelp, etc	Temperature anomalies	IR imager	30 to 2,000	0.5	8 to 13 μ.
			IR radiometer/spectrometer	30 to 300	0.1 to 0.2	0.8 to 1.5 μ.
		Water color	Multispertral camera	20 to 50		0.3 to 0.9 μ.
	Selective absorption	Bottom reflectivity	Metric camera	20 to 50		0.48 to 1.0 μ.
Coastal marine processes	Fresh water effluents	Temperature anomalies	IR imager	30 to 2,000	0.5	8 to 13 μ.
			IR radiometer/spectrometer	300 to 100 Km	0.5 to 1.5	10 to 12 μ.
	Sediment transport	Water color	Multispectral camera	20 to 50		0.3 to 0.9 μ.
	Shoreline configuration	Land/water interface	Metric camera	20 to 100		0.7 to 1.0 μ.
			Radar imager	30 to 1,000		3.00 to 19.3 Cm.

STATEMENT OF DR. JOHN DENOYER, DIRECTOR OF EARTH OBSERVATIONS PROGRAMS, OFFICE OF SPACE SCIENCE AND APPLICATIONS

EARTH OBSERVATIONS PROGRAMS

Mr. Chairman and members of the committee, it is my pleasure to present to you a review of the NASA Earth observations programs, covering the areas of meteorological satellite programs, and Earth resources survey programs. Many major decisions concerning the environment, resources, and total ecology must be made during the decade that has just started. Conventional methods of information gathering, analysis, and interpretation have become inadequate to provide a sound basis for these decisions. The Earth observations programs are dedicated to developing methods to provide this timely information and to working in close cooperation with the user agencies that have operational responsibilities in these critical areas.

Earth observations represent an increasingly significant portion of the OSSA and NASA program. There are several reasons why we should continue to move aggressively into the fields of Earth observations and move now. In brief form, these reasons can be stated as follows:

(1) Improvements in space technology and verification of our ability to produce suitable space sensor systems have reached the point where valuable products can be provided to the resource and environmental scientists.

(2) Verification of the useful nature of space-acquired remote sensor data has been obtained by many investigators in the resource and environmental scientific community.

(3) Ability to use the data is being developed rapidly in the user agencies, the world of commerce, and the academic community.

(4) Guidance has been provided through the 1967–68 NAS/NAE Summer Study at Woods Hole on all space application disciplines, and more recently in 1969 by the NASA Summer Study at Williams College, Massachusetts, on the application of space and astronomical techniques to Solid Earth and Ocean Physics. The results from both conferences clearly demonstrate that attainable and significant contributions can be obtained through application of space technology to problems in these areas.

(5) Continuing research and development, and the results from experimental satellites in the meteorological program are exceeding the expectations of the original space concepts. We fully expect these advancements in meteorology to continue, and we expect a parallel and possibly even more significant history of valuable application and development opening new horizons for improved methods to help us face the critical resources and environmental crises of the nation and the world.

The Space Task Group, in its Report to the President, dated September 1969, recognized these capabilities and requirements in its conclusions and recommendations by stating:

"We have found increasing interest in the exploitation of our demonstrated space expertise and technology for the direct benefit of mankind in such areas as earth resources, communications, navigation, national security, science and technology, and international participation. We have concluded that the space program of the future must include increased emphasis upon space applications."

Objectives

The basic objective in the Earth observations programs in NASA is to perform the research and development of space technology needed by the user community that is responsible for the management of the resources and the environment. This research and development include vertification through prototypes of operational satellites and/or aircraft experiments. This research and development also makes it possible to provide:

(1) Experimental data for application to the users' specific problems.

(2) Decision criteria for evaluating costs, value and adequacy of systems, and rates of transition from experimental system to operational systems.

(3) Development of methods and capabilities for processing and analyzing the large quantities and detailed information content of data acquired from space.

METEOROLOGICAL PROGRAMS

The goals of the meteorological program have been defined as follows: "To understand the physics of the atmosphere, to bring about improved prediction of weather, and to establish a basis for eventual weather modification and climate

control." NASA is conducting an active, dedicated research and development program designed to provide global observations of the earth's atmosphere from space to assist in the achievement of these goals.

Three specific objectives have been established for the meteorological satellite program in meeting the requirements for global meteorological data. These objectives are shown on chart SR 70–126.

The first objective, *global cloud cover imaging*, is the capability to obtain the information that enables us to identify and track storms and to observe their formation and dissipation. Information of this nature is valuable in the analysis of current weather and the prediction of 24 to 36 hour changes. The present operational meteorological satellite system, which serves the Environmental Science Services Administration, is the first-generation system developed by NASA and constitutes a major step toward this objective.

The second objective, *continuous viewing of the atmosphere*, responds to the need to keep significant portions of the Earth's cloud cover under constant surveillance, providing essential information on rapidly-developing weather phenomena, such as thunderstorm and tornado formation, growth, and decay. This information is valuable for short-period (zero to 12 hours) forecasts. The technological basis for achieving this objective has already been demonstrated by our successful experimentation with the applications technology satellites (ATS 1 and 3), launched in 1966 and 1967, which are providing near-continuous observations of the eastern Pacific and western Atlantic areas.

The third objective, *global quantitative measurement of the atmospheric structure*, will provide quantitative information on atmospheric parameters, such as the temperature, wind, water vapor content—global information on the three-dimensional structure of the atmosphere, and its temporal and spatial variations. These data will vastly increase our knowledge of global weather conditions, increase our understanding of atmospheric processes, and, when used in conjunction with mathematical models of global atmospheric behavior, may make possible extended period (2 to 3 weeks) forecasts. The first major breakthrough toward this objective was made in 1969, with the successful measurement of the vertical distribution of temperature, ozone, and water vapor content from the Nimbus 3 satellite.

Progress toward reaching these three objectives of the NASA meteorological satellite program has made it possible to plan for a very important international cooperative research effort aimed at increasing understanding of the general circulation of the atmosphere and establishing the mathematical and physical basis for long-range weather prediction. This global atmospheric research program (GARP), administered and coordinated by the International Council of Scientific Unions and the World Meteorological Organization, is planned for the 1975 time frame, with participation by scientists and technologists from universities, industry, and government services of many countries. The GARP program will use computational methods to design and test theoretical models of atmospheric behavior, and to further develop these models through observational and experimental studies of the atmosphere.

Many of the observational and experimental studies will be accomplished by using the combination of existing operational meteorological satellites and the NASA experimental earth observations satellites. The availability of these satellites will make a major contribution toward providing global cloud cover data, continuous viewing of the atmosphere, and quantitative measurements of the atmospheric structure for the GARP program. The concept of GARP requires global atmospheric observation and measurement capability. This capability has become possible through the successful development of the meteorological program. The atmospheric sounding capability demonstrated by the Nimbus 3 satellite is of special importance.

Accomplishments during 1969

Probably the most significant achievement of the past calendar year was the successful measurement from space of the vertical distribution of temperature, ozone content, and water vapor content in the atmosphere, by sensors installed on Nimbus 3. This satellite, launched on extremely short schedule following the unsuccessful launch of its predecessor, Nimbus B, represents our first real step toward achievement of our third objective, quantitative measurement of the atmospheric structure. Two experimental sensors, the satellite infrared spectrometer (SIRS) and the infrared interferometer spectrometer (IRIS), have demonstrated the feasibility of obtaining atmospheric temperature soundings from

space. The first SIRS indirect temperature sounding (chart SA 69–645) was derived from satellite data obtained in the vicinity of Kingston, Jamaica, on April 14, 1969. The space-acquired data correlated almost exactly with data obtained by conventional radiosonde procedures at this same location and at approximately the same time. Chart SR 70–147 represents soundings of temperature, ozone content, and moisture content (mixing ratio) obtained from the IRIS sensor in the vicinity of Montgomery, Ala., on April 23, 1969, also showing excellent correlation with conventional sounding techniques. This new capability, which represents a genuine breakthrough in meteorological technology, will enable us to obtain quantitative data from the entire globe, rather than from the conventional stations, which, for the most part, are located in the temperate belt of the northern hemisphere. The Nimbus 3 satellite has also demonstrated excellent long life characteristics. On February 6, 1970, the spacecraft successfully completed 4,000 orbits, 9 months and 23 days after launch.

Plans are being made to exploit the principles and techniques that have been developed through the successful Nimbus 3 experiment. The next Nimbus spacecraft, Nimbus D, has been fabricated, and launch is scheduled for spring of 1970. Nimbus D will contain improved versions of the quantitative vertical sounding sensors flown on Nimbus 3, as well as newly developed infrared sensors which will provide improved resolution and higher accuracies for vertical sounding. Two additional spacecraft, Nimbus E and F, scheduled for launch in 1972–73, respectively, will incorporate microwave and advanced infrared sounding techniques designed to extend the vertical range and versatility of our quantitative sounding capabilities, and to provide soundings below the level of cloud layers which presently limit our capability.

The objective of the meteorological satellite program to obtain global cloud cover imaging, has been partially satisfied by the TIROS operational satellite (TOS) system which currently serves the meteorological community. This satellite system provides local and global cloud cover data on a daily basis to users throughout the world. Chart SA 69–383 illustrates the dual satellite nature of this system, in which the global cloud cover satellite provides worldwide data to the National Environmental Satellite Center for global analysis and forecasts, while the local cloud cover satellite provides limited area data to regional weather centers for local analysis and forecasts.

Chart SP 67–15411 contains a sample of the global analysis obtained from the global cloud cover satellite. Chart SA 70–304 is a sample of the product of the local cloud cover satellite, covering most of North America. Over 500 ground stations are now in existence throughout the world for the reception of local cloud cover data. During 1969, one global cloud cover satellite (ESSA–9) was launched by NASA as the newest component of the TOS system. Data provided by these satellites were used daily in preparation of weather analyses and forecasts by the U.S. Weather Bureau, Army, Navy and Air Force, and by meteorological organizations throughout the world.

Developmental work was also carried out on a second-generation operational meteorological satellite system, which has been designated the improved TIROS operational satellite (ITOS) system. Design and fabrication of TIROS–M (chart SR70–136), the operational protoype for this new system, was completed, and the satellite was launched successfully on January 23, 1970, and designated ITOS–1. ITOS–1 is now being tested in space. It is providing day and night observation of cloud cover, and combines in one spacecraft the global and local capabilities previously requiring two spacecraft of the TOS system. The ITOS system will provide improved capability along with the economy of only requiring half as many spacecraft for cloud cover observations.

ATS 1 and 3 (chart SR 70–176) have continued to provide near continuous observation of cloud cover of the eastern Pacific region (ATS–1) and the western Atlantic region (ATS–3). These satellites, designed as experimental vehicles for the advancement of satellite technology, have proven so useful that their products have been incorporated into routine weather observations. They observe the earth from synchronous altitude, producing a new image as often as every 20 minutes of an area of 3,000 mile radius around the equatorial subsatellite point. This near continuous viewing capability meets some, but not all, of the requirements for meeting the objective of continuous viewing of the atmosphere. This capability enabled us to observe the formation and progress of Hurricane Camille during daylight hours. Satellite observations made it possible for the U.S. Weather Bureau to issue exceptionally accurate forecasts of the time, location, wind speeds, and wave heights for the gulf coast.

In view of the success and operational importance of the ATS satellites, studies have been conducted during the past year toward the development of a synchronous meteorological satellite (SMS) which will serve as a prototype for an operational system. Feasibility and project definition studies for the SMS have been completed, and a system has been designed which will employ flight-proven hardware and concepts and existing launch vehicles.

NASA, in conjunction with the Department of Commerce, other government agencies, and scientific members of the academic and industrial communities, has participated in the organizational and conceptual studies for the Global Atmospheric Research Program. These studies have identified requirements for global meteorological data and have defined a concept of a global satellite observing system for the acquisition of these data. NASA is participating in studies to determine the extent of the U.S. participation in this program, and in preliminary studies for the analysis of technical approaches.

FUTURE PROGRAMS

Our future programs in meteorology are directed to refining methods that have been successfully demonstrated, to exploiting the successes achieved in the meteorological satellite program, and to accomplishing major developments needed for reaching each of the stated objectives.

First, we plan to improve upon the highly successful TOS system for global cloud cover observations with the ITOS system. The instruments on ITOS include a high-resolution infra-red sensor for viewing cloud cover during daylight and darkness. The ITOS system, like the current TOS system, will be developed, procured, and launched by NASA, and funded and operated by the Department of Commerce, to provide local and global cloud cover data to the Weather Bureau, the Department of Defense, and other user agencies in this country and abroad

Similarly, we plan to exploit the successes of the Applications Technology Satellites 1 and 3, which have given us our first capability to achieve continuous observations of selected portions of the earth's cloud cover. Our preliminary studies have indicated the feasibility of a Synchronous Meteorological Satellite (SMS) and we plan to initiate development of SMS–A in fiscal 1970. Launch of this prototype spacecraft is scheduled for early 1972. Its successful deployment will serve as the basis for an operational system. This initial capability will be limited by current sensor technology to cloud cover observations; however, we are also looking beyond this initial phase, and are considering a dedicated satellite of the ATS-series to serve as a platform for continuing our R. & D. in continuous viewing and sounding of the atmosphere.

The successful sounding of the atmosphere by Nimbus 3 has focused the attention of the meteorological community on plans for further development of this capability. Nimbus D, the next spacecraft in this series of R. & D. vehicles for the development of advanced techniques and concepts, will be launched in 1970. It will contain advanced sensors for determining the vertical temperature structure and additional experimental sensors such as a temperature/humidity infrared radiometer, a monitor of the water vapor content of the atmosphere, and a more refined worldwide data collection system. Improved spatial and spectral resolution of the sounding sensors is expected to provide higher accuracies of measurement.

The next major milestone in our program to quantitatively measure the structure of the atmosphere will occur with the launch of Nimbus E and F in 1972 and 1973. These satellites will make the first exploratory use of the microwave region of the spectrum for atmospheric sounding. The microwave spectral band offers the attractive possibility of sounding the atmosphere despite the presence of cloud layers which restrict sounding by infrared techniques. In addition to the microwave sensors, Nimbus E and F will contain infrared sensors for comparison with and evaluation of the microwave sensors and will also test the feasibility of data relay and satellite tracking techniques using polar-orbiting satellites.

All of these meteorological satellite development programs will contribute to the technology required by the current concept of the global satellite observing system for GARP. However, the full requirements for global quantitative data will probably not be met by the operational satellite systems envisioned for the 1975 time frame; therefore, a detailed comparative analysis and preliminary system design study will be conducted to identify the advanced technology and

advanced development tasks required to support the global satellite observing system concept and to identify the optimum participation by the United States in the development and operation of this international program. This study will provide information essential to the design of the satellite observing system for GARP.

EARTH RESOURCES SURVEY PROGRAMS

Next, I wish to discuss our earth resources survey program. We cannot claim that this program is as far advanced as the meteorological satellites program since we do not have experimental or operational earth resources satellites in orbit. We have, however, developed an active and productive program by conducting prototype experiments through the aircraft program, using earth oriented space photography obtained through the manned space flight programs, and we have tested an analog of the TV camera systems that are planned for the Earth Resources Technology Satellites (ERTS) A and B. The test of the analog of the ERTS TV camera system was accomplished by using conventional cameras, filters and film on the Apollo 9 mission.

These experimental programs have served as data sources for many investigators and have been oeveloped by NASA in close cooperation with the user Government agencies, Department of Agriculture, Department of Interior, Department of Commerce, and the Navy Department. The mechanism for coordination of these activities continues to be the interagency Earth Resources Survey Program Review Committee (ERSPRC). (Chart SR 70–111.) The scientific community, outside of Government agencies, has also been included in this program through direct NASA support and through cooperative programs with the user agencies.

NASA, in close cooperation with the user agencies, is developing techniques for economical use of satellites for surveying the resources of our earth, measuring the changes in these resources, and monitoring many environmental and ecological relationships. Within this overall purpose, the following specific objectives can be defined: (Chart SR 70–85.)

To define those practical problems to which space technology can make a beneficial contribution, by providing repetitive, synoptic observations and measurements from space.

To conduct research in multispectral sensing to determine performance of remote sensors and to establish signature recognition criteria.

To develop sensors, subsystems, and experimental spacecraft.

To determine the scope and configuration of future operational systems (including spacecraft, aircraft, and ground segments) to accomplish necessary surveys of earth resources and for global environmental monitoring.

To develop data handling techniques for the processing of earth resources survey data.

To assist user agencies in developing a community of experts prepared to utilize space-derived remote-sensing data.

Reaching these objectives will provide a very important contribution to man's ability to cope with his increasing resources and environmental problems on earth. Even more important, as with the meteorology program, there may be capabilities and functions that these earth observations can serve that can only be assessed after experimental, space-acquired data are availble.

Accomplishments during 1969

The great strides which have been made in space technology during the last decade now provide us with the capability to obtain a new view of our planet earth. During the past year, several significant accomplishments have advanced the Nation's Earth resources survey programs; these will be reviewed briefly.

The S065 experiment on Apollo 9 was a highlight of the Earth resources survey program. This multispectral photographic camera experiment that was designed to be an analog of the ERTS television cameras provided the first space-acquired pictures specifically designed for earth resources objectives. An example of Apollo 9 S065 multispectral imagery is shown in chart SR 69–544. This is the now-familiar Salton Sea-Imperial Valley area. The images shown are in color IR, and in green, red, and near infrared bands approximately the spectral bands planned for ERTS. These and similar data have been used to verify the capability of the green band for water penetration, the red and near IR bands for crop and feature identification and the near IR band for plant stress determination and identification of surface water.

In addition to the primary objective of verifying the choice of spectral bands for the ERTS TV cameras, an experiment was conducted in conjunction with the S065 experiment to evaluate the utility of simultaneous spacecraft-aircraft imagery and sequential aircraft imagery for inventorying resources. This is outlined in Chart SR 70–104 where the concurrent use of high- and medium-altitude aircraft is indicated. The areas of the United States over which simultaneous spacecraft and aircraft imagery was obtained are indicated in chart SR 70–191. The two areas in the west include the Imperial Valley, Calif., and Mesa, Ariz., agricultural test sites; the areas in the east were studied by the Forest Service in a timber inventorying experiment.

Comparative samples of color IR photography obtained from spacecraft, high-altitude aircraft and low-altitude aircraft are shown in the next three charts, SR 70–323, SR 70–324, and SR 70–325. The area shown is the Imperial Valley agricultural test site just above the Mexican border. The spacecraft photograph is at a scale of 1 : 2,600,000, the high altitude aircraft photograph is at a scale of 1 : 940,000, and the low altitude aircraft is at a scale of 1 : 68,000. It may be of interest to note the clear demarcation of the Mexico-United States border due to differences in land-use practices. The twin cities of Mexicali, Mexico, and Calexico, Calif., are clearly seen in chart SR 70–323.

The test fields, as seen in Chart SR 70–325 are sugar beets (fields 1 and 2) and alfalfa (fields 3, 4, and 5). It is of interest to note that while the cultivation patterns first become evident in the 1 : 68,000 photograph, the tonal signatures are well preserved in the small-scale spacecraft photograph. The e types of tonal signatures, when combined with sequential coverage, have established the feasibility of constructing crop calendars which, in turn, can be used for identification, vigor, and yield estimation.

The time variability of crop signatures is illustrated in the next chart (SR 70–183) which shows three color IR photographs of the same agricultural test site in Mesa, Ariz., taken at 1-month intervals, using a high-altitude aircraft. The photograph on the left was taken concurrently with S065 (Apollo 9). A typical wheat field and a typical sugar beet field are indicated on the photographs and the tonal progression and be followed from left to right during the growing season. The wheat field shows a very distinctive change in tone in the May photograph due to harvesting having taken place. The sugar beet field shows some tonal change as the growing season progresses. In addition, it can readily be noted that there are significant overall tonal variations in the three images probably due to film, exposure, and processing differences. This illustrates the major difficulties in maintaining quality control when photographic color film techniques are used.

In the Earth resources survey S.R. & T. program, we have been pressing for establishment of quantitative relationships in the analysis of remote sensing. Some notable work has recently been demonstrated by the Forest Service in the application of Apollo 9 (SO65) spacecraft imagery, together with concurrent aircraft and ground data, to the practical operational problem of timber inventorying. The principal area inventoried consisted of 5,000,000 acres of the Mississippi Valley, in the States of Louisiana, Mississippi, and Arkansas, as shown in the Apollo 9 color photo in chart SR 70–15303. The mathematical formulation is based on a multistage sampling analysis technique indicated in chart SR 70–189. The calculated timber volume (V) is determined by five stages of sampling and calculation with the first stage being dependent directly on space imagery, the three intermediate stages are dependent on aircraft coverage, and the last stage depends on detailed, but limited, three volume measurements on the ground.

The calculations carried out in this pilot inventory of 5,000,000 acres have demonstrated a reduction in expected error in the timber volume estimate from 31 percent to 13 percent due directly to the ultilization of the space photography. This represents a significant reduction in error that can be obtained by combining available space-acquired data with efficient use of aircraft and ground coverage. Alternatively, the space-acquired data could have been utilized to reduce the required aircraft and ground effort by a ratio of approximately 6 :1, while maintaining the original 31-percent error in the estimate of timber volume. These 6 :1 savings apply directly to the aircraft flight hours, the maintenance crews, the photointerpreters who evaluate the large-scale aerial photos, and the field crews who locate the plots on the ground and measure the sample trees.

This application example demonstrates the potential for practical savings in operational inventorying problems through exploiting the complementary nature of space and aerial imagery in a statistical sampling approach. The technique is applicable to other earth resources inventorying problems.

Automatic data processing will be essential for many broad scale applications when ERTS data become available. Experiments using the Apollo 9 (SO65) photographs demonstrate that certain automatic processing methods can be applied to ERTS data to help solve important problems. Chart SR 70–309 shows a color infrared photograph of snow cover in Arizona. The processed photograph shows both thin snow and thick snow. The ability to separate thick from thin snow was an unexpected result and depends on vegetation protruding above the snow cover. Chart SR 70–310 is an example of an automatic-process map of vegetation in the Phoenix, Ariz., region. This map was prepared by the same type of density slicing used in the snow cover analysis. Natural vegetation and cultivated areas can be further subdivided on the basis of shape of the region and color on the original photograph. Chart SR 70–311 shows a photograph of the region northeast of Montgomery, Ala., with an automatic-process map of surface water prepared by photographic enhancement methods. The ability to obtain automatic presentations of these important parameters is encouraging. We expect to make additional progress by using additional properties of these multispectral photographs.

Significant progress is also being made in the area of automatic classification of earth features using data obtained from multispectral scanners. The original work done at Purdue University was focused on crop identification and considerable success has been achieved. More recently, attempts have been made to extend these identification techniques to other types of earth features. Some promising results in automatic soil classification are illustrated in chart SR 70–15302. The area shown is an agricultural test site in Tippecanoe County, Ind. Digitized data from line scan information obtained with the University of Michigan multispectral scanner were processed. The left-hand image represents the classification of soils by standard color indices. The right-hand image shows the same test area classified according to organic matter content. In both cases, the automatic classifications correlated over 90 percent correct when compared with ground truth measurements. In addition, it was found that once the organic content exceeds 2 percent, it becomes the dominant factor in the color of the soil. It appears possible, therefore, to use color to determine organic content automatically.

The automatic digital classification techniques are being extended into the geological area. A promising example of automatic terrain classification is shown in chart SR 70–184. Ten terrain classes have been identified in a test area in Yellowstone National Park. The results of three classification experiments are shown. In the top of the chart, the four optimum spectral bands were used; in the middle, the three proposed ERTS bands were used; and, in the bottom, a thermal IR band was substituted for the ERTS green band. It is significant to note (1) that all three criteria produced relatively high levels of correlation with ground truth (81–86 percent) and (2) that the ERTS bands produced very nearly the same accuracy (82 percent) as the four optimum bands (86 percent). This indicates considerable promise for automatic terrain classification from ERTS data.

We have been examining the application of ERTS A and B data to oceanographic uses. An Apollo 9 color photograph of Cape Lookout, N.C., is shown in chart SR 70–181. This image has been color separated into two black and white images as shown in the next two charts. Chart SR 70–185 represents what would be seen by the ERTS red band and chart SR 70–186 represents what would be seen by the ERTS green band. The red band shows only surface and shallow water features such as sediment, shoals, etc., while the green band penetrates to greater depths. Thus, one may conclude that coastal processes, such as large-scale sedimentation flow pattern, together with the smaller-scale behavior in the inlet areas, potentially will be observable in the green and, perhaps, red bands of ERTS A and B data.

Actual depths of the water and effective distribution of sediment in the vertical water column are being quantified by means of experiments involving the Ben Franklin research submersible to obtain measurements during its recent voyage in the Gulf Stream. The experiments involved test panels of known reflective characteristics mounted on the top of the submersible. These test panels were detectable down to depths of 25 meters.

Parts of the Apollo 9 photography over the Gulf of Mexico and Caribbean Sea indicated inadequacies for ocean color determination. These results will be used to guide us in determining the optimum spectral regions and required sensitivities for future ERTS missions for oceanographic investigations.

Major program accomplishments during the past year have been the completion of preliminary analyses and the selection of contractors to proceed with system definition and design for the ERTS A and B satellites. The design specifications for these satellites have been reviewed and approved by the Earth Resources Survey Program Review Committee (ERSPRC). As a result of a competitive procurement, General Electric and Thompson-Ramo-Woolridge have been selected (chart SR 79–91) to perform the phase B/C study to define the spacecraft and the data management system.

The concept and principal mission goals of ERTS A and B, scheduled for launch in 1972 and 1973, respectively, are indicated on chart SR 70–90. These spacecraft will orbit the earth at 496 n.m. altitude, in near polar orbit, providing repeated coverage of the earth on a 17-day schedule. The principal objectives are to (1) determine by operation in space the usefulness and efficiency of an earth resources survey satellite system, (2) flight test sensors, and (3) provide earth resources survey data products to the user community. It is expected that analysis of the data acquired by ERTS A and B will provide significant information for each of the listed objectives. Our boackground studies and the experimentation which we have conducted in the laboratory, in the field, and by aircraft over the past several years, as well as analysis of photography acquired by the Gemini and Apollo flights, provide a substantial basis for expecting successful achievement of these objectives by ERTS A and B. The flow of data from ERTS A and B will provide raw, uninterpreted data to the user community. The user community will, in turn, produce the products listed in the chart.

Products to be developed by the user community will include: photo images at about a 1:1,000,000 scale, photo images of large geological features, land-use plots, coastal area plots, and snow covered plots. These can all be derived from imagery obtained at the spectral and spatial resolution performance capabilities specified for the ERTS A and B sensors. The repeated coverage each 17 days provided by the ERTS A and B orbits will allow additional information to be extracted about time-dependent phenomena such as the variations in snow cover which are related to water runoff and abundance, as well as the seasonal variations in color and tone relating to agriculture, rangeland and forestry phenomena. Our experience with the limited data that have been available indicates that these time-dependent phenomena often reflect illusive features related to geologic and hydrologic characteristics. The data will also provide a means to further develop and refine systems to extract and apply the space-acquired information. As a consequence of the length of time for mission operation, it should be possible to accurately assess the performance of the sensors and ancillary data transmission and reproduction systems. The flight test information gained during the ERTS A and B missions is expected to provide extensive system engineering data for the refinement of follow-on missions.

The principal performance parameters of the sensors proposed for ERTS–A are indicated on chart SR 70–167. The selection of these sensors reflects a careful consideration of the current state of sensor technology, the scheduled launch date of ERTS–A, and the data use and format requirements of the user community.

The selection of a high-resolution TV system capable of recording images in three regions of the visible and near IR spectrum is based primarily upon the need to continuously and repeatedly acquire images of the best possible spatial resolution and geometric characteristics of large surface areas. The provision of a capability for acquiring these images in the three different spectral bands (red, green, near IR) selected and approved by the user agencies allows for intercomparison of spectral responses which assist in identifying various earth resources phenomena. The image format (100×100 n.m.) is determined largely by the desire to obtain ortho-photo images which are map-like so that rectification requirements are kept to a minimum. Chart SR 70–302 illustrates this orthographic character. Cultural features and location names from the most recent (1970) compilation for this 1:250,000 map have been superimposed on a mosaic of two Apollo 9 photographs. Orthography has been maintained, information content has been increased, and the Apollo 9 photograph is more up-to-date than the map.

The four-channel scanner (red, green, near-IR, IR) provides an extension in spectral coverage to include important longer IR wavelengths. However, the primary feature which the scanner provides, and which is not readily available from the TV camera system, is the inherent capability of the scanner data for automated analysis by digital computers. The feasibility of automatically classi-

fying various earth resources phenomena has been demonstrated by experimentation with aerial scanner data. The ERTS–A scanner will provide a means to extend the technique of automated information extraction to include data acquired from orbital altitudes on a repetitive basis over large areas.

The data collection system was selected as a candidate for ERTS–A in order to test the feasibility of repetitively collecting and relaying a comprehensive sequence of time-variant data from earth-based sensors. Typical sensors would measure and transmit to ERTS–A parameters such as stream flow rates, water content of snow, moisture, and temperature. ERTS–A would accumulate these data and read them out to ground receiving stations. These in situ "ground-truth" type data would be utilized in conjunction with the return beam vidicon and scanner images in conducting user-oriented data utilization experiments.

Preliminary studies have indicated the rate and volume of data expected from ERTS A and B are large, and these data will require great care in handling to presreve the quality of the original sensor responses. Chart SR 70–192 indicates the essential components of the data handling and control system envisioned for use with ERTS A and B, consisting of the command and data telemetry links, the receiving stations, the operations control center at Goddard Space Flight Center (GSFC), and the NASA data processing facility, also at GSFC. We are working closely with the user agencies and endorse their plans to serve as major distributors and bulk processors of the data. NASA will also work with the user agencies to rapidly develop their capability for operating receiving stations and assuming operational control when appropriate.

Aircraft were used effectively during 1969 to provide experimental remote sensor data to prepare for and support the future ERTS A and B missions. The Earth Resources Survey Aircraft program has produced most of the experimental data used to date. It is the facility we have used to define and develop remote sensor systems. The aircraft provides a flexible large platform on which we can carry combinations of developmental sensors for the required intercomparison of performance and utility (chart SR 70–170). The aircraft observation program has been executed in cooperation with Federal user agencies, including the Departments of Agriculture, Interior, Commerce and Navy, and other qualified investigators, to provide a broad base of resource and environmental data.

The remote sensors that are being evaluated are (a) those that actively "illuminate" targets and receive reflected energy, and (b) those that operate as passive monitors of natural and cultural emissions or reflections from the earth's surface. With these types of sensors, it is possible to obtain multispectral data of terrestrial phenomena for disciplinary analysis. Rather than going directly to instruments in spacecraft, user agencies and cooperative scientists are obtaining precursory data from multispectral instrumentation in aircraft. The data are used to evaluate the sensors over specific instrumented test sites and to develop a solid foundation for scientific observational and interpretive techniques, in preparation for the advent of earth resources space missions.

The aircraft program has, until recently, used two operating aircraft, a Convair 240 and an Electra P–3A. Extensive modification internally and externally has converted these aircraft into excellent multispectral airborne platforms for evaluation of a variety of sensors.

The National Academy of Sciences space applications summer study at Woods Hole, Mass., 1967–68, suggested the use of high-altitude platforms, including a jet aircraft (chart SR 70–171). The principal advantages of high-altitude flights are in simulating conditions nearer to those which can be expected from an orbiting spacecraft and in permitting assessment of the roles which may be effectively filled by aircraft in future operational aircraft-spacecraft mixed systems. By flying remote sensors at altitudes above about 90 percent of the earth's atmosphere, we extend the established range of the sensors' performance capabilities, as well as verify our data handling and analysis techniques. The additional data on the variation of signal-to-noise ratio with altitude permit us to do better remote sensor planning, and to define in a more realistic manner the input specifications for the space sensors.

An agreement signed with the USAF allows part-time use of an RB–57F, assigned to the Air Weather Service. The RB–57F can fly at altitudes in excess of 60,000 feet. (NASA is programed for 200 hours of flight time on this aircraft during each 3-month period.) The RB–57F aircraft has conducted a number of earth resources flights since June 1969. The sensors are installed on a pallet which is easily detached for servicing the sensors. Because of the inaccessibility of the pallet in flight, operation of these sensors may be viewed as an "automated" mode.

Sensors presently located on the pallet include (from top): an IR imager, IR spectrometer and radiometer, two metric cameras, and six Hassleblad multiband cameras. Microwave sensors are located in the nose section of the aircraft.

After the first 2 years of experimentation it became obvious that the Convair 240 and the P–3A aircraft could not fulfill the complete low to medium altitude test requirements of the participating earth scientists for experimentation with the sensors over many different test site areas. Consequently, a Lockheed C–130B was obtained to replace the CV–240 (chart SR 70–182). The C–130B aircraft provides a considerably greater payload capacity, and performs at greater ranges and at higher altitudes. The sensors that are currently being integrated into this aircraft are being transferred from the CV–240. The C–130B also provides a large internal volume for instrument installation and for personnel. Since essentially all instrumentation will be accessible during flight, this aircraft may well be termed a "flying laboratory."

The next figure (chart SR 70–88) shows the earth resources survey test sites overflown in fiscal 1969 and those that will be overflown by the end of fiscal 1970. In fiscal 1969, NASA earth resources aircraft conducted 23 missions, while in fiscal 1970 we expect to conduct 42 missions. A typical mission overflies from three to six test sites. Thus, a number of disciplinary scientists are usually furnished with research data after each mission is completed.

In addition to test sites within the continental U.S., NASA has initiated a cooperative test site research program with two Latin-American countries. The test sites overflown during 1969 in Mexico and Brazil, are shown in chart SR 70–89. In Mexico, the NASA P–3A aircraft overflew six multidisciplinary test sites; in Brazil five test sites were overflown. While in South America for the Brazilian program, we were also requested to obtain some data in Argentina in support of the international biological program. Each test site, its approximate location and the discipline involved in the investigation are shown. This initial and limited foreign cooperative program is illustrative of the means by which other countries may eventually be assisted toward participation in earth resources survey activity. This type of experience may be of considerable benefit in preparing for international use of the earth resources technology satellite data.

An important aspect of our supporting research and technology program is the instrumentation research and development program. One of the most significant research instruments currently under development is a 24-channel scanning radiometer being built by Benedix Corp. This instrument will facilitate detailed examination of spectral signatures in a format readily amenable to automatic data processing. This will permit determination of the most suitable wavelengths for identification of various types of earth resources phenomena. In addition, using existing aircraft-based systems and ground-based data facilities, considerable progress has been made in automatic classification and identification of earth features such as soils, crops, and geological terrain. We have also, through our advanced studies, significantly increased our understanding of total earth resources survey system concepts, the research requirements for their ultimate implementation, and the benefits—human and dollar-wise—which can be anticipated.

One further accomplishment in 1969 that warrants mention is the NASA-sponsored summer study on solid earth and ocean physics, conducted at Williams College, Mass. National and international participation in this summer study produced increased interest in the complementary use of space technology and precision measurement techniques toward improved understanding of the dynamics of the solid earth and oceans. In addition to its innate scientific interest, this area shows promise for leading toward improved tracking of earth resources satellites with the implied simplification in data reduction requirement.

Future Programs

The immediate future holds much promise for the Earth Resources Survey program. The ERTS–A. & B. spacecraft systems are entering the definition and design phase (phase B/C) to be conducted by two experienced competing design teams at GE and TRW. At the end of this phase, early in 1970, the most promising ERTS design will be selected and a single contractor will proceed with the hardware development. Separate contracts will continue with RCA for the television system, with Hughes for the multispectral scanner, and RCA for the video tape recorder. The launch of ERTS–A is scheduled for early calendar year 1972; ERTS–B will be launched the following year.

The ground data handling system will continue under development at GSFC This constitutes a very significant portion of the overall ERTS system since large

volumes of data must be processed, maintained and appropriately indexed, annotated and gridded to provide image data to users. Provisions will be made for attendance of user agency experts at the GSFC ground station to monitor results and to provide any necessary guidance to the satellite command and control center. Master copies will be provided to the user agencies for reproduction, additional processing and dissemination to their respective constituencies of experimenters and investigators. In preparation for this activity, detailed plans for coordinated data utilization experiments are being made by user agencies for submission to NASA. A general announcement of experiment opportunities will also be made to the scientific community during 1970.

The aircraft program will be partially redirected to provide specific observations that will enhance the value of early data obtained from ERTS–A. Specific test sites will be selected in cooperation with the user agencies to obtain repetitive multispectral coverage that will provide a time history of the dynamic nature of the changes that we expect ERTS to monitor. These test sites will be selected on the basis of resource, environmental, and ecological relationships in specific regions. After ERTS–A is in operation, the aircraft program will provide follow up observations to develop the use of combined spacecraft and aircraft observation systems. The aircraft program will also be available for additional sensor development and specific experiments in automated procesing of multispectral sensor data. In particular, it will be important to:

(1) Further investigate and demonstrate the complementary nature of aircraft- and spacecraft-based remote-sensing for resources inventorying, and

(2) Further develop automated data processing of remote sensing data.

These two efforts will be facilitated through efficient use of the recently operational RB–57F and C–130B aircraft. By late 1970, the C–130B will be carrying the 24-channel research scanner now under development.

The supporting research and technology efforts are closely interwoven with the aircraft program. We plan to continue these studies in close cooperation with the user agencies, on the processing and application of earth resources survey data. The significant accomplishments already achieved in the classification and identification of surface features by remote sensor signatures will be exploited. Emphasis will be on improved understanding of the spatial, spectral, and time-variant aspects of these signatures and on the further development of automatic data processing techniques. We will continue our advanced studies to increase our understanding of total earth resources survey systems and the benefits which they will provide.

CONCLUDING REMARKS

During 1969 there were significant accomplishments in the application of space technology to the fields of meteorology and earth resources surveys. These accomplishments open the door to even greater opportunities to be attained from active, forceful pursuit of the space applications programs we are proposing for fiscal year 1971. These programs present outstanding opportunities to apply our Nation's space endeavors to the benefit of mankind. The potential benefits to be gained from advance knowledge of earth's weather, discovery of new resources, and ability to monitor our environment and ecological system, certainly warrant a continuing and increasing support of these programs.

METEOROLOGICAL PROGRAM OBJECTIVES

GLOBAL CLOUD IMAGING

- 24-36 HOUR WEATHER FORECASTS

CONTINUOUS VIEWING OF ATMOSPHERE

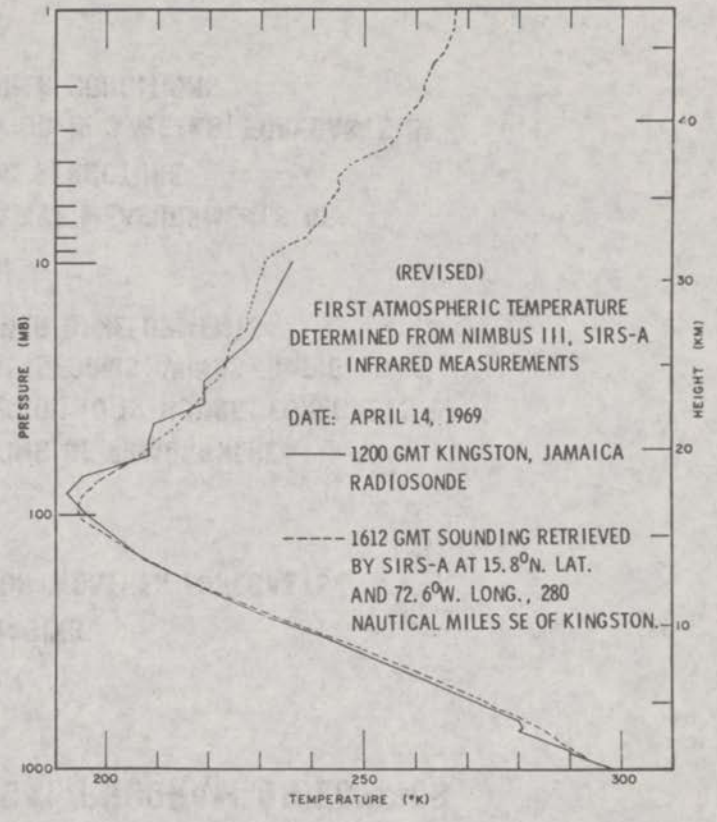
- SHORT PERIOD (0-12 HOURS) FORECASTS OF SEVERE STORMS, WINDS, RAPID WEATHER DEVELOPMENTS

GLOBAL QUANTITATIVE MEASUREMENTS OF ATMOSPHERIC STRUCTURE

- LONG PERIOD (2-3 WEEKS) FORECASTS OF WEATHER CONDITIONS

NASA SR70-126
11-4-69

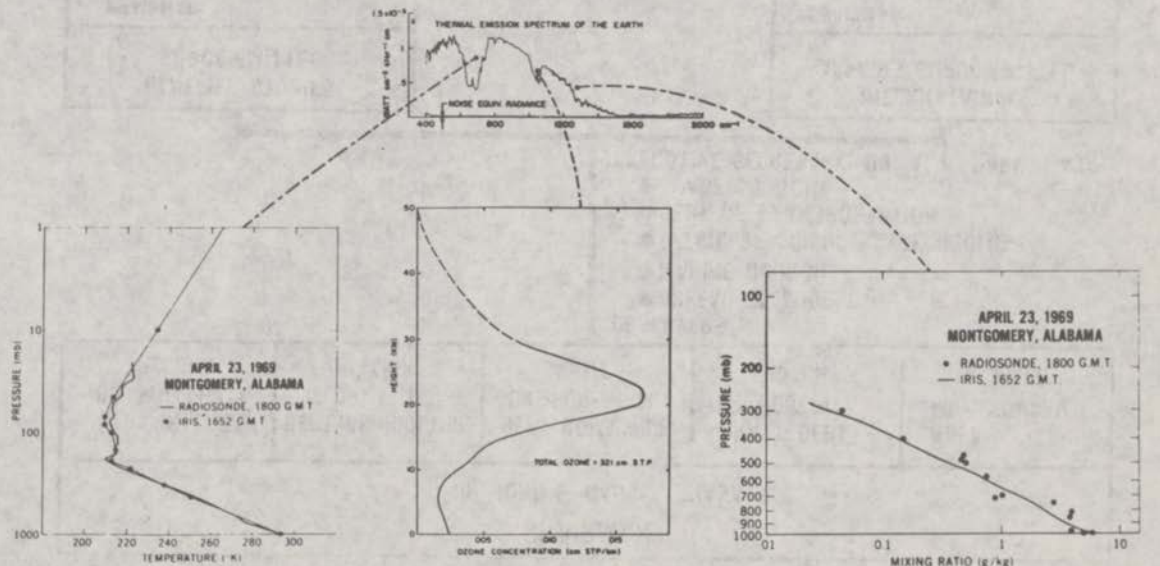
NIMBUS III
ATMOSPHERIC TEMPERATURE
PROFILE



NASA SA 69-645
4-21-69

NIMBUS III DATA PRODUCTS

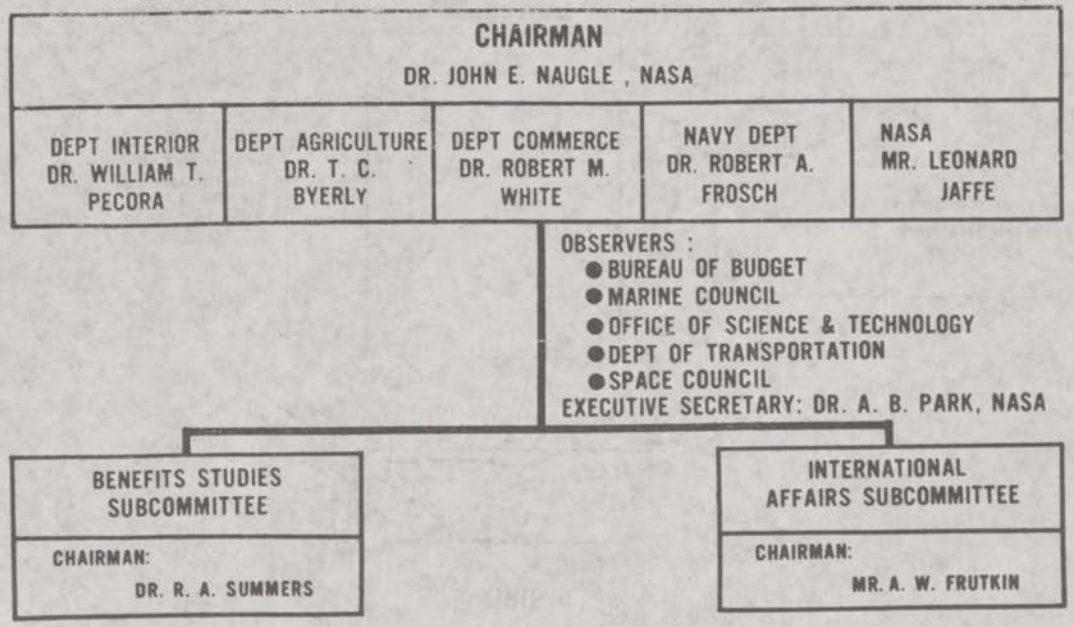
- IRIS -



NASA SR70-147
11-4-69

EARTH RESOURCES SURVEY PROGRAM REVIEW COMMITTEE

*FUNCTION: REVIEW TOTAL ERS PROGRAMS AND SUBSTANTIVE ISSUES



[*REF: NASA - NMI #1154.9, JULY 15, 1968]

NASA SR70-111
(REV. 1) 1-8-70

EARTH RESOURCES SURVEY PROGRAM

NASA OBJECTIVES

- DEFINE REAL WORLD PROBLEMS TO WHICH SPACE TECHNOLOGY CAN MAKE A BENEFICIAL CONTRIBUTION
- DETERMINE PERFORMANCE OF REMOTE SENSORS, ESTABLISH SIGNATURE RECOGNITION CRITERIA
- DEVELOP SENSORS, SUBSYSTEMS, AND EXPERIMENTAL SPACECRAFT, ALONG WITH EFFICIENT MEANS FOR GETTING INTO ORBIT.
- DETERMINE SCOPE & CONFIGURATION OF OPERATIONAL SYSTEMS (INCLUDING SPACECRAFT, AIRCRAFT, AND GROUND SEGMENTS)
- DEVELOP DATA HANDLING TECHNIQUES
- ASSIST USER AGENCIES IN DEVELOPING A COMMUNITY OF EXPERTS PREPARED TO UTILIZE SPACE-DERIVED REMOTE-SENSING DATA.

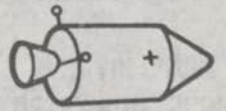
NASA HQ SR70-85
11-4-69

EARTH RESOURCES SURVEY PROGRAM

S065 MULTI-SPECTRAL PHOTOGRAPHIC EXPERIMENT

(MARCH 8-11, 1969)

OVERALL OBJECTIVE: COMBINED USE OF SPACE, SIMULTANEOUS-AIRCRAFT AND SEQUENTIAL-AIRCRAFT MULTI-SPECTRAL IMAGERY FOR INVENTORYING RESOURCES.



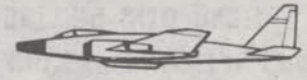
APOLLO IX

SPACE

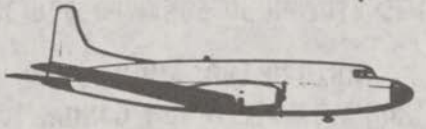
- EVALUATION OF MULTISPECTRAL PHOTOGRAPHY
- SIMULATION OF ERTS-RBV IMAGERY
- ADDITIVE COMBINING OF MULTISPECTRAL IMAGERY FOR OPTIMUM PHENOMENA ENHANCEMENT

HIGH-ALTITUDE

RB-57F
OTHER DOD



- SIMULATE SPACE PHOTOGRAPHY
- STUDY TIME-VARIANT PHENOMENA OVER GROWING SEASON



MEDIUM ALTITUDE

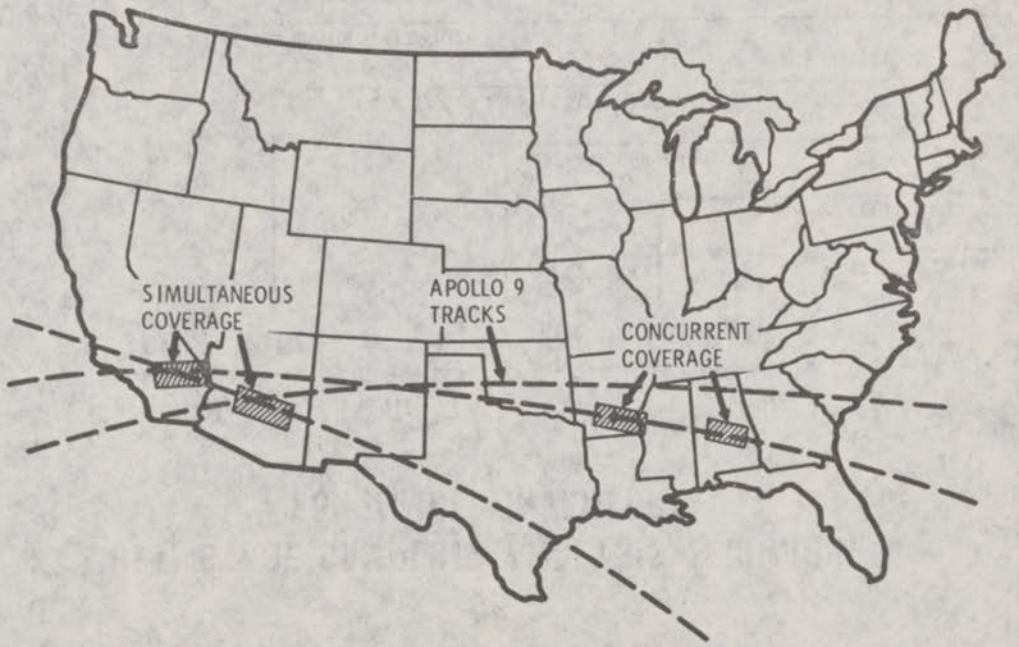
NASA - CV-240

NASA SR70-104
11-4-69

43-601 O - 70 - pt. 4 - 27

EARTH RESOURCES SURVEY PROGRAM

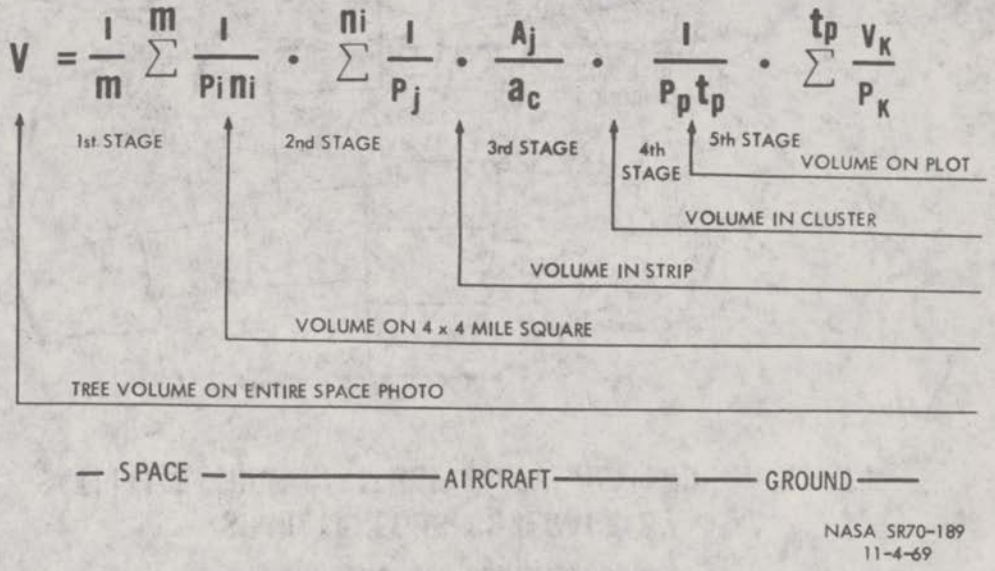
SIMULTANEOUS COVERAGE BY SATELLITE, HIGH-ALTITUDE & LOW-ALTITUDE AIRCRAFT



NASA SR70-191
11-4--69

EARTH RESOURCES SURVEY PROGRAM

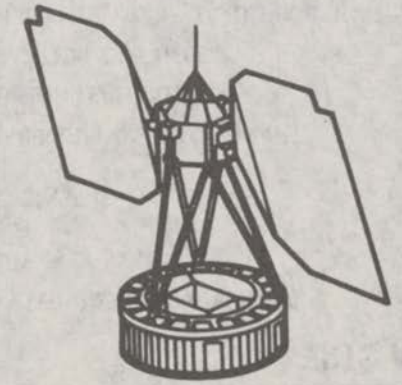
MATHEMATICAL FORMULATION OF MULTI-STAGE SAMPLING ANALYSIS TECHNIQUE FOR TIMBER INVENTORY



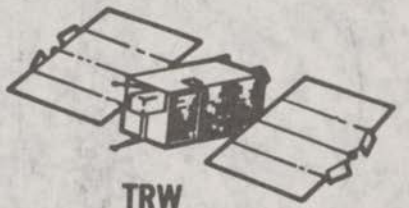
NASA SR70-189
11-4-69

EARTH RESOURCES SURVEY PROGRAM

ERTS A&B SPACECRAFT
(PROPOSED)



GE

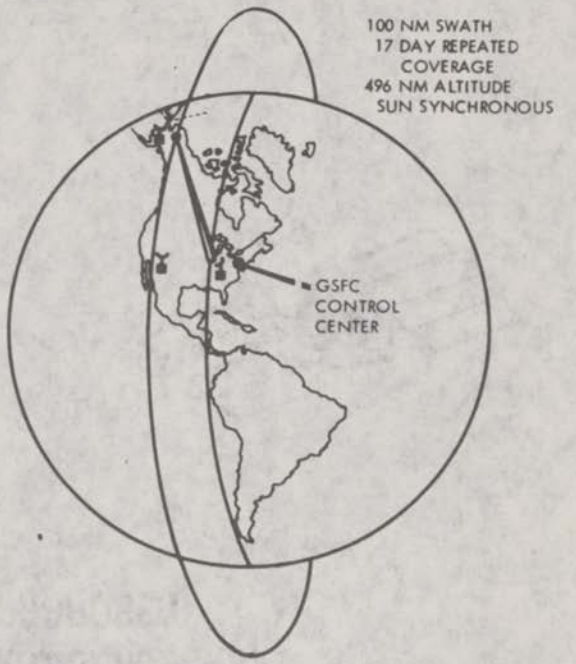


TRW

NASA HQ SR70-91
11-4-69

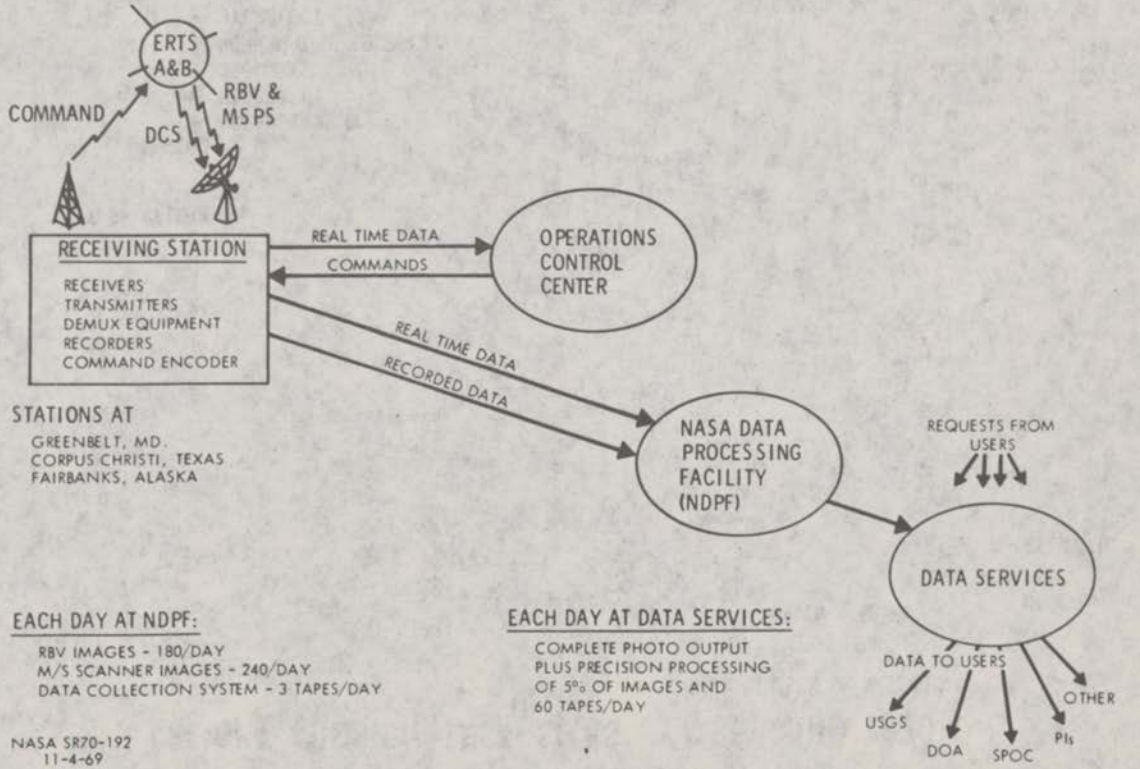
EARTH RESOURCES SURVEY PROGRAM
ERTS A&B OBJECTIVES

- DETERMINE USEFULNESS AND OPERATING EFFICIENCY OF SYSTEM
- FLIGHT-TEST SENSORS
- PROVIDE PRODUCTS TO USER COMMUNITY TO DEVELOP APPLICATIONS (OPERATIONAL EXPERIENCE)
  - PRODUCE 1:1,000,000 SCALE PHOTO IMAGES
  - PLOT GEOLOGICAL FEATURES
  - PRODUCE GROSS LAND-USE PLOTS
  - PLOT COASTAL AREAS
  - PLOT SNOW & ICE COVER
  - OBTAIN ANNUAL RECORD OF TEMPORAL CHANGE



NASA SR70-90
11-4-69

GROUND DATA HANDLING & CONTROL SYSTEM



EACH DAY AT NDPF:

RBV IMAGES - 180/DAY
M/S SCANNER IMAGES - 240/DAY
DATA COLLECTION SYSTEM - 3 TAPES/DAY

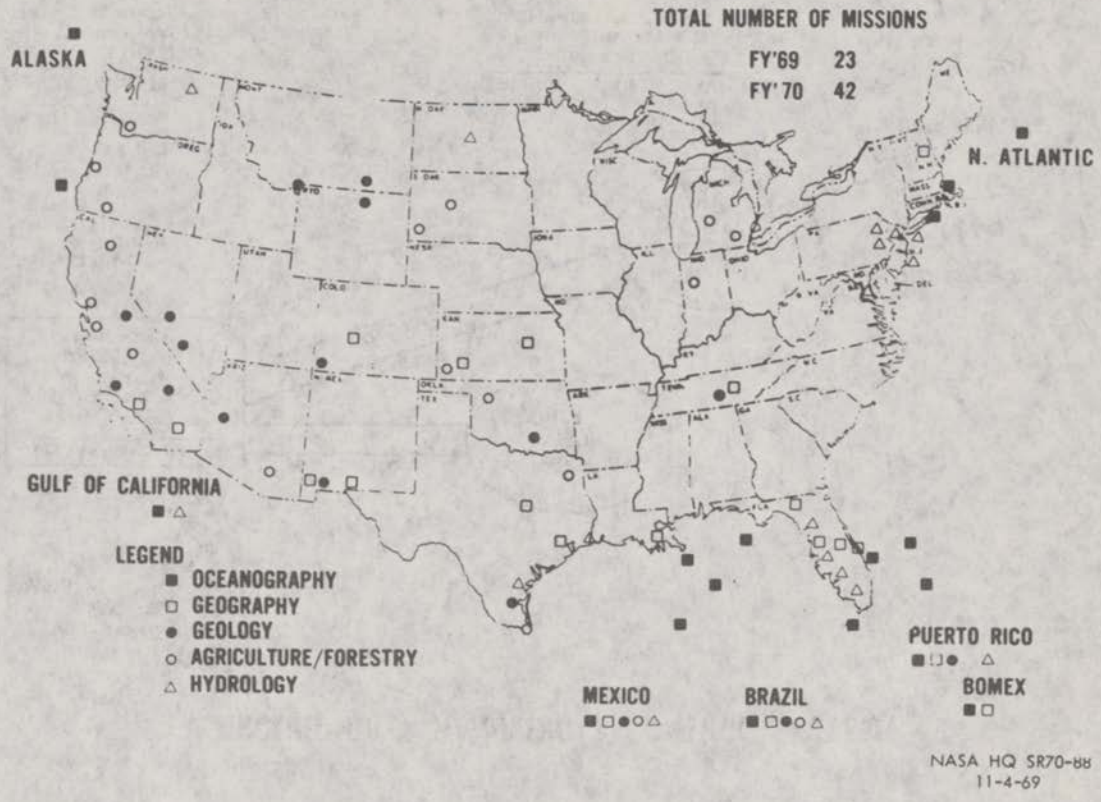
EACH DAY AT DATA SERVICES:

COMPLETE PHOTO OUTPUT
PLUS PRECISION PROCESSING
OF 5% OF IMAGES AND
60 TAPES/DAY

NASA SR70-192
11-4-69

EARTH RESOURCES SURVEY AIRCRAFT PROGRAM

FLIGHT MISSION TEST SITES FY 1969 AND 1970



EARTH RESOURCES SURVEY AIRCRAFT PROGRAM

FOREIGN COOPERATIVE TEST SITE RESEARCH



MEXICO MISSION - 91
MSC P-3A ELECTRA
APRIL 7 - 20, 1969

TEST SITE	DISCIPLINE
IXTLAN	GEOLOGY
ELORO	GEOLOGY
TOLUCA	HYDROLOGY
CHAPINGO	AGRICULTURE/FORESTRY
VERACRUZ	OCEANOGRAPHY
PAPALOAPAN	HYDROLOGY

BRAZIL MISSION - 96
MSC P-3A ELECTRA
JULY 2 - 18, 1969

TEST SITE	DISCIPLINE
CABO FRIO	OCEANOGRAPHY
RIO DE JANEIRO	HYDROLOGY/GEOGRAPHY
IPEACS	AGRICULTURE
CAMPINAS	AGRICULTURE/FORESTRY
QUADRILATERO FERRI FERO	GEOLOGY

ARGENTINA MISSION - 97
MSC P-3A ELECTRA
JULY 19 - 20, 1969
INTERNATIONAL BIOLOGICAL PROGRAM

TEST SITE	DISCIPLINE
PIRANE	AGRICULTURE/FORESTRY
RIVA DAVIA	AGRICULTURE/FORESTRY
SALTA	AGRICULTURE/FORESTRY

NASA HQ 5R70-89
11-4-69

NAVIGATION AND TRAFFIC CONTROL SATELLITE

Mr. BOLAND. With regard to navigation traffic control satellites studies, you are requesting $3 million. This is a new program, is it not, for 1971?

Dr. NAUGLE. This is a new program, Mr. Boland. It is for studies. We are not committed to the development of the flight hardware at this point in time. That would be a decision that would be part of the 1972 budget.

Mr. BOLAND. What does description spacecraft and support mean?

Dr. NAUGLE. That is to define what the satellite system would be, what the ground support equipment and so forth would be.

Now we are working very closely with the Department of Transportation, the Federal Aviation Administration. We are also working very closely with the European Space Research Organization. The specific type of satellite that we are thinking about would be a pair of air traffic control satellites which would operate over the North Atlantic and would be really operated jointly between the United States and the European nations that fly over there.

These are funds for studies to see what the requirements are, what the specifications would be, the specific frequencies that we would want to use, this type of thing.

Mr. SHAPLEY. This is one of the areas where we have some good prospect of getting cost-sharing with the European countries when it comes to the actual development of the operational satellite. We are engaged in discussions with them, as Dr. Naugle mentioned, right now.

By the time we come back next year, we would hope to have a plan whereby we could achieve the very important result here on a cost-sharing basis.

SPENDING BY OTHER AGENCIES

Mr. EVINS. What are other agencies of the Government spending in their budgets for the earth resources satellite program?

Insert the table in the record showing the total cost in 1971.

(The table follows:)

The following fiscal year 1971 funds appear in other agency budgets, and have been approved by the Bureau of the Budget for earth resources survey programs:

	Millions
Department of Agriculture	$1.526
Department of Interior	1.600
Department of Commerce	.100
Navy Department	.070

Mr. EVINS. Other agencies are also spending money in this area. The cost goes up perceptibly.

FAA CONTRIBUTION

Mr. BOLAND. What has FAA been spending in the traffic control area, in this particular area?

Dr. NAUGLE. We will have to supply it.

(The information follows:)

The FAA has provided a total of $1.7 million during the period from fiscal year 1966 through fiscal year 1970 for contracted studies and support of satellite assisted air traffic control experiments, exclusive of in-house manpower. These

funds have supported FAA participation, with NASA, in a number of aircraft-satellite-ground experiments to demonstrate new communications and navigation techniques having applications to aeronautical satellites for air traffic control. The FAA has provided suitably equipped aircraft to conduct these tests and the support or data analyses and aircraft operations. NASA has provided the spacecraft transponder capability on ATS–1, 3, and 5 satellites, and the ground station support.

Mr. BOLAND. I mean in this specific area.

Mr. EVINS. Dr. Naugle, we are going to let you expand in the record on this. Put some statements of the benefits in the record.

(The information follows:)

NASA's early research program with Echo, Relay, and Syncom resulted in two follow-on programs. One, to capitalize on the technology base developed by NASA and to provide immediate benefits to the Nation and its people, was conducted by the Communications Satellite Corp. (Comsat) on behalf of the international telecommunications satellite consortium (Intelsat). The other, to develop the more sophisticated and complex multidisciplinary technology required for future applications satellite systems was conducted by NASA: the applications technology satellites or ATS program.

Another significant but less direct contribution of our early research program has been to the communication satellite systems launched and operated by the U.S. Department of Defense. The interim defense communication satellite program (IDCSP), and more directly the tactical satellite communications (Tacsatcom) program, have drawn extensively upon the technology, both satellite and ground station, developed by NASA during the relay and syncom programs.

The total operating Intelsat system of today draws heavily upon the ground station and satellite technology that was developed by NASA in its earlier programs. As a result of the improved facilities developed by Comsat, new operational services have become available. The improved efficiency through which those services can be performed using satellites has permitted the citizens of this country to see real-time television from around the world, and to communicate with high quality telephone circuits to Europe, Japan, and the Pacific and Asian areas at less cost than prior to the establishment of satellite systems. The details of these cost reductions are below. The Intelsat system was an integral part of the supporting network for Apollo operations, and, of course, permitted worldwide television coverage of the Apollo 11 and 12 missions. The DOD Tacsatcom satellite was temporarily added to the network to provide, for the first time, live television coverage of Apollo 12 to the State of Alaska. It is estimated that more than 500 million people around the world witnessed this event.

It is worthwhile noting, as cited in the President's Annual Report on Activities and Accomplishments under the Communications Satellite Act of 1962 which reports activities during 1968, that as of the end of that year the four Intelsat satellites in service were being used at approximately 75 percent capacity and provided an estimated 75,000 trunk route miles containing an estimated 1,800,000 individual circuit route miles. The trend in these figures has been continuously upward since 1965 when the first Intelsat, Early Bird, was launched.

As Dr. Charyk, president of Comsat, testified before the Subcommittee on Space Science and Applications of the Committee on Science and Astronautics, U.S. House of Representatives during December of last year (Dec. 17, 1969), the investment cost per circuit year in the Intelsat satellites has fallen from $16,000 for Early Bird to about $1,000 for Intelsat III. The projection for Intelsat IV is about $600 investment cost per circuit year.

Similar reduction in investment and operating costs are being made in the ground station portion of the system. As cited in a recent article in Electronics, February 16, 1970, the original ATT satellite earth station in Andover, Maine, cost about $15 million and required a staff of more than 50. Comsat has requested proposals for a new installation at Andover which will have greater capacity than that original installation but is expected to cost about $3,500,000 and require a staff of 12 or 14.

These improvements in efficiency and reduction in both investment per channel year and operating costs having resulted in real and significant reductions in the price paid by the consumer for communications services. As Dr. Charyk testified during those hearings cited earlier:

"During this time (1965 to 1969), Comsat has reduced its television rates twice. Charges for the satellite portion of a 1-hour color telecast between New York and Europe are now only 19 percent of what they were 3 years ago—a reduction of 81 percent."

Before Early Bird was launched about 4 years ago, the U.S. carrier portion of leased voice/data circuit between New York and France cost about $10,000 per month. Now, largely as a result of satellites, this circuit sells for about $6,000 per month. The Comsat portion of this tariff between New York and France has been reduced from $4,200 for 16 hours a day service to $3,800 for 24-hour service.

Dr. Charyk testified further as to reduced costs to the subscriber for leased circuits during subsequent testimony before the same committee on December 19, 1969. In substance, he indicated that Comsat had offered to lease to the DOD "10 circuits between Hawaii and Japan, 10 between Hawaii and Thailand, and 10 between Hawaii and the Philippines * * * at about $4,000 per half-circuit per month * * *" The bids by the international communications carriers were quoted as being "about $12,000 per half circuit per month." After the carriers appealed to the FCC, a compromise price was worked out whereby the Government obtained access to circuits—whether carried by cable or satellite—at a price of $7,100 per half-circuit per month; $4,000 of this charge goes to Comsat from the carriers.

Thus we see that the consumer in America (and the U.S. Government is perhaps the largest single consumer of communications services) is today benefiting directly—both in hard dollar terms and in terms of new services such as international television—from national commercial capabilities that are an outgrowth of our aggressive research and development program at NASA.

The world weather program—plan for fiscal year 1970 submitted by President Nixon to the Congress of the United States on March 13, 1969, states in part that: "In 1966, for example, the United States lost approximately a thousand lives and over $1 billion to severe weather. This toll could have been substantially reduced by adequate warnings and proper precautions."

The "adequate warnings" are obviously dependent on two factors: advance knowledge of the impending severe weather and the ability to communicate that information rapidly to those in a position to take proper precautions. Many of the severe weather phenomena either are short-lived storm systems such as tornados or are somewhat erratic in their rapid course such as hurricanes, and thus need to be tracked more often than once or twice a day to determine their local behavior to a level of detail adequate for local warnings.

The spin-scan cameras on ATS–I and ATS–III do provide a relatively high resolution look at the cloud patterns associated with such storms over the United States every 20 minutes during daylight hours. The cloud patterns associated with many tornados have been observed and are being studied by meteorologists in an attempt to determine the mechanisms of tornado development so that more adequate forecasting can be carried out in the future. Many hurricanes have been tracked by these same cameras and techniques have been developed for determining wind speeds around the eye of the hurricane.

The Environmental Science Services Administration (ESSA) considers these experimental capabilities so important as a partial input to their weather research and forecasting activities that they have been using ATS–I in a quasi-operational mode with their own ground station for more than a year and have made arrangements for a similar use of ATS–III starting this spring.

We cannot quantify the cost benefits or cost savings resulting from this quasi-operational use, although the camera experiments and operational experiments are providing the basis for the design of the synchronous meteorological satellite (SMS) that we are developing in cooperation with ESSA. The follow-on geostationary operational environmental satellite (GOES) will be funded by ESSA and will be an integral and important part of our Nation's weather forecasting system.

A second development that was successfully conducted as part of the ATS program is the weather facsimile or WEFAX experiment in which weather data is transmitted via the VHF transponder on ATS–I to hundreds of small, inexpensive receivers—some built and operated by radio amateurs, widely distributed throughout a major portion of the world. This system could be the precursor for a warning system to deliver the severe weather alerts directly and rapidly to those in local communities who are in a position to take proper precautions.

An additional experimental use of this same VHF transponder was the collection of river gage data from remote, widely spaced automated stations. A report to the Administrator of ESSA discussing the Virginia floods of August 19–22, 1969, that were the result of Hurricane Camille and that caused more than 100 deaths in the James River Basin highlighted the need for both invulnerable and widely distributed rain and river gages connected with automatic networks, and the need for invulnerable emergency communications links to widely dispersed communities to carry warning alerts. The results of the ATS–I WEFAX information distribution experiment and data collection experiment clearly indicate that the technology is avaiable to meet these needs.

Launch Vehicle Procurement Program

Mr. Evins. We will now turn to the "Launch vehicle procurement program" section.

Mr. Reporter, place pages RD 8–1 through RD 8–8 in the record.

(The pages follow:)

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1971 ESTIMATES

OFFICE OF SPACE SCIENCE AND APPLICATIONS LAUNCH VEHICLE PROCUREMENT PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The Launch Vehicle Procurement program objective is to provide launch vehicle and launch services to support mission requirements. Major activities include the procurement of vehicle hardware, launch operational services, engineering and maintenance support, and necessary product improvements to flight vehicles and support equipment. The program includes Supporting Research and Technology/Advanced Studies efforts for necessary vehicle improvements. The vehicles being procured are: Scout, Delta, Thor Agena, Atlas Centaur, Titan III Centaur, and the Titan IIIC. They comprise a balanced family of vehicles which is planned to satisfy present and future automated spacecraft requirements in the most efficient and economical manner.

The Launch Vehicle Procurement program is subdivided into three major categories: (1) vehicle hardware, (2) supporting activities, and (3) product improvement. This subdivision, as presented during FY 1970, permits vehicle hardware to be readily identified with specific missions. This vehicle hardware is shown parenthetically in the budget requests of the various spacecraft missions in addition to being presented in the Launch Vehicle Procurement request in total. Funding requirements for supporting activities and product improvement are not included in the parenthetical notations shown with spacecraft projects since these efforts are not directly associated with specific missions.

The supporting activities category includes funds to cover recurring costs, which are continuing in nature, such as launch operations services, guidance services, engineering support, and launch complex maintenance. These costs, unlike the cost of hardware, are based on the establishment of a capability, rather than a quantity of units produced.

In the product improvement category, the major work is dedicated to enhancing reliability and performance in support of spacecraft requirements.

SUMMARY OF RESOURCES REQUIREMENTS:

	1969	1970	1971
Supporting research and technology/advanced studies	$4,400,000	$4,000,000	$3,000,000
Scout	12,600,000	13,700,000	15,100,000
Delta	24,300,000	32,100,000	34,000,000
Agena	11,300,000	5,300,000	---
Centaur	44,200,000	50,000,000	68,100,000
Titan IIIC	3,100,000	3,700,000	4,700,000
Total	$99,900,000	$108,800,000	$124,900,000

Distribution of Program Amount by Installation:

John F. Kennedy Space Center	$3,329,000	$1,717,000	$2,968,000
Marshall Space Flight Center	202,000	---	---
Goddard Space Flight Center	26,734,000	35,199,000	33,975,000
Jet Propulsion Laboratory	265,000	490,000	510,000
Electronics Research Center	1,282,000	1,257,000	---
Langley Research Center	12,905,000	13,582,000	15,130,000
Lewis Ressearch Center	50,455,000	50,963,000	65,573,000
Headquarters	4,728,000	5,592,000	6,744,000

The overall plan for launches during this period is:

Vehicle	Calendar Year 1969	Calendar Year 1970	Calendar Year 1971
Scout	1	7	5
Delta	6	2	2
Agena	2	2	-
Centaur	3	1	3
Titan	-	-	-
Total	12	12	10

The above table includes Advanced Research and Technology missions but excludes reimbursable launches and vehicles procured for other agencies, which average approximately six per year.

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology/Advanced Studies

	1969	1970	1971
Advanced studies	$750,000	$1,025,000	$1,030,000
Propulsion and energy conversion	740,000	730,000	500,000
Guidance, control and navigation	1,480,000	1,675,000	1,260,000
Instrumentation and electronics	225,000	60,000	60,000
Structures and materials	405,000	510,000	150,000
Vehicle engineering	800,000	---	---
Total	$4,400,000	$4,000,000	$3,000,000

The objective of the Supporting Research and Technology/Advanced Studies project is to provide data for management decisions concerning launch vehicles and stages required for future automated missions by conducting a systematic program of studies and research.

In FY 1970, three launch vehicle advanced studies were initiated. One was directed at design of a versatile upper stage concept for high energy missions. The second study involves the design of a minimum cost launch vehicle as a replacement for one or all vehicles of the current automated launch vehicle family. The third study includes an analysis of growth versions of the Titan III (including 7 segment solids) for possible use with Centaur for planetary missions. Supporting Research and Technology effort was initiated on the effects of long term space vacuum on solid propellant motors and to determine long term space mission requirements for solid propulsion systems. Extensive effort was directed at testing and evaluating the modular strapdown guidance system presently under development. In the area of instrumentation, studies were continued in developing nondestructive test techniques for electro-explosive devices.

In FY 1971, advanced studies of spacecraft thermionic and magneto-hydrodynamic nuclear-electric propulsion systems are planned. The advantage of hybrid rocket motors for combined launch vehicle and spacecraft applications will also be studied. Effort will be directed at upper stage propulsion and astrionics problems and their interaction with spacecraft systems.

Additional study emphasis will be placed on the application of non-chemical propulsion systems to launch vehicle upper stages. Minimum cost launch vehicle system design studies, least cost vehicle family studies, and high energy upper stage studies will be continued to help provide direction to future automated launch vehicle developments in order to maintain an economical and reliable transportation system.

Scout

	1969	1970	1971
Hardware procurement.....	$3,900,000	$4,700,000	$7,100,000
Supporting activities.....	7,300,000	8,000,000	7,000,000
Product improvement.....	1,400,000	1,000,000	1,000,000
Total.....	$12,600,000	$13,700,000	$15,100,000

Scout is a four stage all solid propellant launch vehicle. It is the smallest in the NASA vehicle family and is used for small scientific satellites, space probes and high speed re-entry experiments. The Scout project has been in existence for ten years and over this period, 67 launches have been conducted of which 54 have been successful. The vehicle has been used to support missions for the DOD, AEC, foreign countries and international organizations.

The technical management of the Scout project is at the Langley Research Center. The prime contractor for the production, checkout and launch of this vehicle is Ling-Temco-Vought (LTV), Dallas, Texas. Launch operations of the Scout vehicles are conducted from the Western Test Range, California, Wallops Island, Virginia, and from the Italian San Marco platform in the Indian Ocean off the Coast of Africa.

In FY 1970, funds are being utilized to complete vehicle hardware production contracts and systems management and engineering contracts started in fiscal years 1968 and 1969. In addition, the Scout first stage motor is being improved. This improvement will increase the performance capabilities of the vehicle by approximately 30 percent.

In FY 1971, funds requested will be utilized to initiate new hardware procurements, to sustain the Scout launch capability at two launch sites and continue efforts related to the Scout first stage motor development in addition to completing a new "S" band telemetry destruct system development.

Delta

	1969	1970	1971
Hardware procurement.....	$8,852,000	$12,800,000	$14,200,000
Supporting activities.....	11,593,000	14,000,000	17,600,000
Product improvement.....	3,855,000	5,300,000	2,200,000
Total.....	$24,300,000	$32,100,000	$34,000,000

Delta is the workhorse vehicle in the NASA launch vehicle family. Through 1969, it has performed successfully 68 times in 74 attempts. Delta is a three stage vehicle consisting of the first stage Thor booster, the Delta second stage and a solid propellant motor third stage. This vehicle is capable of lifting a wide variety of payloads into orbit. It has been used to launch communication, meteorological, scientific, and biological satellites.

Technical management for the Delta project is assigned to the Goddard Space Flight Center. The prime contractor for the Delta vehicle is the McDonnell-Douglas Astronautics Company, Santa Monica, California. NASA procures the first stage Thor boosters through the U. S. Air Force, which has management responsibility for the production of this vehicle stage. Launch operations of the Delta vehicles are conducted from the Eastern Test Range, Cape Kennedy, Florida, and the Western Test Range, California.

Fiscal year 1970 funds are being used to initiate new hardware contracts for Thor boosters, Delta second stages and solid motor third stages along with the necessary launch operations services and other supporting services necessary to sustain the Delta launch capability during this period. In addition, major product improvements being accomplished during FY 1970 are: the design, test and qualification of a larger version of the TE-364 solid motor; completion of the adaptation of the Thor booster to use six solid motors for thrust augmentation; and the incorporation of an inertial guidance system into the Delta vehicle.

Fiscal year 1971 funds will be utilized to continue funding of hardware contracts initiated in FY 1970, and for continued support of launch operations and maintenance of ground support equipment. In addition, the major product improvement efforts on the TE-364 and the inertial guidance system for Delta started in FY 1970 will be completed with FY 1971 funds.

Agena

	1969	1970	1971
Hardware procurement.....	$6,770,000	$1,751,000	---
Supporting activities.....	4,530,000	3,549,000	---
Total.....	$11,300,000	$5,300,000	---

The Thrust Augmented Thor Agena is a two stage vehicle using the same Thor stage as Delta and a second stage Agena vehicle. This vehicle system is used by NASA for polar orbital missions launched from the Western Test Range in California.

The technical management of the Agena project is assigned to the Lewis Research Center and to the Goddard Space Flight Center. Lockheed Missiles

and Space Corporation, Sunnyvale, California is the prime contractor for the Agena stage. McDonnell-Douglas Astronautics Company, Santa Monica, California is the prime contractor for the Thor booster. The Agena and booster stages are purchased from these contractors through the U. S. Air Force.

No FY 1971 funds are required since there are no NASA missions currently planned for this vehicle system after the launching of the SERT IIA and Nimbus-D missions during the first half of 1970.

Centaur

	1969	1970	1971
Hardware procurement.....	$21,700,000	$20,000,000	$21,700,000
Supporting activities.....	21,600,000	14,400,000	20,800,000
Product improvement.....	900,000	15,600,000	25,600,000
Total.....	$44,200,000	$50,000,000	$68,100,000

Centaur is a high energy upper stage vehicle using liquid hydrogen and liquid oxygen propellants. This stage has been used with the Atlas booster in successfully supporting NASA's Surveyor, Mariner, Orbiting Astronomical Observatory and Applications Technology Satellite missions.

A new Centaur configuration - the Titan Centaur - is currently being developed. It is based on integration of an improved Centaur stage with the Titan III booster. This configuration involves four stages: one stage consisting of two strap-on, five segment solid motors, the second and third composed of the two stage Titan core and the fourth, the Centaur upper stage. This vehicle configuration will become operational in 1974.

The Lewis Research Center has technical management responsibility for the Centaur project. General Dynamics/Convair is the prime contractor for the Atlas Booster and the Centaur stage. Associate contractors are Honeywell, Inc. for the Centaur Guidance System and Pratt and Whitney Division of United Aircraft for the Centaur engines. The prime contractor for the Titan III booster is the Martin Marietta Corporation. The five segment solids for Titan III are manufactured by the United Technology Corporation and the propulsion system for the Titan III core stages I and II is produced by the Aerojet General Corporation. The Atlas Centaur is launched from the Eastern Test Range and the Titan Centaur will be launched from the ITL (Integrate-Transfer-Launch) facility also located at the Eastern Test Range.

In FY 1970, funds are being utilized to continue previously initiated vehicle procurements, to sustain the Centaur capability, and to initiate

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new hardware procurement to support missions planned for launch in the next few years. These missions include the OAO, Mariner Mars 1971, and Pioneer F and G missions. In addition, two major improvement efforts are being continued with FY 1970 funds. The first concerns improvements to the Centaur stage which will enhance reliability and flexibility of the vehicle. The changes include a new guidance computer, a standard forward adapter, and fixed insulation. The second improvement consists of the integration of the Centaur stage with the Titan III booster, and the establishment of an operational capability for Titan Centaur at the Eastern Test Range required to support the Viking mission. This effort includes funding for a proof flight of the Titan Centaur configuration, in order that this vehicle and launch facility may be adequately tested prior to the Viking mission.

During FY 1971, funds will be required to continue funding of vehicle hardware contracts for the Pioneer, Mariner Mars 1971, Proof flight, and OAO missions. In addition, funding will be required to begin efforts on the vehicle hardware and support of Mariner Mercury 1973 and Helios A missions. Effort required to continue the vehicle improvements begun in prior years, will also be funded.

Titan III C

	1969	1970	1971
Hardware procurement.....	$3,000,000	$3,700,000	$4,700,000
Supporting activities.....	100,000	---	---
Total.....	$3,100,000	$3,700,000	$4,700,000

The Titan III C launch vehicle is a four stage solid and liquid fuel vehicle developed and managed by the United States Air Force. Since the performance of the Titan III C vehicle is greater than that of the Atlas Centaur vehicle at synchronous velocities, NASA is using this vehicle for launch of the Applications Technology Satellites F and G missions. Depending on mission requirements, the Titan III C will be considered for other future synchronous altitude missions.

The NASA Headquarters will have primary management responsibility for the NASA Titan III C activity. The vehicles will be procured through the United States Air Force, with Martin Marietta Corporation, Denver Division, Denver, Colorado, as the prime contractor. The United Technology Corporation, Sunnyvale, California and Aerojet General Corporation, Sacramento, California, are associate contractors providing solid boosters, and core stage engines, respectively. Martin will provide mission integration services; Martin along with its associate contractor will provide launch operation services. Launches will be from the Titan ITL (Integrate-Transfer-Launch) facilities at the Eastern Test Range in Florida.

During FY 1971, funds are required to continue hardware procurements and supporting services initiated in prior years in support of the ATS-F and G missions which are planned for launch in 1973 and 1975.

VEHICLE MANUFACTURERS

Mr. EVINS. Who manufactures these vehicles, the Scout, Delta, Thor-Agena, Atlas Centaur, Titan III Centaur, and the Titan III C?

Dr. NAUGLE. Of course they are manufactured by a variety of companies, Mr. Chairman.

The Scout is assembled and integrated by the Ling-Temco-Vought Co. in Dallas, Tex. The Thor used as the first stage of the Delta and Thor-Agena and the Delta stage manufactured by the McDonnell-Douglas Corp. in Santa Monica, Calif., the Centaur stage and the Atlas booster are manufactured by the Convair Division of General Dynamics in San Diego, Calif. The Titan booster is manufactured by the Martin Co. in Denver, Colo.

Mr. EVINS. I notice you have no funds programed in 1971 for the Agena, that is the only one you are cutting back.

Dr. NAUGLE. Yes. We have no mission firmly scheduled after 1970 which will use the Agena.

Mr. EVINS. Your program was $99.9 million in 1969, $108.8 million in 1970, and you are requesting $124.9 million in 1971.

Dr. NAUGLE. Yes.

Mr. EVINS. In 1969, you had 12 launches and in 1970, you expect to have 12 launches. In 1971, you are eliminating the Agena launches and the total drops to 10 launches, but the costs go up.

How do you account for this? You cut down on the number of launches, but the costs go up.

Dr. NAUGLE. Let me make it clear that using these same vehicles over the past several years, we have systematically upgraded them.

For instance, the Scout now carries about three times the payload that it did when it was first introduced.

Mr. EVINS. They are more sophisticated vehicles, heavier and better?

Dr. NAUGLE. That is right. There are two other points I want to make here.

One is that we also provide launch vehicles and associated services on a reimbursable basis for non-NASA users such as ESSA, COMSAT, and other nations. The cost of the NASA share of maintaining the basic vehicle systems capability will vary depending upon how many of those launches are scheduled in any given year; that is, less NASA costs when there are more reimbursable launches and conversely more NASA costs when there are less reimbursable launches.

The major area of cost which is not directly related to the launch rate is that associated with major product improvements such as the Titan Centaur, where we are integrating the Centaur with the Titan for the Viking and other missions for which the capability of the Titan-Centaur is required.

COST PER VEHICLE

Mr. EVINS. What is the cost per vehicle, what is the average cost for the Scout and Delta?

Mr. LILLY. Average cost on the Scout hardware has run about $1.2 million; the average cost on the Atlas-Centaur hardware has been running about $9.9 to $10 million.

Mr. EVINS. What are the other costs besides the cost of the vehicle?

Dr. NAUGLE. I would like to ask Mr. Johnson to answer that.

Mr. JOHNSON. The cost that Mr. Lilly provided you was the cost for a single launching, once you have established and maintained a launch vehicle program.

The other costs are supporting base costs of that program. These include the costs of the launch crews, the cost of supporting facilities at the Cape, keeping those facilities up, the cost of failure analysis, maintaining supporting engineers. The $1.2 million that he mentioned was the cost only for Scout hardware.

Mr. EVINS. What is the cost of the Delta and Titan?

Mr. JOHNSON. Again, the cost per launch, once you have established and maintained the base capability of a Delta, is about $3.5 million for each launch. The cost of an Atlas-Centaur, Mr. Lilly gave you at $9.9 million. The cost of a Titan-Centaur, the vehicle we will be using for Viking, is about $18.8 million.

SUSTAINING UNIVERSITY PROGRAM

Mr. EVINS. I notice you are not continuing the sustaining university program after 1970. Place in the record page RD 9–1.

(The page follows:)

RESEARCH AND DEVELOPMENT—FISCAL YEAR 1971 ESTIMATES

OFFICE OF UNIVERSITY AFFAIRS—SUSTAINING UNIVERSITY PROGRAM

Program objectives and justification

The sustaining university program was established in 1962 when NASA's expanding responsibilities required increased participation of the educational community in the space program. The objectives were to provide adequate laboratory facilities, to increase the number of highly trained people, and to conduct broad multidisciplinary research. Many of these goals have been met, NASA programs have benefited and the universities have been strengthened through their participation.

NASA will continue to support research at universities as needed for NASA's mission with funding requirements to be met from program office R. & D. resources. The sustaining university program will be phased to an orderly conclusion.

SUMMARY OF RESOURCES REQUIREMENTS

	1969	1970	1971
Sustaining university program (total)	$9,000,000	$7,000,000	.....

ADVANCED RESEARCH AND TECHNOLOGY

Mr. EVINS. We will proceed to "Advanced research and technology programs."

Mr. Reporter, place pages ART 1 and ART 2 in the record.

(The pages follow:)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1971 ESTIMATES

RESEARCH AND DEVELOPMENT BUDGET PLAN FOR

ADVANCED RESEARCH AND TECHNOLOGY PROGRAMS

Program	Fiscal Year 1969	Fiscal Year 1970	Fiscal Year 1971
Basic research.....	$20,220,000	$18,902,000	$17,600,000
Space vehicle systems.....	31,349,000	30,670,000	30,000,000
Electronics systems.....	34,460,000	33,500,000	22,400,000
Human factor systems.....	19,402,000	21,900,000	17,900,000
Space power and electric propulsion systems.....	38,787,000	34,450,000	30,900,000
Nuclear rockets.....	33,502,000	36,500,000	38,000,000
Chemical propulsion.....	25,752,000	20,480,000	20,300,000
Aeronautical vehicles.....	74,748,000	75,900,000	87,100,000
Total.....	$278,220,000	$272,302,000	$264,200,000

FISCAL YEAR 1971 ESTIMATES

The Advanced Research and Technology programs shown in the preceding table supports research in two major technological areas, Space Technology and Aviation Technology. The division of effort between these two areas is shown below:

	1969	1970	1971
SPACE TECHNOLOGY			
Program			
Basic Research	$14,320,000	$12,712,000	$11,000,000
Space Vehicle Systems	31,349,000	30,670,000	30,000,000
Electronics Systems	23,360,000	23,005,000	16,600,000
Human Factor Systems	16,402,000	18,305,000	15,800,000
Space Power and Electric Propulsion Systems	38,787,000	34,250,000	30,500,000
Nuclear Rockets	33,502,000	36,500,000	38,000,000
Chemical Propulsion	25,752,000	20,480,000	20,300,000
Total 1/	$183,472,000	$175,922,000	$162,200,000
AVIATION TECHNOLOGY			
Program			
Basic Research	5,900,000	6,190,000	6,600,000
Electronics Systems	11,100,000	10,495,000	5,800,000
Human Factor Systems	3,000,000	3,595,000	2,100,000
Space Power and Electric Propulsion Systems	---	200,000	400,000
Aeronautical Vehicles	74,748,000	75,900,000	87,100,000
Total	$94,748,000	$96,380,000	$102,000,000
TOTAL, ADVANCED RESEARCH AND TECHNOLOGY 1/	$278,220,000	$272,302,000	$264,200,000

Aviation technology includes supporting research and technology effort conducted under Basic Research, Electronics Systems, Human Factor Systems, and Space Power and Electric Propulsion Systems programs related to aeronautics, in addition to all projects itemized under the Aeronautical Vehicles program.

1/ Excludes Launch Vehicle Procurement as follows:

1969	$2,394,000
1970	450,000
1971	2,100,000

INCREASES IN OART

Mr. EVINS. Overall advanced research and technology is going down, but there are a couple of programs that are increasing. Do you want to address yourself to those increases?

Mr. NICKS. Yes, Mr. Chairman.

The small increase in nuclear rockets, Mr. Chairman, will keep the program going at about the present rate. We are now entering the hardware development phase of the flight weight engine for the nuclear system. This program will produce a usable nuclear propulsion system in the late 1970's.

In the aeronautical program we are continuing to increase that activity. We believe that a lot of concepts are ready for application for short takeoff and landing vehicles and the vertical takeoff vehicles. We are therefore beginning to intensify work pertaining to short haul transportation for the country.

Mr. EVINS. Nuclear power holds great potential for long stays in space plus many other advantages; is that correct?

Mr. NICKS. Yes, sir.

Mr. EVINS. Tell us about your aeronautical vehicle increase, from $74.7 million in 1969 to $87.1 million in 1971.

Mr. NICKS. A major part is in moving from the component development of such things as rotorcraft and short takeoff and landing airplanes that would be used in our commercial transportation system.

Mr. EVINS. Are there any new breakthroughs in any of these areas?

Mr. NICKS. We think so, Mr. Chairman. There are two or three areas that look very promising. Some of these you have heard a little about in the past years.

One is a so-called blown flap configuration that allows an airplane to use part of the jet thrust to provide lift. It may make the takeoff run on the order of 1,500 to 2,000 feet instead of the usual long runs. This would be quite a boon to suburban communities and areas where short-haul transportation is needed.

BASIC RESEARCH PROGRAM

Mr. EVINS. Let's turn to "Basic research" and place in the record pages RD 10–1 through RD 10–7.

(The pages follow:)

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1971 ESTIMATES

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY — BASIC RESEARCH PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The Basic Research program supports fundamental research in the physical and mathematical sciences. It is aimed at providing an understanding of the physical phenomena pertinent to other NASA programs concerned with current and future aircraft and space activities. This basic research is carried out principally in NASA's research and space flight centers supplemented by investigations at universities, industrial research laboratories, and other Government research centers. Fundamental understanding of physical phenomena in many fields of science is required to develop the technology for NASA's programs. Basic research in NASA, therefore, must encompass a wide spectrum of disciplines. It ranges from very fundamental studies into the nature and properties of atoms and molecules to the more applied research areas such as determining the best materials for the space shuttle.

The Basic Research program is divided into four broad disciplines: Fluid Physics, Electrophysics, Materials, and Applied Mathematics. These are discussed below, as applicable to Aeronautics and Space. The division of the Basic Research Program into these two categories is somewhat arbitrary where the Program is applicable to both categories.

Aeronautics Research and Technology

The Fluid Physics subprogram promotes basic research on aerodynamic and gas-dynamic problems relevant to NASA objectives in aeronautics. During the past year, new research programs have been initiated on air pollution from aeronautics sources, noise generation from turbofan systems, and supersonic engine exhaust jets. Substantial progress has been made in the understanding and reducing of sonic boom and noise, and also, in understanding the origin and mechanisms of clear air turbulence.

The Materials subprogram conducts basic studies to understand the relationship between the structure and properties of materials that are used in aircraft. Typical examples are studies of surface physics to understand and improve the performance of avionics devices, alloys research to increase the performance of both structural and power plant materials and basic studies to better understand such failure mechanisms as fatigue and corrosion.

The objective of the Applied Mathematics subprogram is to develop new mathematical models and methods so that problems in aeronautics may be solved more readily or efficiently than possible today. Research is currently being carried out in data representation, ranking of alternatives, and in new methods of representing stochastic processes. Future plans include work in simulation, information retrieval, and adaptive control.

Space Research and Technology

The Fluid Physics subprogram promotes basic research on aerodynamic and gas-dynamic problems relevant to NASA objectives in space. During the past year, entry gas-dynamic research has been continued with studies primarily concerned with experimental simulation and verification of theories regarding high speed entry. A significant advancement in gas-dynamic laser research has been made by the recent demonstration of an all chemical laser.

The Electrophysics subprogram is devoted to increasing our understanding of the behavior of electrons, nuclei, atoms and molecules comprising gases, liquids and solids under the influence of acoustic, electric, and magnetic forces. Such new information is applicable toward the advancement of the technologies of electronics, space power and propulsion. In electronics, new paths will be made toward stable wide-band modulated optical and infrared lasers capable of transmitting and receiving increased information, and higher temperature superconductors. For space power and propulsion, progress is being made to achieve stable high density plasmas and to minimize energy losses so that the magnetoplasmadynamic technique may be practical.

The Materials subprogram is conducting basic studies to understand the behavior and properties of materials for use in space. The research is concerned with materials for use in electronic devices such as semi-conductors and thin films, and with structural materials for spacecraft, in particular for their use at high temperature. In the next year, a sizable portion of these studies will be directed toward materials for the space shuttle.

The goal of the Applied Mathematics subprogram is to achieve new mathematical techniques for the solution of problems related to space flight. Future plans include work in mathematical approaches to pattern recognition, information retrieval, automatic theorem proving, and adaptive systems. This work will be applicable to many social and technological problems in addition to the NASA requirements.

SUMMARY OF RESOURCES REQUIREMENTS:

	1969	1970	1971
Aeronautics research and technology	$5,900,000	$6,190,000	$6,600,000
Space research and technology.....	14,320,000	12,712,000	11,000,000
Total.....	$20,220,000	$18,902,000	$17,600,000

Distribution of Program Amount by Installation:

	1969	1970	1971
Marshall Space Flight Center.....	$820,000	$555,000	$1,588,000
Goddard Space Flight Center.....	122,000	100,000	100,000
Jet Propulsion Laboratory.....	3,155,000	2,435,000	2,200,000
Ames Research Center.....	2,561,000	2,775,000	2,805,000
Electronics Research Center.....	1,952,000	2,060,000	---
Langley Research Center.....	2,457,000	2,310,000	2,175,000
Lewis Research Center.....	2,895,000	4,247,000	4,510,000
NASA Headquarters.....	6,258,000	4,420,000	4,222,000

BASIS OF FUND REQUIREMENTS:

Aeronautics Research and Technology

Fluid physics.....	1,500,000	1,640,000	1,750,000
Materials.....	4,300,000	4,350,000	4,650,000
Applied mathematics.....	100,000	200,000	200,000
Total.....	$5,900,000	$6,190,000	$6,600,000

During the past year, Fluid Physics research has resulted in substantial progress in sonic boom and clear air turbulence research. New research programs were initiated on fluid dynamic mechanisms of atmospheric pollution from airborne and ground sources, and aerodynamic noise from engine turbofan systems and engine exhaust jets.

The research program on sonic boom prediction and reduction has provided techniques for predicting the pressure waves from aircraft maneuvering through a nonuniform atmosphere. Current theories have been extended to include the effects of unsteady winds and atmospheric turbulence. Results of several theoretical investigations of aircraft configurations have indicated that significant boom reductions are potentially feasible. The theoretical concepts are being evaluated experimentally in the NASA wind tunnels.

Progress has been made in understanding the origin and mechanisms of clear air turbulence which is an important operational problem of present jet transports. The results of these studies should contribute to eventual detection and avoidance.

The new research program on atmospheric pollution is an investigation of the fluid dynamic mechanisms of the interaction and dispersion of pollutants from airborne and ground sources in urban areas. Wind tunnel tests of gas concentrations around model buildings are expected to provide quantitative data on pollution concentrations caused by aircraft and motor vehicles, in terms of the strength of the source. Preliminary visual data of smoke flow experiments involving a building and street model in a wind tunnel have

shown that, perpendicular to the wind direction, there appears to be low ventilation, i.e. high pollutant concentrations, into the adjacent streets. Further research in this program will provide quantitative data for a variety of atmospheric and pollution source conditions.

New research programs have been initiated to gain an understanding of the mechanisms of noise generation from turbofan systems and supersonic engine exhaust jets. Some progress has already been made, theoretically, for predicting noise from supersonic jet exhausts. Also, studies are being continued to determine the flow mechanisms by which noise reductions are achieved in the jets.

Materials research seeks to determine why engineering materials fail under the various mechanical, chemical and thermal environments that they encounter in aircraft structures and propulsion systems. Part of the research is motivated by the need for improved avionics for advanced aircraft. One such program is in the area of the surface physics and chemistry of solids and is concerned with studying the effects of surface oxygen on the electrical properties of germanium. This research is useful for predicting device performance and reliability.

In the coming year, alloys for advanced aircraft structures and power plants will receive increased emphasis. Basic studies of the stability and oxidation characteristics of the nickel, cobalt, and chromium based alloys together with compatibility with various ceramic oxidation resistant coatings are expected to yield information which will increase materials performance in these applications.

Research on the newer composite materials including high strength and high modulus fibers, higher temperature resins, and oxidation resistant metal-matrix composites will be maintained because they continue to offer the best potential for significant savings in weight for advanced aircraft.

Basic studies of such phenomena as fatigue, corrosion, and friction will continue to be supported on a modest scale. Because such research tends to be long term it will have to lag behind higher priority items.

The Applied Mathematics subprogram is supporting research directed at the ultimate solution of problems in aeronautics. Examples of the research are mathematics of aircraft environment, e.g., solutions to nonlinear integral equations arising from adsorption kinetics; mathematics of aircraft performance, e.g., transforms related to generalized heat equations; and mathematics of aircraft control, e.g., adaptive control methods of optimizing climb rate, fuel consumption, etc.

In addition, much of the space related research is of considerable value to aeronautical problems. For example, both space and aeronautical problems generate nonlinear differential equations that require new techniques for solution.

Space Research and Technology

	1969	1970	1971
Fluid physics	$3,485,000	$2,855,000	$2,120,000
Electrophysics	6,260,000	4,910,000	3,350,000
Materials	3,455,000	3,987,000	4,555,000
Applied mathematics	1,120,000	960,000	975,000
Total	$14,320,000	$12,712,000	$11,000,000

During the past year, Fluid Physics research has resulted in a significant advancement in gas-dynamic laser research with the recent demonstration of an all chemical laser. This new chemical laser is the first for which continuous operation is achieved solely by mixing commercially available bottled gases together. The potential advantages of this chemical CO_2 laser (in comparison with those of the highest power, conventional, electrically-excited CO_2 lasers) are its compactness and simplicity, and the fact that no electrical power or thermal sources are required for excitation. High power, high efficiency gas-dynamic lasers, with their compactness and simplicity, show great promise for such applications as space communications and power transmission to satellites.

A research program on the flow field analysis of rarefied gas has provided an exact analytical method for predicting heat transfer, skin friction coefficients, and pressure coefficients on space vehicles flying through the upper atmosphere. Accurate prediction of such rarefied gas-dynamic quantities can become significant for certain designs of the space shuttle. Other methods currently being used start to lose accuracy in the slip flow regime (20 - 40 mile altitude) and eventually become invalid in the transition flow regime (40 - 80 mile altitude). This exact method of prediction will also provide a guide for obtaining good experimental data in low density wind tunnels.

Recent research in the Electrophysics subprogram resulted in internally modulating a semiconductor laser which consequently transmits in a manner similar to an FM broadcast station. Because of its small size, this type laser should be useful in spacecraft communications.

Last year a new and very sensitive gallium antimonide pressure transducer was described, mounted at the tip of a catheter, to monitor blood pressure variations. Further progress has been made in reducing the size so that the transducer can now be placed in a hypodermic needle. Several hospitals have become interested in experimenting with the device.

Research on superconductors to increase the transition temperature will be continued by investigating the effect of depositing a polarizable inorganic film on a superconductor to induce some electron-pair formation without the intervention of phonons. A further step will be the laying of a more highly polarizable organic film on a superconductor to accentuate

pair formation still further through the interaction of electrons with the positive charges in the film. Hopefully, the transition temperature will be greater than the present upper limit of 21° K because of additional electron pairs induced in the superconductor by the polarized film.

Thin film amorphous semiconductors possess unusual switching and memory characteristics. This behavior could lead to useful applications in computer systems. Intensive research is underway to determine the responsible fundamental mechanisms in order to later develop reliable components.

For applications in space propulsion and power, plasma dynamics research is concerned presently with high power density ionized gases and their interactions with electromagnetic fields and confining wall structures. In this context, the unique characteristics of uranium plasmas are being explored, such as the radiation, spectra, and transport of the charged fission fragments. Plasma instabilities and boundary layer effects are also being investigated.

Space-related materials research ranges from studies of the relationship between the electronic structure of solids and their physical and mechanical properties to investigations of how materials behave in a space environment.

In the past, research on materials for electronic applications has yielded improvements in the performance of lithium ferrites for memory cores for high speed computers. This improved material has now been incorporated into onboard spacecraft computers. The continuing requirement for improved computer memories has stimulated additional research projects for this coming year on new and potentially higher memory storage capacity magnetic materials for future spacecraft.

In the area of alloys research, added emphasis was placed on increasing the use temperature of nickel and cobalt base superalloys for the space shuttle. The principal direction of the work in the next year will be on strengthening these alloys by dispersing inert oxides in the alloys. It is believed that such materials are a prime candidate for large areas of the skin of the space shuttle. Efforts on fiber reinforced superalloys will be continued at about the same level as last year to provide an alternate research approach to increasing the use temperature of these alloys. High temperature materials research will also be maintained in the refractory materials which in the past have been primarily of interest for space power but are now finding additional interest for the space shuttle.

Most high strength materials fail in a brittle and catastrophic manner, because as the strength of ceramics and composite materials increases, their ductility generally decreases. The Materials subprogram will increase its emphasis during the coming year on studies of fracture and failure mechanisms particularly as they relate to the use of these materials for advanced space missions. The knowledge gained will also be used to develop theories for predicting the life of such materials when they are subjected to complex patterns of temperatures and loads for long times. This data is particularly needed for advanced spacecraft having long mission times.

Applied mathematics research is currently being carried out on many diverse space related problems. Among the most significant are new ways to reduce, represent, and interpret data, a method for ranking and selecting among several alternatives, development of methods for scientists and non-scientists to interpret research results, and new methods of representing stochastic or random processes.

The results of the research in progress will not only help solve some of NASA's important problems; they will augment other technological approaches in pollution, health, transportation, and education.

In the immediate future, the Applied Mathematics subprogram will focus on mathematical approaches for recognizing patterns (e.g. cloud cover, ocean currents, crop damage, etc.), methods for retrieving information from very large stores of documents and data, new automatic problem solving methods using modern theorem-proving research, and research into adaptive robots for taking over some of man's functions in an unfriendly environment.

Mr. EVINS. Your basic research program had reduced from $20.2 million in 1969, to $18.9 million in 1970, and to $17.6 million in 1971.

SONIC BOOM

The results of several theoretical investigations of aircraft configuration have indicated that significant sonic boom reductions are potentially feasible. It is always potential. We provided money in here to build a noise reduction center and we still have not gotten the answer.

Has this any connection with the supersonic transport aircraft program? What results have you been able to achieve?

Mr. NICKS. The research mentioned on the reduction of the sonic boom is related to the supersonic transport. Theoretical work is continuing to see if the pressure waves caused by the boom can be modified by the shape of the aircraft to lessen the sonic boom problem.

Now I must admit that while this research summary sounds hopeful, there is a lot of debate on this, Mr. Chairman. It is not at all clear to me that this will lead to a simple way to reduce the problem of sonic boom.

Mr. EVINS. NASA is working on it and private industry is working on it, but there are no appreciable results.

Mr. NICKS. The theoretical research results look promising but there are many steps that you have to apply those; that is why I am being cautious in saying we are making progress.

AIRCRAFT POLLUTION

Mr. EVINS. What about pollution emanating from aircraft, are there any achievements, any breakthroughs, any progress?

Mr. NICKS. As you probably read, it is expected that the black smoke we see coming from jets will be eliminated within a couple of years. This will be primarily made possible by changing the combustion chambers, so that the fuel is more completely burned in the combustion process.

Now this will be of great help to us to have clearer skies around the airports. However, there is still work to be done in reducing the more or less invisible pollutants, such as the nitrous oxides. We are continuing to work on that. Altogether, if you took a cross section of the advanced research and technology efforts pertaining to pollution—noise, sonic boom and chemical—you will find the total effort to be on the order of $15 million.

NOISE REDUCTION

Mr. EVINS. You indicate that studies are also being continued to determine the flow mechanisms by which noise reductions are achieved in the jets. To what extent?

Mr. NICKS. This is a very interesting area. The research phase is on the basic phenomena, what causes these noises, their nature, and what might be done to stop noise at its source.

It is interesting to me that we are now in the process of designing an engine for people who never use it—the ones on the ground who do

not fly. Trying to make engines quieter is a new challenge for an aeronautical engineer. But we see great possibilities there.

The engine nacelle acoustic treatments of existing engines and the new quiet engine itself, which is a rather large program going on this year offer both short and long term solutions.

Mr. BOLAND. Who else is doing research in noise reduction? Are you doing it for FAA or is FAA doing some of its own research in this area?

Mr. NICKS. The FAA is also working on noise. We are closely coordinated with the FAA and other government groups in the interagency aircraft noise abatement program.

Dr. PAINE. Also HUD and other people who belong to this group.

SST PROGRAM

Mr. BOLAND. You talked about the research program on the sonic boom, most of it attuned to the SST program.

Should we slow down the SST program to determine whether or not you can actually reduce the boom or eliminate it if the configuration of the plane is different?

Mr. NICKS. Sir, my opinion on that is negative. Oftentimes, parallel work on problems produces answers in time to fit into the development process. If they should not, as, I believe, is the case here, and since there are so many uses of the supersonic transport in places where the boom is tolerable, such as overocean flights, I believe there is a net gain to the country by going ahead with development of the supersonic transport.

Mr. BOLAND. Thank you.

SPACE VEHICLE SYSTEMS PROGRAM

Mr. EVINS. Gentlemen, let's turn to the "Space vehicle systems program" and place in the record pages RD 11–1 through RD 11–6.

(The pages follow:)

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1971 ESTIMATES

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY — SPACE VEHICLE SYSTEMS PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The Space Vehicle Systems program is an applied research and technology program. The primary objectives within the disciplinary areas of aerothermodynamics, structures, and space environmental protection and control are to (1) conduct focused research and technology efforts on critical problems associated with the reusable space shuttle, the space station, lunar exploration, and planetary vehicles, and (2) conduct carefully selected advanced technological research of particular importance for all types of unmanned and manned space vehicles.

The program also includes the formulation of space vehicle design criteria documents as well as a special activity concerning aerospace safety.

SUMMARY OF RESOURCES REQUIREMENTS:

Research and Technology:	1969	1970	1971
Space vehicle aerothermodynamics.	$9,116,000	$9,673,000	$7,300,000
Space vehicle structures.....	9,496,000	10,355,000	12,050,000
Space environmental protection and control.....	10,603,000	8,048,000	7,800,000
Space vehicle design criteria....	1,669,000	1,394,000	1,350,000
Aerospace safety research.....	465,000	1,200,000	1,500,000
Total.....	$31,349,000	$30,670,000	$30,000,000

Distribution of Program Amount by Installation:

Manned Spacecraft Center.....	$947,000	$1,740,000	$1,050,000
Marshall Space Flight Center.....	3,462,000	3,943,000	3,035,000
Goddard Space Flight Center.....	2,351,000	2,400,000	1,475,000
Jet Propulsion Laboratory.....	1,710,000	1,465,000	1,475,000
Ames Research Center.....	3,560,000	3,165,000	3,100,000
Electronics Research Center.....	425,000	389,000	---
Flight Research Center.....	1,220,000	1,205,000	1,200,000
Langley Research Center.....	13,482,000	12,452,000	13,985,000
Lewis Research Center.....	3,070,000	2,910,000	3,300,000
NASA Headquarters.....	1,122,000	1,001,000	1,380,000

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BASIS OF FUND REQUIREMENTS:

Space Vehicle Aerothermodynamics

	1969	1970	1971
Research and technology.....	$9,116,000	$9,673,000	$7,300,000
Subtotal.....	$9,116,000	$9,673,000	$7,300,000
Scout (Launch Vehicle Procurement Program).....	($200,000)	($300,000)	($1,000,000)
Total (including Launch Vehicles).....	($9,316,000)	($9,973,000)	($8,300,000)

The main thrust of this subprogram in FY 1971 is research focused on critical aerothermodynamic problems associated with conceptual vehicle configurations and with detailed aerothermodynamic design of (1) the manned space shuttle and (2) advanced unmanned planetary atmospheric probes. Beyond these focused efforts, an important body of more generalized aerothermodynamic research is conducted that is broadly applicable to all types of space vehicles.

The stringent requirements of reuse and operational economy of large multistage space shuttle vehicles pose unique problems in aerodynamic stability, control, atmospheric entry heating, and in heat protection system design. These important factors interface strongly with the need for new, more efficient structural concepts and with consideration of payload, volume, crew quarters, fuel tanks, and other operational necessities. Emphasis will be directed toward (1) investigating the aerodynamic performance, stability, control and flying qualities of promising space shuttle concepts and (2) more accurate determination of the aerodynamic heating environment to permit efficient design of heat protection systems all within the realistic limits of vehicle weight and structural considerations.

The cooperative NASA and USAF lifting-body flight research program is investigating piloting problems and flying and handling qualities of configurations representing concepts of manned reentry vehicles during the terminal phases of space flight, i.e., from supersonic speeds to landing. Fifty-five glide and powered flights have been accomplished on three separate vehicles as of January 1. The powered HL-10 has been flown to a Mach number of 1.6 and an altitude of 80,000 feet. During FY 1971, the HL-10 will be used to study powered approach and landing and terminal guidance, and to complete the investigation of flight stability and control at transonic speeds begun during FY 1970. The X-24A had its initial flight in April 1969, and will be flight tested through its design envelope up to a Mach number of 2.0 at an altitude of 80,000 feet. The rebuilt M2-F3 will resume flights to investigate modifications made to the vehicle to improve its aerodynamic characteristics and to investigate reaction jets for controlling the vehicle.

Research will continue on promising concepts for advanced unmanned planetary atmospheric probes and soft landers. Investigations will be conducted to provide improved ablation heat protection from the extreme heating encountered during Venus and Jupiter atmospheric entry. Technology for advanced inflatable systems to decelerate vehicles during Mars atmospheric entry will be developed to increase instrument payload capability. Flight experiments are planned to confirm deployment, drag, stability, and performance of a promising decelerator concept.

Development of a planetary atmosphere experiment scheduled for a flight test in the Earth's atmosphere in FY 1971 will continue. The planned high-speed trajectory will simulate the entry conditions for a planetary mission. The test will investigate the ability to determine in flight the structure and composition of an unknown planetary atmosphere from measurements of the probe vehicle motion and the ambient gas characteristics.

Broader, longer range advanced technology activities include detailed investigations of the complex interactions of the by-products of ablation, advanced methods for predicting vehicle motions during flight, the conditions of extreme heating of vehicles experienced upon reentering the earth's atmosphere at planetary return speeds of 50,000 feet per second or more, and special programs in support of the Department of Defense.

Space Vehicle Structures

	1969	1970	1971
Research and technology.....	$9,496,000	$10,355,000	$12,050,000
Total.....	$9,496,000	$10,355,000	$12,050,000

During FY 1971 efforts will be directed to advancement of structures technology to meet the critical needs of the reusable space shuttle, the space station and space base, lunar exploration systems, and planetary vehicles. Also, continued emphasis will be placed in important areas of structures research having broad ranges of applicability to future space systems and in determining feasibility of promising advanced concepts.

The technology program is directed toward solving the unique and difficult structures problems of reusable space shuttles. Each stage must withstand repeated launch, reentry, cruise, and landing conditions with many critical loading and temperature environments. Increased efforts will be focused on lightweight, highly efficient structures that are a prerequisite to successful space shuttle development. Reusable thermal protection systems and other vital components that must withstand extreme temperatures repeatedly will be studied extensively.

Problems in the structural design of space stations and space bases that will receive attention include the dynamics of very large flexible vehicles, provisions for artificial gravity, docking, maintenance, and repair for long operational life.

Future expansion of lunar exploration activities will require improved systems with lightweight structures. Technology will continue to be developed for shelters and equipment to permit extended and more versatile manned operations.

For planetary missions beyond Viking, research will continue to be focused on critical structures such as advanced aeroshells for entry into planetary atmospheres and larger, lightweight erectable spacecraft antennas for communication during missions to the more distant outer planets.

In addition to the foregoing, structures technology will be advanced for application to critical subsystems for a variety of space vehicles. Significant progress has been made in technology for pressure vessel design and prolonged storage of cryogenic fluids such as liquid hydrogen, but continued research is needed to provide more detailed data to meet the exacting requirements for engineering design of future systems. For some advanced missions, new and unique structural concepts are needed to achieve feasible approaches, and efforts will continue to explore such concepts. Scale models of a proposed large orbital radio telescope will be tested in the laboratory and in flight to confirm the potential of the concept for a future prototype system.

Space Environmental Protection and Control

	1969	1970	1971
Research and technology.....	$10,603,000	$8,048,000	$7,800,000
Subtotal.....	$10,603,000	$8,048,000	$7,800,000
Scout (Launch Vehicle Procurement Program).....	(---)	(---)	($1,100,000)
Total (including launch vehicles).....	($10,603,000)	($8,048,000)	($8,900,000)

This subprogram seeks to understand the effects of the space environment on space vehicle design, and to provide the technology required for environmental protection and control.

During FY 1971, research will be continued in the laboratory and in flight experiments to provide engineering technologies required for design of the space station/space base, the space shuttle, and extended lunar exploration systems. These activities include a more accurate definition of the space radiation environment as it affects vehicle design, development of advanced radiation dosimeters, and investigations of more versatile heat rejection radiator concepts, along with the associated advanced thermal analyses and thermal/vacuum testing techniques. Increased attention will be given to problems of contamination of optical surfaces which have been encountered recently in space. Meteor observations from ground stations will continue. A flight experiment initiated in FY 1969 will be developed for launch in FY

1972 to measure the effectiveness of a meteoroid bumper in the actual space environment. These measurements, together with secondary measurements of meteoroid velocity and impact flux in the same experiment, as well as in another preliminary flight experiment in late FY 1970, will provide data for design of meteoroid protection systems and correlation with ground-based experiments.

Research will be undertaken to provide technology required for future interplanetary missions. Work will continue on meteoroid technology experiments to be carried on Pioneer F and G spacecraft. These experiments will assess the meteoroid hazard to spacecraft as the vehicles pass through the asteroid belt. In other ground-based research, emphasis will be placed on studies of active spacecraft temperature control techniques, with particular attention to heat pipes. Also, attention will be given to improvement of solar simulation capabilities at the high intensities encountered on missions to the inner planets.

As in prior years, an advanced technology program of broad applicability will include refinement of radiation shielding design techniques, improvement of understanding of the mechanics of hypervelocity impact and related simulation testing capabilities, the development of more stable thermal coatings, and the improvement of thermal/vacuum simulation and testing techniques.

Space Vehicle Design Criteria

	1969	1970	1971
Research and technology.....	$1,669,000	$1,394,000	$1,350,000
Total.....	$1,669,000	$1,394,000	$1,350,000

In this subprogram, criteria and models of the environment applicable to the design of space vehicle structures, propulsion systems, and guidance and control systems are developed, documented and published. Technical experts at the NASA field centers, the Jet Propulsion Laboratory, the aerospace industry and universities work together to formulate the criteria and recommend approaches to be followed to insure the continued development of reliable and efficient space vehicles. These criteria are based on the experience gained from past design and operational experience and the latest results from research.

Activities during FY 1969 and FY 1970 are expected to lead to the release of approximately twenty new design criteria monographs. The FY 1971 funds will be used to contract for the services of technical experts from outside the Government who have the knowledge and experience to continue this effort.

Aerospace Safety Research

	1969	1970	1971
Aerospace safety research.....	$465,000	$1,200,000	$1,500,000
Total.....	$465,000	$1,200,000	$1,500,000

The Aerospace Safety Research and Data Institute (ASRDI), which was recently established, has played an active and increasing role in support of aerospace safety improvement. A key responsibility of the ASRDI is the Aerospace Safety Data Bank which was established to collect and disseminate information on aerospace safety and is scheduled for initial operation in early 1970.

Initial implementation of reference storage and retrieval is planned for February 1970. At this time, the ASRDI staff shall have on-line acess to the NBS Cryogenic Information Center files and the AEC Nuclear Safety Information Center files, as well as the NASA Scientific and Technology Information Aeropsace reference files.

Several research programs, planned for FY 1971, will seek practical solutions to extremely pressing safety problems. A program to identify and develop improved techniques for detecting and extinguishing fires in manned spacecraft which was initiated in FY 1970 at the request of the OMSF will be continued. Much of the work will also intrinsically have application to aircraft. Other programs are being pursued (1) to develop practical engineering safety criteria for roadable cryogenic dewars to assist the Department of Transportation in establishing testing standards, (2) to provide increased understanding of the potential shrapnel hazards resulting from explosion of liquid propellant systems on launch pads, and (3) to study in detail the operational safety problems related to the use of liquid hydrogen in large quantities as proposed for the manned shuttle spacecraft.

Mr. EVINS. The space vehicle systems program in 1969 was $31.3 million, in 1970, $30.7 million, and in 1971 you are requesting $30 million. You state that efforts in 1971 will be directed toward the advancement of structures technology to meet critical needs of the reusable space shuttle, the space station and space base, lunar exploration systems, and planetary vehicles. You are sort of duplicating in this program what we are funding in another place.

How long do you expect this to continue?

Mr. NICKS. Mr. Chairman, our job in advanced research and technology is to stay out in front of the others, and also to help apply the technology that we have developed from the past when there is a project that needs it. So we are heavily involved in trying to insure that developments in the shuttle and space station technologies get properly fed into those systems.

It is not unlike the job of the air-conditioning firm that has to provide more than the compressors and pumps, but also the installation engineering service to help insure they are properly applied.

Mr. EVINS. To continue your advanced technology?

Mr. NICKS. Yes, sir.

PROBLEMS IN SPACE SHUTTLE AREA

Mr. EVINS. The stringent requirements of reuse and operational economy of large multistage space shuttle vehicles pose unique problems in aerodynamic stability, control, atmospheric entry heating, and in heat protection system design. These important factors interface strongly with the need for new, more efficient structural concepts and with consideration of payload, volume, crew quarters, fuel tanks, and other operational necessities.

Emphasis will be directed toward:

(1) investigating the aerodynamic performance, stability, control and flying qualities of promising space shuttle concepts, and

(2) more accurate determination of the aerodynamic heating environment to permit efficient design of heat protection systems all within the realistic limits of vehicle weight and structural considerations.

How far along are we in these programs?

Mr. NICKS. We are in the process of assessing that carefully right now with the phase B shuttle studies that are going on.

We believe that we have enough know-how to do most of the things needed for the shuttle. We are, however, emphasizing certain areas that came up a bit short, and where possible payoffs can be achieved. The shuttle is a great challenge to aerospace designers to reduce operating costs. I think this effort will also produce some byproducts very useful to us.

Mr. EVINS. In space vehicle design, you state that the 1971 funds will be used to contract for the services of technical experts outside the Government who have the knowledge to continue this effort.

Mr. NICKS. Yes, sir. Some of our work is done outside but as you recognize, in the advanced research and technology, a large part is done with out own research people.

ELECTRONICS SYSTEMS PROGRAM

Mr. EVINS. Let's turn to the "Electronics systems" section and place in the record pages RD 12–1 through RD 12–11.

(The pages follow:)

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1971 ESTIMATES

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY — ELECTRONICS SYSTEMS PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

Aeronautics Research and Technology

Modern aircraft rely heavily upon electronic systems both in the fundamental operations necessary to atmospheric flight and in the interactive functions between the vehicle and its external environment. As aircraft speed, size, complexity and the density of air traffic increase, the dependence on electronic aids in all aspects of aircraft operations multiplies rapidly. The objectives of applied research and development efforts in aircraft electronics, or avionics, are to provide advances in technology which significantly improve the performance, cost effectiveness and reliability of avionic systems, offer important new functional capabilities and solve interface problems between flight operations and the operating environment.

While a broad base of fundamental knowledge in avionic systems and components is necessary to maintain competency over a period of years, specific techniques and components which are pacing items in near term aeronautical applications must be selected and developed in periods of constrained resources. This program is aimed at the development of such items including economical collision avoidance systems, all-weather landing techniques, improved display systems, effective vertical and short take-off and landing techniques and advanced components for control, communications, navigation and guidance.

Space Research and Technology

Achievement of space mission objectives is completely dependent on the successful operation of the systems and subsystems which comprise the space vehicle and couple it to the terrestrial world. Electronics is a key element in most of these systems. The objective of the Electronics Systems program is to insure the availability of components, subsystems and systems which will permit continued success in future space missions. This objective is pursued through a selected program of applied research and development in the functional areas of guidance, control, communications, tracking, instrumentation and data processing. Common to each of these areas and supporting their development is a more fundamental research and development effort in electronic techniques and components which applies recent advances in solid state physics to the development of new and improved electronic devices for system applications.

Special emphasis is being devoted this year to the development of technology which will provide an integrated electronics system for the Space Shuttle Vehicle and an advanced information processing system for the Space

Station/Base program. This effort is drawing on the broad base of fundamental electronics knowledge established through prior years' research and development activity. The work is accomplished through a coordinated program of in-house research among the various NASA centers supplemented by contractual efforts with academic and industrial facilities where necessary.

SUMMARY OF RESOURCES REQUIREMENTS

	1969	1970	1971
Aeronautics research and technology	$11,100,000	$10,495,000	$5,800,000
Space research and technology			
Supporting research and technology	22,960,000	22,705,000	16,600,000
Flight projects	400,000	300,000	---
Total	$34,460,000	$33,500,000	$22,400,000
Distribution of Program Amount by Installation:			
Manned Spacecraft Center	---	$425,000	$700,000
Marshall Space Flight Center	$2,180,000	2,870,000	3,790,000
Goddard Space Flight Center	2,801,000	3,130,000	3,940,000
Jet Propulsion Laboratory	2,891,000	3,540,000	2,660,000
Ames Research Center	3,231,000	3,235,000	4,787,000
Electronics Research Center	16,048,000	13,665,000	---
Flight Research Center	740,000	725,000	900,000
Langley Research Center	4,555,000	4,510,000	4,723,000
NASA Headquarters	2,014,000	1,400,000	900,000

BASIS OF FUND REQUIREMENTS:

Aeronautics Research and Technology

Advanced concepts	$3,120,000	$3,280,000	$1,200,000
Guidance systems	3,000,000	3,100,000	1,260,000
Control systems	3,000,000	2,507,000	1,857,000
Communications	200,000	125,000	125,000
Tracking and data acquisition	400,000	100,000	150,000
Data handling and processing	140,000	175,000	175,000
Instrumentation	1,240,000	1,208,000	1,033,000
Total	$11,100,000	$10,495,000	$5,800,000

Advanced Concepts

Advanced Concepts research is directed toward defining future electronic systems and their applications. Objectives include the understanding of the interactions between system, subsystem and environment, and the development

of advanced technology and new techniques relative to system accomplishment. Concentration, as in previous years, continues to be placed on aircraft, or avionic systems.

A research effort being conducted under the Advanced Concepts area is aimed at aiding in the solution of the air traffic congestion problem. The landing rate per instrumented runway can be significantly increased if the basic aircraft separation standards are reduced. This reduction cannot occur under all-weather conditions without violating safety standards until it can be demonstrated that aircraft can fly precise time and path constrained trajectories. The proposed use of inertially derived translational information in conjunction with ILS and automatic flight control equipment is a new concept that has been shown analytically to be capable of up to a factor of four improvement in lateral dispersion at touchdown. A joint NASA-FAA flight evaluation of this development will be conducted in late FY 1970. With the closure of the Electronics Research Center (ERC) this effort will be transferred to the Langley Research Center for completion.

The continuing effort in V/STOL avionics will begin flight test of several system components in FY 1971. The basic avionics system will serve as a test bed for the evaluation of advanced components such as a laser gyro inertial reference unit and a redundant sensor system. Through FY 1970, this program was conducted at ERC. In light of the closing of that facility, the FY 1971 effort will be transferred to the Ames Research Center.

The current commercial jet aircraft and the "jumbo" jet now in service are incorporating into their control, guidance and navigation systems a high degree of automation. Because of advances in electronic systems, these aircraft will also have some increased capacity for precision in enroute and terminal area navigation. A research effort is underway to develop systems criteria for defining the pilot's role in systems with varying levels of automation. Efforts in FY 1971 will emphasize both simulation and flight test of representative pilot managed systems.

Guidance Systems

In the area of backup or independent landing aids for aircraft, the first pilot flight evaluation of STOL aircraft landing under low visibility conditions using a pilot display generated by onboard equipment and ground based beacons has demonstrated the feasibility of the technique. Further efforts will include evaluation of improved displays and incorporation of simplified inertial sensors in the system. A new effort to determine the feasibility of using passive radiometric techniques for low visibility landing is currently under study. Hardware efforts planned to begin during the last half of FY 1970 will be continued in FY 1971.

Efforts on optimization of guidance and navigation for supersonic aircraft climb and cruise will be continued. This will include the application of fixed time of arrival techniques developed for space to aircraft navigation.

Control Systems

Proper integration of man into a complex aeronautical vehicle's control and guidance system requires a detailed quantitative description of the human operator performance characteristics. Design of both the display and control systems are heavily dependent upon the humans capabilities and limitations. A continuing research effort is directed toward defining the capabilities and requirements of the human operator when he is placed as an active element in the control system. A result of this program has been the development of techniques and a body of knowledge useful in determining optimal information display-pilot-vehicle control interfacing.

Current efforts will extend these techniques and knowledge to include the prediction of pilot workload and the optimization of human performance in multidimensioned tasks such as an aircraft approach and landing.

In the aircraft components area, emphasis is on reliable, low cost performance for general aviation applications. Fluidic components for autopilot subsystems have shown considerable promise and development efforts will be continued in FY 1971.

The results of efforts on fluidic components will be incorporated in fluidic subsystems for light airplane flight evaluation. An X-14 aircraft is being modified to be a flight test bed for VTOL aircraft control investigations. These investigations will be aimed at developing advanced techniques for improved attitude, altitude and translational stability and control.

Communications, Tracking and Data Acquisition

Flyable models of both microwave and optical pilot warning indicators have been constructed. The microwave system performed satisfactorily in flight tests, and future effort will be directed toward making it light and inexpensive enough for use by general aviation. The optical system will be flight tested and the results turned over to the Federal Aviation Administration and industry for decisions on rule making and for construction of production models.

Data Handling and Processing

Digital computer systems play leading roles in the analysis of aircraft configurations and design factors. Research on techniques for utilization of large ground computer complexes has yielded important contributions in several NASA studies of aircraft design for the DOD in the past year. In FY 1971 efforts in this area will continue with emphasis on techniques for increasing the real-time simulation processing power of computer systems, reducing the down-time of elements in these systems, and developing methods of measuring and analyzing the efficiency of large ground computer complexes in solving complex simulation and design problems.

Instrumentation

In support of future aeronautic programs and associated test facilities, advancement of measurement capabilities is needed for a wide variety of physical parameters.

An instrument technique based on use of a vibrating diaphragm and originally developed with considerable success to measure aerodynamic pressure in wind tunnels has been applied to a variety of other uses because of its excellent characteristics of ruggedness, small volume and wide measuring range - 8 decades. Its potential capability as an aircraft altimeter with a predicted resolution of 10 feet at 100,000 feet altitude is planned to be tested in high altitude aircraft flights during FY 1971.

Supporting the V/STOL program, progress was made in the development of a fluidic wind velocity indicator to accurately measure low relative air speeds during transition and hover. Wind speeds as low as .3 ft/sec have been measured in wind tunnel tests with a single axis model. Continuation of prototype development and flight testing is planned for FY 1971.

The laser backscatter technique discussed in prior years, for measuring atmospheric density, was used during 1969 as part of NASA participation in the Barbados Oceanographic and Meteorological Experiment project. The laser instrumentation was successfully used aboard ship for the first time to measure spatial and temporal distribution of aerosols and the reflectivity of thin clouds and moisture layers. This knowledge will contribute to better meteorological forecasting and better understanding of the errors in sea surface temperature measurement by satellite. In FY 1971 the technique will be extended to multifrequency operation to permit identification of atmospheric components (molecules and aerosols) and remote measurement of water vapor profile data to better describe the meteorological state of the lower atmosphere.

Progress was also made in development of systems to detect flow turbulence remotely. Laser instrumentation techniques developed to measure flow velocities in wind tunnels by the Doppler effect were adapted to measurements of near field atmospheric turbulence caused by the trailing vortices of jet aircraft during landing or takeoff. An experimental airborne system for detecting clear air turbulence, which uses a microwave radiometer to measure temperature fluctations as a function of atmospheric oxygen absorption has been developed, and aircraft installation and flight tests are planned for FY 1971.

Space Research and Technology

	1969	1970	1971
Supporting Research and Technology			
Advanced concepts	$1,872,000	$420,000	---
Guidance systems	2,372,000	2,743,000	$2,336,000
Control systems	2,617,000	1,480,000	1,659,000
Communications	3,493,000	3,310,000	2,750,000
Tracking and data acquisition	3,995,000	3,685,000	1,912,000
Data handling and processing	3,088,000	3,975,000	3,504,000
Instrumentation	1,995,000	2,692,000	1,788,000
Electronic techniques and components	3,528,000	4,400,000	2,651,000
Total	$22,960,000	$22,705,000	$16,600,000

Guidance Systems

The feasibility of onboard spacecraft guidance for planetary approach was successfully demonstrated in an experiment on Mariner Mars 69. A new concept for increasing accuracy by using the moons of planets for approach guidance is being explored with the objective of performing an advanced experiment on Mariner Mars 71. Research on strapdown celestial sensors using conventional as well as holographic star mapping techniques will be continued for use as earth orbital spacecraft attitude references.

Development of electromagnetic sensors for more reliable horizon sensors, star tracker and planet approach guidance will be continued. Efforts on devices for calibrating infrared radiometers have yielded a factor of five improvement in calibration accuracy. These results will be incorporated in a calibration system to be completed in FY 1971. Design of a precision horizon measurement radiometer will be completed early in FY 1971 and development of a breadboard system initiated.

Automatic reentry, approach and landing of space shuttle vehicles has been identified as a significant technology area. Studies to develop guidance techniques for all of these phases will be initiated in FY 1970 and continued in FY 1971. In the landing phase, this effort will be closely coordinated with on-going work to evaluate, in flight, the applicability of inertial filtering of Instrument Landing System reference beams used by conventional aircraft.

The optical laser rendezvous and docking radar is a strong candidate for space shuttle application. Along with continued efforts to refine its performance, a study is being initiated to determine the parameters needed for shuttle application. This effort will lead to a laboratory prototype development in FY 1971.

Control Systems

In automatic control systems, areas of effort include components, systems, and flight experimentation. The space vehicle components effort emphasizes devices for improving the lifetime, precision and reliability of control systems. As a follow-on to the successful development of brushless, direct current motors, a motor combining magnetic suspension and a brushless commutator has been developed. This technology will be applied as the motor for a long-life reaction wheel control device.

Passive gravity gradient stabilization techniques developed in previous years have shown considerable promise but because of limited accuracy and technical problems, they have been used in one or two axis systems for applications requiring only modest performance. Recent control theory results have produced a technique for improving attitude estimation and prediction which offers promise for application to advanced earth resources satellites and will receive increased emphasis in FY 1971.

A major effort in the space vehicle control systems area is directed towards control of the space station/base and the experiment platforms requiring precision pointing. In addition to this effort, the change to a Saturn V launched workshop in the Apollo Applications program has required additional supporting control system analysis and simulation.

Current efforts on components for extending the operating life and improving the performance of the large control moment gyro (CMG) will continue in FY 1971, aimed at space station requirements for long term mission reliability. These efforts include advanced designs of speed reducers and control systems incorporating brushless DC motor torquers. Advanced bearing technology has yielded promising results for inertial and large control gyros and will be continued.

Communications, Tracking and Data Acquisition

Space communication and tracking systems of the future require unusual technological progress in three specific areas: electronically steered antennas, use of higher frequencies, and longer life. Progress is also needed on a broad front in all areas of technology, but these are the limiting factors in the most important mission areas of the future and will be main thrusts of the fiscal year 1971 research program.

Future electronically steered (phased array) antennas are particularly important to NASA space missions and are in some cases an actual necessity to meet mission requirements. An example of this is the Navigation/Traffic Control Satellite now under study which must communicate rapidly and sequentially to different aircraft in transit over the Atlantic or Pacific oceans.

The need for expansion of communication services continues to grow and considerable effort will be devoted to the development of circuit components of all kinds for the higher wavelengths which offer the only room for

expansion. One example of this is the waveguide which is used to carry millimeter wave signals from place to place within a receiver or transmitter. Traditionally these have been made by extruding square pipes or waveguides which at millimeter wavelengths become so small, they are almost unmanageable. A new technique developed at the Goddard Space Flight Center uses flat strips of metal or dielectric material with fences on each side. This structure operates at the same wavelengths, permits easier access to the guided signal and is larger and, therefore, more manageable. This, and similar activities, will be continued in FY 1971.

Long life components are required for all NASA missions but especially for the outer planetary scientific spacecraft. A broad spectrum of effort will be devoted to increasing component lifetime in fiscal year 1971. An example of this work is a turret cathode developed at the Jet Propulsion Laboratory. This device permits automatic replacement of a deteriorated cathode in a microwave tube by the simple process of rotating the turret to a new position.

Work will also continue in the broad areas of telescope technology, optical communications and tracking, coding for high data rate communication, and microwave solid state components.

Data Handling and Processing

The need for automated monitoring and control of more onboard functions plus demands for greater reliability and longer lifetimes have added to the technological challenge of advances in computer performance and data processing techniques. Laminated ferrite memory development, started in 1964 to obtain a high capacity, radiation resistant, low cost computer memory, was found to be applicable also to computer logic circuits and offers promise of "all magnetic" digital circuits with few interconnections. During the past year problems in material production were solved and considerable progress was made in the fabrication of memory components. This technology will be actively pursued in FY 1971 for application to computing devices required for Space Shuttle/Station and Grand Tour missions.

In the longer range research program to obtain large computer memory capacities of 10^{10} and 10^{12} bits, progress was made in the investigation of photochromic and magneto optic materials in system studies of laser deflection techniques and in volume holographic storage techniques. These efforts will be continued in FY 1971.

In the field of onboard computers, a reliability model of the self test and repair concept was developed last year which indicated the possibility of 12 years of operation with 90% reliability if triple redundancy is used. Originally started as a guidance computer system, this effort is being expanded to perform functions such as automated in-flight testing and maintenance monitoring for a space station.

Two general approaches are being pursued to provide maximum information from large volumes of video data - one is to extract only required, useful,

information by means of techniques such as pattern recognition and automated image classification; the other is to use "compression" techniques so that more information can be transmitted over a given telemetry channel. In the past year, progress was made in both the development of mathematical pattern recognition techniques and in the development of a system for onboard image data compression using coherent optics to yield a data compression ratio of 100 to 1. These efforts will be continued in FY 1971.

In a concentrated effort to obtain solutions to aerospace software problems (SOFIX), grants were awarded in FY 1970 to 8 universities and one nonprofit organization in the areas of language, parallel computation and computer system design. Initial results of this effort will be evaluated in FY 1971 and support will be continued in the areas which promise maximum benefit.

Instrumentation

Research efforts to advance sensing capabilities in many parts of the electromagnetic spectrum are required to support future space measurement efforts.

For example, astronomy and earth orbital missions use photomultipliers in many experiments to detect low level light signals although their efficiency is low. Optical enhancement techniques were developed in the past year which achieved sensitivity increases by a factor of 2 to 5 permitting detection of fainter signals or use of smaller diameter telescopes. Application of the technique to image intensifiers and TV vidicons will be pursued in FY 1971.

To permit future astronomical observations from a space base to fully utilize diffraction limited space telescopes, high grade optical subsystems and image recording systems compatible with the high resolution of such telescopes are required. Development of large aspheric gratings, light converter/intensifier systems, and combined imaging and recording systems such as the dielectric camera will be initiated in FY 1971.

Electron beam flow visualization techniques for hypersonic aerodynamic studies mentioned in last years report are now in operational use and have found wide application. This method permits viewing of the complete flow field around a model and was recently used to test space shuttle configurations at Mach 20. It was possible to identify shock patterns and flow disturbances which would have been very difficult to distinguish by other methods. Additional applications of the technique will be investigated in FY 1971.

Previously, instrumentation circuits with inductive components could not be fully miniaturized. Significant progress was made in the past year on the development of "active" networks of integrated circuits as replacements for inductive components. A size reduction from 120 to 4.5cc and a weight reduction from 100 to 5 grams was achieved when applied to a magnetometer filter which originally used inductive components. Active filters will have wide application commercially in radio and TV circuits which now use inductors

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and transformers. Another instrument circuit innovation was achieved in the design of a self tuning band pass filter. Filters commonly used for rejecting noise in instrument systems are limited in performance when the input signal varies over a wide range. The self tuning filter improves noise rejection by using a narrow band-width which is automatically aligned to the varying signal frequency. These techniques will be applied to instrument system designs in FY 1971.

Electronic Techniques and Components

Solid state technology offers the electronic system design engineer great new opportunities to create systems of reduced size, weight and cost while increasing their versatility, performance and reliability. To keep pace with the system designers, a vigorous research and development program in solid state materials, components and techniques for fabrication and test of these devices is required.

Research on new materials and their applications in component form will continue to provide the electronic functions needed in system design. Particular emphasis will be placed on solid state display devices, data storage and microwave components to support Space Station technology development. As electronic devices become smaller, yet more complex, new techniques for their design, fabrication and test must be evolved. Automation of the screening and testing steps in medium and large scale integrated circuit manufacture was initiated during FY 1970 and will continue in FY 1971. Special emphasis is being given to this effort to ensure the availability of qualified devices in the Space Shuttle and Space Station Technology Programs. Standards for the design, qualification and test of these devices will be developed to guide the systems engineers in their applications work. Instrumentation and techniques to assess the reliability, and improved methods for assembling and packaging solid state devices are being developed to increase the yield and economy of the fabrication process and provide long life components for use in missions of extended duration such as the Space Station and outer planet explorations. These efforts will be continued in FY 1971.

Flight projects

	1969	1970	1971
Radio attenuation measurements (RAM-C)	$400,000	$300,000	---
Scout (Launch Vehicle Procurement Program)	(300,000)	(---)	(---)
Total (including Launch Vehicles)	($700,000)	($300,000)	(---)

Radio Attenuation Measurement (RAM)

The purpose of the Radio Attenuation Measurement (RAM) project was to verify the theory of the interaction of radio waves with a plasma by laboratory and flight tests, and to apply this theory to the prediction and prevention of radio blackout in practical circumstances. Two successful flights have been completed in this series. The first, RAM-C-I, demonstrated the use of water injection to ameliorate communication blackout during re-entry, and the second, RAM-C-II, provided valuable flight information to support the work of the theoreticians. The project will be concluded in FY 1970 with a third flight, using an available backup spacecraft, to explore the potential of electrophilic materials as a means to alleviate blackout conditions in a realistic re-entry environment. This flight is scheduled for May 1970.

Mr. EVINS. The funding in the electronics systems program goes down from $34.5 million in 1969 to $33.5 million in 1970 and to $22.4 million in 1971. We have to commend you here. Are there any questions on this, gentlemen?

Mr. NICKS. If I might say something, Mr. Chairman, on this.

Mr. EVINS. Surely.

Mr. NICKS. As has already been said a number of times, this reduction was painful to us, but it seemed the best course of action at the time.

Dr. PAINE. That is p-a-i-n-e-ful.

Mr. NICKS. I would not want the committee to get the impression that electronics technology is less important. It is very important. We are planning to proceed with other means to fill the need for advanced electronics technology.

ELECTRONICS RESEARCH CENTER

Mr. BOLAND. Is there a likelihood that you may in the future reactivate the ERC at Cambridge, I mean NASA, itself?

Mr. NICKS. Perhaps Dr. Paine should speak to that. I do not know of any plan to do so.

Dr. PAINE. We have no plan to do this. In fact, the President announced this morning, Mr. Boland, that the electronics research center will be transferred to the Department of Transportation for a transportation research center.

We look forward to maintaining very close relations with that in areas like air traffic control, but that particular center will now, of course, become a part of another Government agency.

NASA ACTIVITIES AT ERC

Mr. BOLAND. The greatest part of ERC, with respect to aeronautics research and technology is right in this tab, I noted. The reduction in the program comes about as a result of the $13.665 million reduction for the electronics research center.

Were they primarily engaged in aeronautics research and technology?

Mr. NICKS. No, sir; it worked across the board in both aeronautics and space electronics.

Mr. BOLAND. What part of it was for research which would be attuned to problems that the Federal Aviation Agency might have?

Mr. NICKS. Work on guidance systems, landing aids, collision avoidance.

Mr. BOLAND. Is not the FAA doing this type of research in some of its other facilities like NAFEC?

Dr. PAINE. Not at the level of the electronics research center. We were carrying out very basic studies there which go well beyond that.

Mr. BOLAND. Were you doing it for NASA itself or for the FAA?

Dr. PAINE. For NASA, but in close concert with the FAA.

Particularly, we would have been able to take some of the work we

have done in the area of space in the past, for example, the Gemini electronics system, and find ways of adapting this to things like V/STOL terminal guidance and control.

Again, I would expect that this work will continue in the future and we would be very happy to make available our space activity to the ERC people. I think the fact that they started in NASA and have now moved to DOD will make it very easy for us to maintain this very close coupling between new space technology and other applications in aeronautics.

TRANSFER OF ERC

Mr. BOLAND. So actually NASA is going to continue to expend considerable sums of money in aeronautics research and technology. I would assume from the announcement made this morning at 10:30 that apparently the Department of Transportation is going to use this facility for research in aeronautics. Your interest, of course, is still going to be high in this area.

Will your personnel or the Department of Transportation personnel be doing the work at the ERC? Will the programs in which you are now engaged be continued at ERC with Department of Transportation personnel?

Dr. PAINE. Actually, there is no transfer of functions from NASA to the Department of Transportation involved in this transfer of facility. We expect to probably be carrying out about $4 million worth of NASA interest aeronautics and space activity at the Electronics Research Center next year under the Department of Transportation, just as we have work done in Air Force installations and other laboratories for NASA, where they have the particular facilities and expertise to do this.

I would expect that the work——

Mr. BOLAND. Would this be a NASA expenditure at ERC?

Dr. PAINE. Yes, for work which is within the NASA charter carried out by the new Department of Transportation employees who were formerly NASA employees.

CLEAR AIR TURBULENCE

Mr. EVINS. Mr. Nicks, you speak of clear air turbulence. What causes clear air turbulence?

Mr. NICKS. Mr. Chairman, we are trying to find out what causes it. We can tell you what it is. It is probaly caused by the combination of the jet streams and the movements of the air at high altitude where you get a sheer, like the edge of a stream against the bank and then the eddy currents cause this high turbulence.

The problem with clear air turbulence is that it is not visible. There are no clouds to warn a pilot. All of a sudden he may fly into a very strong gradient which could damage the airplane. So the techniques we are trying to develop would enable clear air turbulence to be seen from the ground with lasar techniques. These new technology developments would improve the safety of flight.

GUIDANCE SYSTEMS

Mr. EVINS. You state that studies to develop guidance techniques will be undertaken in the 1971 budget. Are not the current guidance systems working well?

Mr. NICKS. This is a case where I think there can be a reverse flow of space technology to help in aeronautical technology and other areas to make this flying safer.

As you know, we are getting more and more airplanes in the air. The problem of control is growing greater.

HUMAN FACTOR SYSTEMS

Mr. EVINS. We will now turn to "Human factor systems program" and place in the record pages RD 13–1 through RD 13–6.

(The pages follow:)

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1971 ESTIMATES

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY — HUMAN FACTOR SYSTEMS PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

Aeronautics Research and Technology

Aeronautical vehicles are causing significant changes in the environment of people within and outside the vehicles. The Human Factor Systems program is developing techniques to characterize those changes and conducts research to determine the extent of their effects on man. The program examines man's requirements, his capabilities, and his limitations and translates these into design criteria for future aeronautical systems including both airborne and ground based components. Since the human is a critical element in most advanced systems, studies are being made on decision making functions and the information processing aspects of human performance, and on the effects of stress on human operators.

Space Research and Technology

In order to determine and insure man's role in future extended space operations, it is necessary to qualify both man and his supporting equipment. The qualification of man implies a detailed understanding of the unique capabilities and capacities of the human organism in space, the optimal contributions of this organism to the performance of a wide variety of space flight objectives, and the development of an ability to predict potential physiological and behavioral changes.

To accomplish this goal, both ground based research and flight projects are necessary. The ground based studies must be of such sophistication and depth as to be applicable not only to identified and predictable problems but to unpredicted problems as well. The Human Factor Systems program was initiated in the pattern of traditional medical research, but it is evolving by developing and utilizing more advanced methodologies. Innovative methods and techniques are employed. Mathematical modeling and systems analysis are already being applied to problems of the cardiovascular system.

The Human Factor Systems program includes these elements: (1) Human Research and Performance, (2) Man-Systems Integration, and (3) Life Support and Protective Systems. By necessity, the work is accomplished through a multidisciplinary approach which includes research in physiology, psychology, medicine, biology, engineering, physics, chemistry, mathematics, and electronics. It is carried out at the various NASA Centers, Department of Defense aerospace medical laboratories, other Government facilities, universities, and industry.

SUMMARY OF RESOURCES REQUIREMENTS:

	1969	1970	1971
Aeronautics research and technology	$3,000,000	$3,595,000	$2,100,000
Space Research and Technology			
Supporting research and technology	14,329,000	16,010,000	14,200,000
Biotechnology flight projects	2,073,000	2,295,000	1,600,000
Total	$19,402,000	$21,900,000	$17,900,000

Distribution of Program Amount by Installation:

Manned Spacecraft Center	$3,089,000	$4,150,000	$2,900,000
Marshall Space Flight Center	287,000	200,000	150,000
Jet Propulsion Laboratory	50,000	---	---
Wallops Station	1,073,000	1,115,000	100,000
Ames Research Center	5,815,000	5,180,000	5,700,000
Electronics Research Center	975,000	1,240,000	---
Flight Research Center	899,000	800,000	800,000
Langley Research Center	5,407,000	6,880,000	6,900,000
NASA Headquarters	1,807,000	2,335,000	1,350,000

BASIS OF FUND REQUIREMENTS:

Aeronautics Research and Technology

Human research and performance	$1,100,000	$1,445,000	$675,000
Man-systems integration	1,900,000	2,150,000	1,425,000
Total	$3,000,000	$3,595,000	$2,100,000

Human Research and Performance

Aircraft operations will increase rapidly as jumbo jets and V/STOL and supersonic transports are introduced while the number of private aircraft continues to grow. Noise pollution will become intolerable unless steps are taken to combat it systematically. The Human Research and Performance subprogram is developing techniques for predicting the level of noise an aircraft will produce before it is actually built and the effects of such noise on man. These techniques will be made available to aircraft manufacturers for use in designing less noisy vehicles and to the Federal Aviation Administration for preparing certification standards.

The utilization of man in operational aeronautical systems must be planned in a manner which will optimize overall system performance. To do this it is necessary to develop advanced techniques for evaluating the performance of the system with the human element in it. The environment

which the system imposes on the human will affect his performance both directly and indirectly; for example, directly by so vibrating the man that he may not be able to control the vehicle, and indirectly by, imposing psychological stress which alters his body system functions. A major research and development effort is necessary to provide measures of both the stresses and their effects.

Man-Systems Integration

The issues related to pilot workload during reduced visibility landing operations are being studied, including the type of information provided the pilot. Several different devices are available to project flight data, such as flight path angle, vertical velocity, airspeed, etc., on the aircraft windshield in a collimated image in the pilot's forward external field of view. The ultimate value of different data elements in landing aids displays will be determined.

Space Research and Technology

	1969	1970	1971
Supporting research and technology			
Advanced concepts	$453,000	$465,000	---
Human research and performance	5,213,000	6,087,000	$4,860,000
Man-systems integration	2,457,000	2,105,000	2,020,000
Life support and protective systems	6,206,000	7,353,000	7,320,000
Total	$14,329,000	$16,010,000	$14,200,000

Human Research and Performance

The Human Research and Performance subprogram includes research to: (a) determine the effects of flight environments on cardiovascular, respiratory, vestibular and other physiological functions, (b) develop advanced instrumentation for measuring the physiological and psychological changes caused by flight stresses, (c) identify and develop means to control the microbiological problems which may arise with crews in closed or semiclosed ecological systems in space vehicles, and (d) insure food acceptability.

As is apparent from the above listing of research areas, extensive and varied research efforts are necessary. Much has been learned but much yet remains to be done if we are to "achieve a depth of understanding about man and his role in space that will permit his optimal integration into future space programs." This requirement was set forth in November 1969 by the President's Science Advisory Committee.

In FY 1971, work will continue on the development of a test which permits the identification of viruses within as short a period as 24 hours in contrast to the normal 10 to 14 days. This fluorescent antibody

technique may be applied to preflight screening of astronauts. It may also be used for early identification of infection developed in flight so they may be treated promptly.

In cardiovascular physiology, studies will be continued on identifying the mechanisms of blood pressure control, the role of hormones in governing cardiovascular function, and the renal aspects of orthostatic hypotension. At NASA's request, a subgroup under the National Academy of Sciences' Space Science Board annually reviews the NASA cardiovascular research program to insure its scientific validity and its relevance to aerospace requirements.

Studies now in progress will be continued in order to determine the mechanism by which hypogravic environments modify the composition and morphology of bone.

Man-Systems Integration

Man-Systems Integration issues are crucial ones in the development of space vehicles. The President's Science Advisory Committee noted, "Major engineering decisions, controlling the character of possible future space stations, logistic systems, and other manned spacecraft depend on evaluation of man's potential for useful work in space..."

The Man-Systems Integration subprogram is attempting to: (a) quantify human capabilities for performing physical and mental work as an operator of space systems, and as a scientific investigator, (b) develop methods for flight and ground crew selection and identify training requirements, (c) determine man's individual behavior characteristics and group dynamics in aerospace missions, and (d) develop the technology for living and working in space vehicles and on extraterrestrial surfaces.

In FY 1971, work will continue on the development of equipment to meet the expressed needs of astronauts for off-duty activities and on the design of more efficient but habitable, work and living spaces.

The Tektite Project, early in 1969, required four scientists to live for 60 days in an underwater habitat pressurized at a nominal 42-foot depth. Data were obtained on crew selection; habitability criteria for working, sleeping, eating, waste management, and recreation; architectural design; and psychomotor performance. With continuing cooperation between NASA, the Navy, the Department of the Interior, the College of the Virgin Islands, the government of the Virgin Islands, the Smithsonian Institution, the National Science Foundation, the National Institutes of Health, and the General Electric Company, a second experiment, Tektite II, will be conducted in 1970. Further data will be obtained on the effects of isolation and confinement in a semihostile environment on crew behavior and interaction. Such data will provide a firm basis for space crew

selection and monitoring procedures and vehicle design requirements.

Life Support and Protective Systems

As the duration of man's stay in the space environment increases, the need for reliable and maintainable life support and protective systems become tremendously important.

The Life Support and Protective Systems subprogram has been designed to (a) develop techniques and hardware for personal hygiene and waste management, for the reclamation of potable water from urine, wash water, and humidity condensate, and for converting metabolic wastes into food; (b) develop techniques and hardware for regenerating oxygen and diluents (e.g., nitrogen) for extended mission durations, and for maintaining the carbon dioxide, humidity, and contaminant characteristics of cabin atmospheres within acceptable limits, (c) develop instrumentation for monitoring and controlling atmospheric composition, thermal environment, chemical and microbial contaminant levels, and system functions; and (d) develop the garments, portable Environmental Thermal Control/Life Support (ETC/LS) systems, and other aids for astronauts to perform intravehicular and extravehicular tasks.

Work has been initiated and will be continued in FY 1971 on the advanced integrated life support systems (AILSS) for missions of two years duration without resupply. This will include new components, subsystems, and systems; each will be carried through the stages of proof-of-concept, prototype, and validation in a complete system test. This must include extended life testing of all components, detailed failure modes and effects analyses, complete reliability studies, and finally manned tests to determine the man-system interactions.

Also in FY 1971, work will continue on astronaut protective systems which will maintain and support an environment in which useful work may be performed. These systems must protect man from harsh thermal radiation, micrometeoroids, and the vacuum conditions of the extravehicular environs. They must provide acceptable personal environmental conditions under both normal and emergency conditions. This technical area includes work on: (1) fire resistant materials and thermal protective garments, (2) space suits with constant volume, and (3) portable life support systems which provide five hours or more effective life support at increased work levels and such mobility as is required within anticipated mission constraints.

Biotechnology Flight Projects

	1969	1970	1971
Biotechnology flight projects.....	$2,073,000	$2,295,000	$1,600,000
Scout (Launch Vehicle Procurement Program).....	($1,100,000)	(---)	(---)
Total (including launch vehicles).....	($3,173,000)	($2,295,000)	($1,600,000)

The Biotechnology Flight projects consist of packages of experiments to fulfill needs for data relevant to the Human Factor Systems program. To the extent possible, the program's data needs are fulfilled through ground based research, using simulated flight conditions when necessary and possible. In some cases, however, the flight environment conditions can not be simulated and the data required can be obtained only in flight experiments. When possible these experiments are carried on vehicles flown for other purposes, and only when necessary are special flights scheduled.

In FY 1971, two kinds of activities will be carried out under the Biotechnology Flight projects. One will be the analysis of data obtained and preparation of a report on the Orbiting Frog Otolith experiment which is scheduled to be flown in 1970 on a Scout vehicle launched for this specific purpose. The objective of the experiment is to obtain information on the functioning of the otolith, the balance mechanism in the inner ear, which will contribute to our understanding of this mechanism and its relation to the issue of artificial gravity for long duration manned flights.

The remaining flight project activity in FY 1971 will be on experiment definition for future flights. Work will continue on the definition of experiments on the effects of weightlessness on major body systems. Other flight experiment efforts will be directed toward increasing understanding of the various regenerative life support processes in weightlessness as well as a quantification of the metabolic cost of performing useful work in space.

Mr. EVINS. You state here that noise pollutants will continue intolerable unless steps are taken to combat it. We have known that for a long time. This looks like it is almost a duplication of what you are doing in these other fields.

You have already talked about noise pollutants. Here you talk about it under the label of human factors.

Mr. NICKS. May I speak to that point?

Mr. EVINS. Surely.

EFFECT OF NOISE ON HUMAN BEINGS

Mr. NICKS. In this area we are concerned with noise and its effects on the human.

In the earlier section we were talking about what is causing the noise. The two of these are part of the same problem, of course, but you need to know what man can tolerate and why certain noises are more annoying than others and to relate this to noise fundamentals.

Mr. EVINS. I hope you can come up with some answers.

VIRUSES IN SPACE

In 1971, work will continue on the development of a test which permits the identification of viruses within as short a period as 24 hours in contrast with the normal 10 to 14 days.

Does this mean that viruses appear in space?

Mr. NICKS. You will recall that we had some astronauts get sick after they went aloft and we believe that they had been exposed and had some viruses present when they left the ground. If we had been able to detect this situation, we might have chosen other crew members.

Mr. EVINS. Did you find any answers?

Mr. NICKS. It looks as if we might be able to apply some fluorescent traces in the body that we can see and identify these viruses, and if so, we might have the chance of telling you several days before that you are going to have flu or whatever it is that you have contracted.

MAN-SYSTEMS INTEGRATION

Mr. BOLAND. In fiscal year 1971, work will continue on the development of equipment to meet the expressed needs of astronauts for off-duty activities. What does that mean?

Mr. NICKS. In a space lab, if you were in orbit for long periods—6 months to a year—there is a problem of what do you do during non-work periods?

You cannot go for a walk, and so forth. So the problem is to keep these people healthy mentally and physically.

Mr. BOLAND. In the space lab?

Mr. NICKS. Yes, sir; for a long time in orbit or on a flight to Mars, which might take a couple of years. It is something like the problem encountered during long cruises in submarines, but is, of course, worse in a spacecraft and this has to be considered.

Mr. BOLAND. Thank you.

SPACE POWER AND ELECTRIC PROPULSION SYSTEMS

Mr. EVINS. We will now turn to "Space power and electric propulsion systems programs." Place in the record page RD 14–1 through RD 14–11.

(The pages follow:)

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1971 ESTIMATES

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY — SPACE POWER AND ELECTRIC PROPULSION SYSTEMS PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The principal objective of the Space Power and Electric Propulsion program is to provide the advanced technology base necessary for the development of electric power generation and electric propulsion systems for anticipated aeronautical and space applications.

The power distribution, regulation, and control systems presently employed in aircraft are based on design concepts that are 20 or more years old. The objective of this portion of the electric power generation program is to determine whether more recent technology concepts emanating from the space program can be employed to advantage in aircraft systems.

Future missions such as the space station/base, shuttle, applications satellites and outer planets exploration require the development of electric power systems having power levels, endurances, and reliabilities far beyond those attainable with current systems which were designed to meet the relatively short duration, low power requirements associated with the first ten years of the nation's space program. Within this program, the need for nuclear system technology is becoming particularly pressing as the NASA mission requirements begin to exceed the capability of solar power systems.

The Electric Propulsion program continues to aim at early applications to achieve the potential advantages of mission flexibility and increased payload. The need for long-life, auxiliary electric propulsion systems for future manned space stations and synchronous satellites to perform station keeping is becoming evident. Studies continue to show the advantages of primary electric propulsion in performing difficult interplanetary missions. Continuing good progress is being achieved in both the auxiliary and primary propulsion systems technology areas as demonstrated by ground tests and the SERT II flight program.

SUMMARY OF RESOURCES REQUIREMENTS:

	1969	1970	1971
Aeronautics research and technology			
Supporting research and technology	---	$200,000	$400,000
Space research and technology			
Supporting research and technology	$37,287,000	33,750,000	30,225,000
Space electric rocket test (SERT)	1,500,000	500,000	275,000
Total	$38,787,000	$34,450,000	$30,900,000

Distribution of Program Amount by Installation:

Manned Spacecraft Center	$135,000	$1,405,000	---
Marshall Space Flight Center	200,000	220,000	---
Goddard Space Flight Center	3,306,000	3,150,000	$2,925,000
Jet Propulsion Laboratory	10,805,000	8,450,000	7,075,000
Ames Research Center	408,000	349,000	250,000
Electronics Research Center	1,093,000	1,420,000	---
Langley Research Center	1,377,000	1,375,000	1,820,000
Lewis Research Center	20,348,000	16,985,000	17,925,000
NASA Headquarters	1,115,000	1,096,000	905,000

BASIS OF FUND REQUIREMENTS:

Aeronautics Research and Technology

Power processing and distribution	---	$200,000	$400,000
Total	---	$200,000	$400,000

A thorough study of present and future needs in aircraft electrical systems is underway, together with a low level effort toward reducing the maintenance requirements, weight and complexity of aircraft electrical systems. This work will continue in FY 1971 with a moderate increase in level of effort.

Space Research and Technology

Supporting research and technology			
Nuclear flight safety	$166,000	$200,000	$200,000
Electric propulsion	7,080,000	5,820,000	5,775,000
Nuclear power generation	17,378,000	16,625,000	16,130,000
Solar power generation	6,467,000	5,190,000	2,850,000
Chemical power generation	4,369,000	3,955,000	3,120,000
Power processing and distribution	1,827,000	1,960,000	2,150,000
Total	$37,287,000	$33,750,000	$30,225,000

Nuclear Flight Safety

The objectives of the NASA Nuclear Flight Safety program continue to include: (1) the coordination and direction of the NASA portion of the joint AEC/DOD/NASA reviews and analyses of proposed missions utilizing nuclear space power systems, (2) providing guidelines to the NASA Centers for future mission applications, (3) developing specific design information in such areas as re-entry aerodynamics where NASA has special competence and facilities, and (4) the recovery of NASA launched spacecraft carrying significant quantities of nuclear materials in those cases where a determination is made that recovery is feasible and desirable.

Electric Propulsion

The continuing goals of the Electric Propulsion program are to provide the technology necessary for spacecraft position control systems and the early use of ion engines for primary propulsion of planetary spacecraft.

The major reasons for interest in this technology are the potential for increased mission capability and flexibility, and reduced launch vehicle size and/or costs as compared with existing chemical propulsion systems. These advantages stem primarily from the high specific impulse and accompanying lower propellant expenditure rates achievable with electric thrusters. In these thrusters, electrical energy is used to accelerate a propellant to exhaust velocities considerably higher than achievable by any other known method. Spacecraft utilizing such systems can accomplish missions considered impractical for chemical propulsion such as long duration north-south station keeping of a synchronous satellite, an orbiter of Mercury, out of the ecliptic at one astronomical unit, and a close solar probe. Advantages can also accrue from other characteristics of electric propulsion such as the capability to use biowastes for propellant in manned space stations and the availability of relatively large amounts of electrical power during non-propulsion periods.

The ion engine, an electric thruster of the class which accelerate charged particles in electrostatic fields, will continue to receive the major emphasis in this program during FY 1971. Resistojet thrusters, which produce thrust by means of expansion of an electrically heated gas, and plasma thrusters which depend upon interactions between electric current and magnetic fields, are the subject of the remainder of the program.

Very low thrust (10^{-5} lbs.) cesium contact ion engines with electric thrust vectoring capability, offer advantages for gravity-gradient stabilized geosynchronous satellite to perform east-west station keeping. Experimental contact engines designed for this function were successfully operated on the ATS-IV spacecraft in 1968, and were included as an experiment on ATS-V launched in the summer of 1969. Operation of the ion engines on this latter spacecraft will depend on whether satisfactory spacecraft performance can be achieved. A much higher thrust level (10^{-3} lbs) is required to perform

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north-south station keeping on geosynchronous missions and because of its economical use of electrical power, the bombardment ion engine appears best suited for this role. During FY 1970, effort was initiated on an engine of this type and plans made to include it as an experiment on the forthcoming ATS-F. This work will continue in FY 1971 along with efforts aimed at improved performance and electrostatic thrust vectoring. Evaluation of pulsed plasma microthrusters which, because of their rapid and accurate controllable thrust pulses, offer potential for control of spin stabilized vehicles will also be carried out in FY 1971.

Auxiliary propulsion requirements for manned space station atmospheric drag cancellation and attitude control, are appreciable. Studies have shown that high temperature (3600°F-4000°F) resistojet systems operating with either ammonia or hydrogen at high specific impulse not only reduced the propellant requirement, but also reduced the complexity and increased the safety of resupply operations. Resistojets using biowastes as propellants provide added advantages such as elimination of propellant resupply.

A major milestone in this effort was passed in FY 1970 with the successful conclusion of long term life tests on ammonia and hydrogen units. Four ammonia thrusters completed 8000 hours without incident and one hydrogen thruster completed 6000 hours satisfactorily. During the test program, a second hydrogen thruster operated at 80 percent performance which was attributed to a leak. Upon disassembly of several thrusters, it was determined that no significant material degradation had taken place. This eliminated the concern that material sublimation would limit life at high temperature.

Initial tests of resistojets capable of operating on biowastes, such as carbon dioxide, methane, urine, and water, were also carried out in FY 1970. In FY 1971, this effort is to be continued with emphasis on evaluating materials compatible with the biowastes. In addition to thruster research, the subsystem technology development required for integration with life support systems, will be initiated.

Electron bombardment ion thruster systems continue to show significant promise for interplanetary spacecraft prime propulsion applications at thrust levels from 10^{-2} to 10^{-1} lbs. The two major elements of the program directed toward such applications are: (1) the SERT II flight discussed in a later section; and (2) a systems technology program to simulate as realistically as possible in ground tests all of the required operational functions for a typical interplanetary mission. Spacecraft design analyses of solar powered electric propulsion missions have defined these requirements. An initial laboratory investigation completed in FY 1970, verified stable behavior of the key components during system operation in open loop (manually controlled) configuration. This test provided the information required to proceed with closed loop (automatically controlled) operation of a system closely simulating mission requirements. The necessary hardware and various logic subsystems for this investigation are being assembled for test in FY 1971. With the successful completion of this test program and the SERT II flight,

electric propulsion technology based on mercury electron bombardment ion engines will have achieved a major milestone in its advancement to initial mission use.

Nuclear Power Generation

The primary objective of the Nuclear Electric Power Technology program is to obtain the experimental and analytical data needed to permit the ultimate development of the energy conversion equipment to be used in advanced nuclear electric power generating systems required for such future missions as space station/base and outer planets exploration. The conversion systems will utilize isotope and nuclear reactor heat sources furnished by the AEC and are therefore closely coordinated with the AEC programs.

Two nuclear power generation programs are aimed at supporting the space station/space base program to cover power needs which have now been identified by mission studies to range up to 100KWe, perhaps higher. These are the SNAP-8 and Brayton cycle programs. The space station itself is estimated to need power at about the 25KWe level from the primary power system. Possibly independent experimental modules will require from 2-5KWe. The space base, which will evolve from the station, will require the higher power levels.

The NASA SNAP-8 program has been aimed at developing the technology of a long-life space reactor power system in the 30-50KWe power range. The development of the reactor is the responsibility of the Atomic Energy Commission, while NASA is developing the mercury turbogenerator power conversion system for use with this reactor. During FY 1970, emphasis in the NASA program has been placed on continuing the endurance development of the major components of the power conversion system, and obtaining systems data using two existing breadboarded power conversion systems.

In the past year, both the boiler and turbine, two components which had previously given major difficulty, have been successfully tested for 10,000 hours. The turbine was coupled to an alternator and 2KWe was lost over the test period. Post test inspection of both components did not reveal any significant problems and it is concluded that significantly more life is available. This is considered a major milestone toward the successful development of dynamic systems for use in space. The 10,000 hour boiler is now being disassembled for inspection and results are not yet available. A shorter test of another boiler, however, confirms that the problem of corrosion of boiler tubes by mercury has been solved.

Testing of the power conversion system located at the contractor's plant has given valuable data on component interactions in long-term operation and a dynamic test program to determine transient data in system start-up and shutdown was completed in FY 1970 using the second breadboarded power conversion system (PCS) located at the Lewis Research Center.

Testing by the AEC of the second SNAP-8 reactor for 7,000 hours has revealed that the problem of fuel element cracking found in the first reactor has not been solved. The test of this reactor has been terminated to inspect for the causes of this problem. A study of the test data indicates that adequate corrective action can be taken in the next design. In addition, consideration is being given to reducing the PCS operating temperature in order to increase assurance of achieving long reactor life.

For the remainder of FY 1970 and in FY 1971, the SNAP-8 program will continue with life and performance development of power conversion system components and other development necessary for the combined test of the power conversion system with the reactor. Modifications will be made to current components as necessary for operation with a reduced temperature reactor.

NASA has undertaken the development of Brayton cycle for use in space because of its potentially high energy conversion efficiencies and because the single inert gas phase working fluid of the Brayton cycle will ease development problems. Development has been initially aimed at an isotope system at a power level of 2-10KWe where the efficiencies obtainable with conventional systems would require impractically large quantities of expensive, hard to obtain isotope fuel. The conversion equipment is designed for a turbine inlet temperature of 1600°F.

In 1969, start-up, shutdown, and performance tests were completed on the first combined Brayton gas bearing, turbo-alternator-compressor unit. This unit operated for 1013 hours demonstrating performance as predicted. A complete isotope Brayton power conversion system was assembled and has been run for 592 hours in the Plum Brook Space Power facility using an electrical heat source. These tests, which will be continued through FY 1970, are aimed at obtaining experimental data on system characteristics. A conversion efficiency of 22 percent has been demonstrated. In early CY 1970, long term endurance development of the major power conversion system components will be initiated in a separate component facility specifically designed for this purpose. Based on test results to date, some modification to the current equipment has been shown as necessary to achieve the very long life desired and to determine the operating limits of the current hardware. Also, work will be continued on the development of those components and structural elements associated with the high temperature isotope heat source which will be needed for test of the existing power conversion system with isotope capsules to be developed by the Atomic Energy Commission.

In the past year, estimates of eventual power needs for the space station/base program have grown to 100 to 200 KWe. Because of the importance of high conversion efficiency in achieving maximum power and the very long life desired from the reactor, and because of the initial success achieved in the isotope Brayton program, it is believed that Brayton conversion is the most appropriate approach for this power range. Therefore, in FY 1971, the Brayton cycle program will be expanded toward evaluation by test of key high power components.

The advanced, alkali metal Rankine program is aimed at achieving low power system weights for power in the hundreds of kilowatts to the few megawatts. Eventual applications are for very high power near-earth and electric propulsion planetary exploration missions. The development approach is based on proceeding through progressive development phases which will eventually lead to the test of a complete power conversion system with a reactor. Currently, the program is aimed at developing a sound component technology base.

In FY 1970, 1700 hours were accumulated on a reworked three-stage potassium vapor turbine operating at 1500°F in further investigations of blade erosion. 3000 hours of endurance test of an 1100°F potassium electromagnetic boiler feed pump has been achieved without indications of difficulty. A 3-loop boiler/tube facility is nearing completion, and initial design studies of a potassium vapor turboalternator and reactor loop electromagnetic pump have been completed. Testing of the boiler feed pump and the 3-stage turbine will be continued through FY 1970.

In FY 1971, the major emphasis will be placed on turbine and boiler related experimental investigations necessary to support subsequent fullscale component final designs. Support material and alloy technology investigations will be continued.

Work aimed at developing the technology of thermionic reactor systems continued to make progress during FY 1970. Important results have been obtained in all areas of work outlined in the FY 1970 budget request. These include: (1) analytical reactor and electric propelled spacecraft studies of a system suitable for a Jupiter orbiter mission; (2) completion of two long-term thermionic fuel in-pile tests at the NASA Plum Brook Reactor; (3) a thermionic diode kinetics experiment at the Jet Propulsion Laboratory to study fast thermionic reactor system dynamics and control; and, (4) out-of-pile tests on the redistribution and venting of uranium oxide fueled capsules.

These problem solving efforts will continue in FY 1971 with major emphasis on fuel/emitter technology and an investigation of the uninsulated externally-fueled diode concept. The NASA program assists the National Thermionic Technology program being undertaken by the AEC.

Two SNAP-19 radioisotope thermoelectric generator (RTG) power units supplied to NASA by the AEC were launched aboard the Nimbus B2 on April 14, 1969, as an experiment to demonstrate feasibility and to investigate RTG/spacecraft integration and operational problems. While the RTG performance was satisfactory for the purposes of this mission, differences have been observed between the performance of the isotope fueled units in space and electrically heated units operated in ground vacuum tanks. Studies are in progress to identify the reasons for the observed differences in performance.

An AEC developed and furnished SNAP-27 RTG power source for the lunar surface experiment package (ALSEP) was placed on the moon during the Apollo 12 mission. Performance to date has been as predicted and satisfactory.

Plans to use SNAP-27 RTG's on the Apollo 13, 14 and 15 missions remain firm. Use of improved SNAP-27 units for subsequent Apollo missions is being evaluated by the AEC and NASA.

NASA's Office of Space Science and Applications has selected RTG's to power the Pioneer F and G missions and the Viking Mars Lander. Arrangements have been made to obtain suitable units through the AEC. Several required experiments to define RTG/spacecraft interactions in these missions were identified.

During FY 1971 work will be continued to identify and resolve RTG/spacecraft interactions and operational problems, and will continue testing of RTG's for stability and long-term reliability.

An urgently needed facility for this work is the Isotope Thermoelectric Systems Applications Laboratory, described under the FY 1971 construction of facilities request. This facility is essential to the accomplishment of work vital to the integration of radioisotope thermoelectric generators with scientific instruments and other spacecraft subsystems for future missions to the outer planets.

Solar Power Generation

Goals of the Solar Power System program continue to be (1) investigation of methods for compact stowage and reliable, automatic deployment of large area, lightweight solar cell arrays; (2) adaptation of such arrays to the requirements for manned space station power; (3) understanding the structural and flight dynamic interactions of large, flexible solar cell arrays with guidance, control and propulsion subsystems; (4) development of reliable, long life mechanical drive mechanisms for large solar cell arrays; (5) development of solar cell array designs for application to spacecraft flights on Venus-Mercury flybys, solar probes, Mars landers and Jupiter flybys and orbiters; (6) substantial improvement in the resistance of solar cells to degradation in the space radiation environment; (7) better metal-to-silicon contacts needed to withstand new extremes of temperature and thermal cycling; and (8) new solar cells having greatly improved efficiency and reduced cost.

Fabrication of a 250 square foot (2.5KW) engineering model of a flexible rollup solar cell array is scheduled for completion early in FY 1971. The goal of 30 watts per pound for this array segment is expected to be achieved for planetary spacecraft applications. For manned applications, especially for a manned space station, this unmanned solar array technology will require adaptation to withstand the more severe dynamic interactions with the vehicle during shuttle docking, orbit changes and attitude maneuvers. These mechanical loads are estimated to be an order of magnitude more severe than for the present unmanned planetary application. Thermal cycling will be more extreme and the number of cycles several orders of magnitude greater.

Preliminary studies have indicated that a high voltage power distribution system offers important advantages over conventional low voltage systems for large applications satellites and space stations. Methods are being developed for obtaining high voltages directly from solar arrays with voltage regulation devices mounted integral to the array. A high voltage, self-regulating array should improve reliability and minimize heat loads and power conditioning inefficiency. Work will continue on the effect of ionized particle radiation on solar cells at temperature and solar illumination levels encountered out to the planet Jupiter. Preliminary findings suggest that the near earth superiority of N on P silicon solar cells is no longer valid at the Jupiter orbit conditions of temperature and solar intensity. Under these far from the sun conditions, P on N type doping appears to offer superior radiation resistance. These results were unexpected and will be investigated further in FY 1971. Work will continue in FY 1971 on the lithium doped solar cell to determine its potential radiation resistance and efficiency advantages for use in earth orbit. Work will continue on thin film cadmium sulfide cells which have the potential of reduced cost and compact stowage, providing environmental instability problems can be solved and the efficiency increased substantially.

Chemical Power Generation

The Chemical Power Generation program is aimed at achieving a new technological plateau for batteries, fuel cells and engine generator systems. Batteries are required that are reliable, exhibit a high energy/weight ratio, and fulfill the specific requirements of the various missions, such as long cycle life, long shelf life, high power density, operability at extreme temperatures, or sterilizability. Almost every launch vehicle and spacecraft requires one or more batteries, e.g., the Saturn V/Apollo uses 24 batteries. Traditional materials and methods of manufacture for rechargeable space fuel cells and batteries are being investigated with a view toward improving quality control and upgrading the electrodes that go into nickel oxide/cadmium cells. Life testing of rechargeable batteries under this program has already revealed some of the wearout modes of long-lived cells. These tests have indicated the need for improved separators and more closely controlled pore-size distributions in electrodes in order to function for years in space. Useful as the past tests have been, these results have also highlighted short comings and revealed that more carefully chosen test procedures could result in more useful data from future test efforts. Work is almost complete on defining an improved test procedure with a three-fold purpose (1) it shall be an accelerated, nondestructive test, consuming at most 1 percent of the cell's useful life; (2) it shall permit prediction of cell life with a high degree of confidence; (3) it shall be useable (or modifiable for use) by any spacecraft engineer, so he can pick and match cells for his spacecraft batteries.

A limited technological capability is expected to be in hand by the end of FY 1970 for: (1) heat sterilizable, impact resistant, small primary silver oxide/zinc cells; (2) rechargeable silver oxide/zinc cells; and, (3) nickel oxide/cadmium cells. In FY 1971, efforts to further improve these

capabilities will continue and emphasis will be placed on the complete battery (a series group of cells) and battery monitoring and control electronics. Remote activation of batteries, as well as batteries capable of long-life under wet storage conditions, is being studied; batteries for planetary orbiters are being designed and battery control logic is being developed to obtain more information per channel, to aid in controlling the battery, and to bypass faulty cells.

The space shuttle has re-emphasized the need for fuel cells, so that the current modest level of effort on relatively basic electrochemistry and engineering is being increased to meet the anticipated shuttle needs. Foremost among these is a long-lived, maintenance free system. A promising candidate is the capillary matrix type fuel cell. With further improvements this system has a potential to meet the ruggedness, versatility, and potential longevity required by shuttle missions. A program will be initiated in late FY 1970 for major engineering improvements in such capillary matrix systems.

Substantial quantities of electrical and hydraulic power will be required to operate the flight systems on shuttle vehicles. This year, an in-house study effort at the Lewis Research Center has been initiated to identify the peak power needs, such as for control surfaces, jet engine deployment, etc., for the shuttle, and to define promising chemically-powered auxiliary power units (ADU's) to meet these needs.

During FY 1971, a combined in-house and contract effort will be conducted to study specific APU configurations, develop preliminary designs, identify technology problem areas and initiate component procurement for development testing.

Power Processing and Distribution

The highest capacity space electrical power system flown to date is rated only about four kilowatts and the longest mission duration previously demonstrated for any man-rated spacecraft is less than one month. This compares to an electrical power level of 25-100 kilowatts estimated for space station/base applications and operating life times of 5-10 years for both station/base and shuttle. The shuttle imposes additional constraints of weight sensitivity, onboard checkout and automatic inflight monitoring, not possible within existing power processing and distribution technology. In addition, an important early objective is to identify electrical power processing and distribution concepts permitting the fullest possible degree of commonality between shuttle and station/base.

Solid state distribution systems, circuits and devices require further investigation and development to extend the technology to meet the needs of the shuttle and station/base. Work will be increased in electrical fault identification, isolation and energy management, with an objective of onboard electrical system checkout and automatic inflight monitoring--primary operating characteristics sought for the space shuttle. This necessitates a continuation of analytical and experimental work to identify, measure and control

the thermal, electrostatic and other stresses which induce failure in power processing components and circuits. A developmental wide-band wattmeter resulting from earlier work under this program has proven to be a very useful diagnostic instrument for this purpose.

Ongoing work will be continued in the specialized areas of power processing for use with isotope-fueled thermoelectric generators (goal is unattended life of 12 years or more) and for use in electric propulsion applications (goal is a weight of one kilogram per kilowatt or less). The usefulness of the previously developed standardized multi-purpose control module for power processors, is being fully verified through application to both of these programs.

Space Electric Rocket Test (SERT)

	1969	1970	1971
Spacecraft and experiment development.....	$1,500,000	$500,000	$275,000
Agena (Launch Vehicle Procurement Program).....	(794,000)	(150,000)	(---)
Total (including launch vehicle).....	$(2,294,000)	$(650,000)	$(275,000)

The objective of SERT II, the second flight in the SERT series, is the verification of long-term ion thruster performance in space. SERT I, a sub-orbital flight, launched in July 1964, proved the basic feasibility of ion propulsion.

The SERT II spacecraft is to be launched in the first quarter of CY 1970 from the Western Test Range into a near polar sunlit orbit by a Thorad-Agena. Primary power from a 1.5KW solar array will be used to sequentially power two 1kw thrusters. The major goal is to accumulate 6 months operation on one of these thrusters. Experiments aimed at evaluating the interactions between the electric propulsion system and spacecraft are also carried. This flight is considered to be the next major step in primary electric propulsion.

The launch date was changed from CY 1969 to the first quarter of CY 1970 to allow additional testing of the power conditioner and thruster. The expected long-duration operation of the spacecraft will require FY 1971 funding for data analysis.

ELECTRIC PROPULSION

Mr. EVINS. The ion engine, an electric thruster of the class which accelerate charged particles in electrostatic fields, will continue to receive the major emphasis in this program during fiscal year 1971. Has the ion engine ever been tried?

Mr. NICKS. Yes, sir. We have a spacecraft in orbit right now with two of these very small thrusters that will operate, we hope, for 6 months. It has been up since February 3, and endurance testing began on February 4.These thrusters are very small thrusts, but enough to move the spacecraft to various orbital positions. As a rocket it has a specific impulse of something like 4200 seconds, which is very high, but of course it is a very small thrust.

Dr. PAINE. Ten times greater than we get with, say, a Saturn V.

Mr. NICKS. It does have potential application for long missions out into space and perhaps orbiting planets like Jupiter or Saturn. These applications are down the road, but it will certainly find much more, likely some application in space station control systems and in synchronous orbit satellites.

NUCLEAR ROCKETS

Mr. EVINS. We will now turn to the "Nuclear rockets program" and place pages RD 15–1 through RD 15–7.

(The pages follow:)

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1971 ESTIMATES

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY — NUCLEAR ROCKETS PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The overall aim of the Nuclear Rockets program is to provide a significant increase in propulsion capability for future space activities. The principal objective is to develop a 75,000 pound thrust engine, NERVA, for incorporation in a reusable nuclear stage. Apart from NERVA development, the program includes certain supporting research and technology activities. The objectives of these activities are: (1) to provide support to the NERVA engine design and development, (2) to provide for the continued improvement of nuclear rocket performance, (3) to provide the base of information for the development of a nuclear stage, and (4) to investigate the feasibility of advanced propulsion concepts.

The advantages of nuclear propulsion over chemical propulsion result from its high payload performance, propulsion efficiency, and versatility. In the types of missions involving high energy and large payloads, specific impulse becomes an extremely important performance requirement. The first generation nuclear rocket engine, NERVA, on which work is now underway will provide approximately twice the specific impulse of the best chemical rockets. As an integral part of a new capability for space transportation, this engine incorporated in a reusable nuclear stage can be used to move men, spacecraft and supplies between earth orbit and lunar orbit and between low earth orbit and geosynchronous orbit. It also offers major advantages for transporting heavy payloads into deep space. The increased propulsion energy it makes available can be used for any of a variety of purposes in such missions, e.g., to increase payloads, to reduce trip times and to provide greater reliability for the completion of the mission.

Development of the NERVA engine is being accomplished using a base of technology which took nearly fifteen years of extensive analytical and experimental research to acquire. Through this technology phase, the important aspects of nuclear rocket operation required to develop a flight engine were investigated. This work has now been completed, and all technology goals have been met. In the course of this research, twelve reactors and engines were tested, from which more than fourteen hours of power operating experience were obtained. Approximately four hours of this experience was at high power. In addition to the valuable experience obtained in operating nuclear rocket reactors, engines, and facilities, these tests provided a preliminary assessment of the more obvious needs of a nuclear rocket system, e.g., rapid startup, shielding, liquid hydrogen propellant, high power density, long endurance and self-energized startups (bootstrapping).

The NERVA engine is being designed as a throttleable, restartable, and reusable system so that it can be applied to a "shuttle" stage. The engine is being designed so that any improvements in reactor fuel element capability, and thereby in lifetime, which are the result of the continuing AEC research and technology program, can be incorporated.

The NERVA engine will be approximately 34 feet in length from the bottom of the propellant tank to the exit plane of the nozzle. Its largest diameter will be approximately 10 feet. The engine reactor will have a rating of 1,500 megawatts. Engine weight will be approximately 20,000 pounds, including a shield weight of approximately 3,000 pounds. For certain missions, additional shielding may be required, depending upon the design of the payload and the command module structure. Engine performance goals are as follows:

Thrust	75,000 pounds
Specific Impulse	825 seconds
Endurance	Up to 10 hours
Operating Cycles	Up to 60 cycles

The primary function of NERVA will be to power a reusable nuclear stage. This stage is being studied in the conceptual design phase by several contractors under the supervision of the Marshall Space Flight Center. Both engine and stage will be man rated, have an extended endurance capability, and include maintainability features. The stage will be able to be used over a period of years in space.

SUMMARY OF RESOURCES REQUIREMENTS:

	1969	1970	1971
Supporting research and technology	$6,002,000	$8,000,000	$5,000,000
NERVA	23,000,000	27,085,000	32,000,000
NRDS operations	4,500,000	1,415,000	1,000,000
Total	$33,502,000	$36,500,000	$38,000,000

Distribution of Program Amount by Installation:

Marshall Space Flight Center	$860,000	$1,575,000	$1,600,000
Lewis Research Center	1,145,000	1,000,000	800,000
Space Nuclear Propulsion Office	31,497,000	33,925,000	35,600,000

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology

	1969	1970	1971
Rocket reactor research.....	$3,751,000	$3,300,000	$1,500,000
Nuclear rocket engine systems.	1,236,000	2,900,000	1,700,000
Safety.....	15,000	200,000	200,000
Vehicle technology.....	1,000,000	1,600,000	1,600,000
Total.....	$6,002,000	$8,000,000	$5,000,000

Rocket Reactor Research

The funding in this portion of the program supports: (1) the research and testing of nonreactor components for reactor testing (nozzles, turbopumps, controls, etc.) including the propellants necessary for experimental analyses; and (2) the investigation of advanced concepts and design studies of reactors for future application.

A significant portion of the funds applied in this area are used to provide propellant and nonnuclear components, such as propellant feed systems, for the Los Alamos Scientific Laboratory series of PEWEE and nuclear furnace test bed reactors. The second PEWEE reactor is scheduled for testing in the autumn of 1970. The first nuclear furnace is scheduled for testing in the winter of 1971.

While the NERVA class of nuclear rocket is clearly the first type of nuclear rocket which will be used, exploratory research will continue in FY 1971 on advanced nuclear propulsion concepts, such as gas core reactors, which have theoretical performance capabilities more than twice that of the solid core NERVA type reactors. These reactors, if shown to be feasible, would operate with the nuclear fuel in a gaseous state and would transfer thermal energy from the ultra high temperature uranium plasma to the propellant, by thermal radiation. Therefore, the research emphasis will be placed on determining the high temperature behavior of materials and fluid dynamic systems, and in improving the radiant heat transfer to seeded propellant streams.

Nuclear Rocket Engine Systems

The research conducted in this area provides information for specifying characteristics for improved nuclear rockets as well as establishing a general base of information on the design and operation of components and engines. Therefore, the FY 1971 research will continue to be directed toward the enhancement of the basic design reliability of selected components of a nuclear rocket engine such as the nozzle, turbopump, valves, actuators and

instrumentation. Specifically, work on nozzle coatings, nozzle skirts, and rotor dynamics are typical of the types of activities to be supported.

Other important efforts are directed toward improved instrumentation, fluidic control system components and the analysis of engine transients. Effort is also conducted on the effects of radiation on nuclear engine components, materials and systems. The purpose of this work is to define the behavior of materials in a combined radiation and cryogenic environment. Such information supports all Nuclear Rockets program activities and is essential for the design effort.

Safety

The effort in this area is directed toward the base of knowledge required to define and resolve the new and unique safety problems associated with nuclear rocket propulsion system development. While most of this information stems from the mainstream activities of the Nuclear Rockets program, certain specially directed research and analysis must be conducted outside of these disciplines. Work in progress or planned for FY 1971 will be directed toward identification of the nuclear flight system safety requirements and will include information on the safety requirements originating from operations and interactions with other systems (nonnuclear) during a typical mission. For example, blind spots in the tracking network (if any) would be identified, and their effects on the nuclear flight system safety requirements would be analyzed.

Vehicle Technology

A twofold approach is being followed in the vehicle technology area -- provision of technical information to support a design of a nuclear stage; and conceptual/feasibility studies of nuclear stages for a variety of applications, with primary emphasis on earth and lunar orbit ferry activities.

A continuing technology program has been underway at Marshall Space Flight Center for a number of years, concentrating mainly on radiation effects testing and propellant heating analyses and experiments. These investigations will be continued to extend the operating time capabilities of the nuclear stage, i.e., a stage lifetime which includes exposure to full power engine radiation for at least 10 hours.

The conceptual/feasibility studies are continuing, extending the results of previous years' activity, to include the effects of longer operating times. Examination will be made of orbital maintainability concepts, and a minimum cost development, manufacturing and test program based on first flight in the late 1970's.

NERVA

	1969	1970	1971
Engine system component and subsystem	$11,501,133	$16,728,000	$24,900,000
Ground test and operations support	10,896,867	9,223,000	5,700,000
Propellants	602,000	1,134,000	1,400,000
Total	$23,000,000	$27,085,000	$32,000,000

Engine System Development

During FY 1971, specifications for all of the engine components will be completed, and the preliminary design review of the engine system and components will be conducted. This will involve engine system analyses, engineering and design which will be a continuing part of the development of the NERVA engine.

Component and Subsystem Development

The following is representative of the work that will be accomplished in this area:

1. Reactor subsystem: This effort is largely funded by the AEC and will be carried out by the Westinghouse Astronuclear Laboratory. During FY 1971, work will be concentrated on selected long lead items, including full scale reactor test hardware. Development of control drum actuators also will be continued during the fiscal year.

2. Turbopump assembly: The detailed design, fabrication and testing of the development hardware for this assembly will be continued during FY 1971. The emphasis in this area will be on the development of turbopump bearings to satisfy the 10 hour NERVA performance objective, and the design and analysis of the pump impeller and turbine disc.

3. Thrust chamber assembly: The basis for the design of the NERVA nozzle is the regeneratively cooled, U-tube nozzle development under the NERVA technology phase. Materials research conducted under the SR&T program also supports this effort. During FY 1971, the preliminary design review of the nozzle will be completed, and the detailed design, fabrication and development testing of critical nozzle parts, e.g., tubes, nozzle shells, will be initiated. Design activities associated with the nozzle extension and graphite nozzle skirt will also be initiated.

4. Lines, valves and actuators: The design of lines, valves and actuators for the NERVA engine will be continued in FY 1971. Line sizes will be

optimized with respect to pressure losses and weight. Valves for operation in the radiation environment, e.g., check valves, blocking valves, bypass valves and the main propellant shutoff valve, will be selected for their ability to function over an extended, multicycle engine operating life. The preliminary design review of these components will be conducted, and long lead hardware procurement will be initiated. The actuators for these valves will also undergo similar design and development.

5. Thrust structure and attitude control: During FY 1971, the design of thrust structure and attitude control components (gimbal, actuators, bellows, etc.) will be continued and the preliminary design review will be conducted.

6. Engine system control: The FY 1971 activity in this area will include the design, test and evaluation of instrumentation and controls for the NERVA engine control system. This effort will be based on information from the XE ground experimental test program, LASL, Phoebus and PEWEE reactor programs and laboratory analyses of subsystems and components evaluated under SR&T programs.

Ground Test Operations and Support

The funding in this area provides for: continuation of the design and modification of ETS-1 for the development testing of the NERVA engine; continuation of the design and modification of GSE for the handling, checkout and maintenance of NERVA engine hardware at the Nuclear Rocket Development Station (NRDS); and the operational support necessary to continue NERVA component test activities at NRDS.

Propellants

Funding provided under this heading will be used primarily for the procurement of liquid hydrogen and liquid nitrogen for use in the turbopump bearing test program, and for actuator development and engine simulation tests at NRDS.

Nuclear Rocket Development Station Operations

	1969	1970	1971
General site support.....	$4,492,495	$1,412,000	$995,000
Capital equipment.....	7,505	3,000	5,000
Total.....	$4,500,000	$1,415,000	$1,000,000

This estimate provides for NASA's share of the cost of general support and station operations for the Nuclear Rocket Development Station. NRDS is the national site for the ground static testing of nuclear rocket reactors and

engines. Eventually, it will be used to test the propulsion modules or rocket stages. Overall management of the site is provided by the AEC/NASA Space Nuclear Propulsion Office-Nevada Extension.

The major reactor test activities to be conducted at NRDS during FY 1971 are the PEWEE-2 and nuclear furnace test programs. In addition, NERVA component testing will continue.

Maintenance, housekeeping, and management functions must be provided at the site. These functions, taken together, constitute general site support. They include routine maintenance and operation of site facilities, e.g., custodial services; maintenance of roads, grounds and utility systems; the furnishing of utilities; fire protection; and cafeteria services. Also included are the services of a support contractor to maintain and operate electrical, plumbing, carpenter, welding and machine shops.

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Mr. EVINS. The principal objective of the nuclear rockets program is to develop a 75,000-pound thrust engine, NERVA, for incorporation in a reusable nuclear stage.

We have been studying, investigating, and experimenting on nuclear rockets for a number of years in the NERVA program, through funding in this budget, that of the Atomic Energy Commission, and perhaps other programs. The development is being accomplished using a base of technology which took nearly 15 years of extensive analytical and experimental research to acquire. Through this technology, the important aspects of nuclear rocket operation required to develop a flight engine were investigated. This work has now been completed.

In addition to the valuable experience obtained in operating nuclear rocket reactors, these tests provided a preliminary assessment of the more obvious needs of a nuclear rocket system—rapid startup, long endurance, shielding, liquid hydrogen propellant, high power density, and self-energized startups.

You say these tests have been completed. What are you going to do?

Dr. PAINE. We have the manager of our Joint Atomic Energy Commission, NASA, NERVA project here today, Mr. Milt Klein. Perhaps he would like to say a few words about it.

ENGINE DEVELOPMENT STARTED

Mr. KLEIN. Mr. Chairman, as you mentioned, the one phase of the program has been completed. We have called it the technology phase, which provided the basic understanding, knowledge, and experience for this advanced propulsion system.

We have in the past year then started the development of an actual flight-rated engine, which in effect takes this technology, and reduces it to practice, a very important step, and moves out with the development of a system that we expect to be available in the late seventies for use. It is, as you observe, a very promising type of system. The work has been quite successful.

NUCLEAR AIRCRAFT

Mr. EVINS. We canceled a nuclear-powered aircraft several years ago after about a billion dollars was spent on it because it was said to be like a boxcar, too heavy, would not work.

What have you found out that we did not know then?

Mr. KLEIN. Well, I won't comment very much on the aircraft nuclear propulsion program except that the nuclear rocket is quite different than the nuclear powered aircraft. As far as the nuclear rocket is concerned, our studies and our experiments have verified that the performance we get with this system, as has actually been demonstrated in tests, provides a very useful engine. It has very efficient performance and is a very useful performing system for the types of missions involving heavy payloads and large energies.

Mr. EVINS. You feel that nuclear power holds great potential.

Mr. KLEIN. Yes, sir.

Mr. EVINS. In 1969, we appropriated $33.5 million, in 1970 it is $36.5 million, and you propose to go up to $38 million next year.

Dr. PAINE. In addition to that, Mr. Chairman, there will be money put in by the Atomic Energy Commission.

GAS CORE REACTOR

Mr. EVINS. What is being done with the gas core reactor? Is any funding proposed in the 1971 budget?

Mr. KLEIN. There is a limited effort in the gas core reactor research program in fiscal 1970 and in 1971. These studies are research-oriented to determine the basic feasibility of this kind of concept. We are examining the ways in which one might keep the gaseous uranium which produces the energy in the system while we are passing large amounts of hydrogen through it, a very neat trick.

So we are looking at that problem and other fundamental problems such as that of heat transfer, very much on a research laboratory basis. It is not an engineering program at all.

SAFETY IN NUCLEAR ROCKET PROGRAM

Mr. EVINS. What has been accomplished to date in the field of safety?

Mr. KLEIN. We have examined the safety of these systems, of course, very thoroughly throughout the program.

We find that the system, as it will be used, can be operated with a high degree of safety. We have also found as we have proceeded that it is possible to build safeguards into the system and to develop the reliability in the system to make sure there will be no undue risk in the use of these systems.

Mr. EVINS. Very good.

Mr. BOLAND. What is the AEC spending in this area for NERVA, in fiscal 1971?

Mr. KLEIN. The fiscal 1971 budget for operations and equipment in the AEC is $46 million, Mr. Boland, made up of $43 million in operations and $3 million in equipment.

CHEMICAL PROPULSION PROGRAM

Mr. EVINS. Place in the record the "Chemical propulsion program" section, pages RD 16–1 through RD 16–7.

(The pages follow:)

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1971 ESTIMATES

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY — CHEMICAL PROPULSION PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The Chemical Propulsion program is designed to provide the engineering theory and experimental data on which new and advanced propulsion capabilities necessary to support the nation's space goals can be projected. The program includes: (1) identification of future mission propulsion requirements, (2) research in fundamental propulsion concepts to meet the requirements, (3) studies of principal design parameters, (4) investigation of key design problems with a view to sound technical solutions, (5) development of experimental design, fabrication, and test techniques, (6) testing of component designs and demonstrations of experimental engines and motors, and (7) evaluation of concepts and technical verification of capability to accomplish mission requirements. This effort is a precursor to actual system development.

Research and experimental work is conducted on two principal types of propulsion: systems using propellants in liquid form, and motors which use cast solid propellants. Thrust levels range from millipounds, used in attitude stabilization of spacecraft, to millions of pounds for first stage booster application. The goals of the future space program demand extension of both the performance and long service life of propulsion systems, and these must not jeopardize reliability of the operational system.

Propulsion processes, performance improvements, combustion, engine design, engine materials and fabrication technology are major categories of active research. Propellant properties, gas dynamics, heat transfer, fluid and solid mechanics, elastic properties, and chemical reaction are studied, both theoretically and experimentally, in their relationship to chemical propulsion. Basic theory and experimental findings are supported by complementary demonstrations to establish the validity and practicality of the propulsion systems concepts generated by the program.

The technical projects under the Chemical Propulsion program are managed by NASA field centers and the Jet Propulsion Laboratory (JPL), using in-house research and engineering personnel and unique equipment available at these facilities. Their work is supplemented by contracted work with several industrial and university groups specializing in the fields that apply to chemical propulsion research and technology development.

The information developed by these efforts is published as NASA technical reports or in contractually required reports available at major technical libraries and through government publishing services. It is also discussed

at technical meetings sponsored by professional organizations and by JANNAF (Joint Army, Navy, NASA, Air Force) Chemical Propulsion Group. These presentations are usually published in technical journals. Coordination of the program with Department of Defense agencies is carried out formally through the Aeronautics and Astronautics Coordination Board and through JANNAF, and informally by frequent information exchanges.

SUMMARY OF RESOURCES REQUIREMENTS:

	1969	1970	1971
Supporting research and technology	$25,752,000	$20,480,000	$20,300,000
Total	$25,752,000	$20,480,000	$20,300,000

Distribution of Program Amount by Installation:

Manned Spacecraft Center	$790,000	$970,000	$1,650,000
Marshall Space Flight Center	2,850,000	1,510,000	2,720,000
Goddard Space Flight Center	210,000	50,000	---
Jet Propulsion Laboratory	4,552,000	4,357,000	3,800,000
Langley Research Center	2,310,000	1,295,000	800,000
Lewis Research Center	10,843,000	8,629,000	9,205,000
NASA Headquarters	1,005,000	1,061,000	590,000
NASA Pasadena Office	3,192,000	2,608,000	1,535,000

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology

Liquid rocket research and advanced technology	$10,790,000	$8,637,000	$5,565,000
Liquid rocket experimental engineering	5,501,000	7,195,000	11,275,000
Solid propulsion research and advanced technology	4,394,000	2,971,000	2,725,000
Solid rocket experimental engineering	5,067,000	1,677,000	735,000
Total	$25,752,000	$20,480,000	$20,300,000

Liquid Rocket Research and Advanced Technology

The Liquid Rocket Research and Advanced Technology project is directed toward propulsion requirements consistent with future space program goals. The program in applied research includes key component technology, advancement in reliability of components, their space operation, and improved capability

in engineering data and disciplines pertinent to this work. It covers research into combustion, hydraulics, mechanics, and materials fabrication. Roughly one-third of this work is conducted under contract with industry and with universities.

The effort on component reliability responds to problems of operating space station components for periods of years, and of flying unmanned spacecraft for flights of over ten years. Future unmanned propulsion systems designed for these long durations require new methods of accelerated meaningful testing. Manned vehicle problems will focus on design of components for easy refurbishment from within the spacecraft, with emphasis on facilitating onboard checkout.

Space operation of components is an allied field. To avoid future operational problems we are investigating space ignition, venting, and similar problems with the high energy propellants that can fulfill our future mission requirements.

Supporting technology effort for the shuttle vehicle engines will also be conducted under this project. This effort will include clarification of the role of high speed turbopump inducers in "Pogo-type" low frequency instability, injector improvements and thrust chamber heat transfer improvements to obtain maximum performance, and improved design criteria for reliability of large cryogenic valves. Some of this effort will involve the large engine verification of design parameters derived on smaller engines such as those for acoustic absorbers to control high frequency instability.

Work on engineering problems such as combustion, ignition, injection, combustion stability and heat transfer continue to make steady progress. Significant progress has been made in designing acoustic liners for controlling combustion stability. Parameters affecting transpiration cooling are better defined.

A specific thrust of 508 seconds was measured in an altitude facility with the high energy tripropellant system, lithium-fluorine-hydrogen. This is the highest chemical rocket performance ever recorded, to our knowledge. Further work on tripropellants will be held in abeyance until funding is available and a suitable mission has been identified.

Liquid Rocket Experimental Engineering

The Liquid Rocket Experimental Engineering project has been established to translate the improved components from the Research and Advanced Technology project into working systems. Drawing on mission studies and prior development experience, advanced propulsion systems are defined, fabricated, and then tested over a wide range of operating conditions. New or unanticipated problems or limitations are frequently identified during these tests which require additional work at the component level. In addition such tests

identify real performance potential, define operating limits, assess design and fabrication methods and give an insight into probable schedule, cost, and facility requirements of a potential hardware development program. Performing these services without the inherent pressures in a schedule-oriented hardware development program is very efficient.

Launch Vehicle Propulsion Systems - A significant part of the Chemical Propulsion budget for FY 1971 is identified with a reusable space transportation system. It consists of several vehicles which provide routine transportation of men, materials, and experimental hardware to orbit around the earth and to the surface of the moon. The first link in this chain, the Earth-to-Orbit Shuttle is conceived as a two stage launch vehicle which would be launched to orbit vertically like a rocket and return to earth by accomplishing a horizontal landing on conventional airfields.

Main Engines - In such an application, where the true payload or cargo is a relatively small fraction of the total weight placed in orbit, engine performance becomes an overriding consideration. The performance of the J-2 engine which is used in the SIVB and SII stages of Saturn V, is totally inadequate for the shuttle vehicles. Fortunately, the work on the high pressure engine which has been pursued in previous years, provides the basis for confidence that the required engine performance can be obtained.

The most recent high performance engine program carried through to production was initiated in 1960. Meanwhile the state-of-the-art for hydrogen-oxygen engines has been considerably advanced by technology contracts in the disciplines of combustion stability, advanced fabrication techniques, and experimental hardware work with turbopumps and combustion chambers. The task of developing a new engine which meets the performance and weight requirements of the shuttle and which has the operational flexibility and long life desired will benefit from an early start and a sustained high level of effort. Detailed design of several conceptual approaches will be carried out in competitive contracts funded by the Office of Manned Space Flight. Supporting technology effort will be conducted under the Chemical Propulsion program.

In addition work will continue at a modest pace on future propulsion systems. In particular, advanced fabrication methods will be used to build segments of a very large thrust chamber which promises to sustain high performance at relatively low development and procurement cost.

Space Propulsion Systems - Development of advanced space storable propellants will allow significantly higher payloads when used on upper stages of existing launch vehicles. The high performance potential demonstrated in the last year, along with high density and other desirable physical characteristics, makes these propellants attractive for planetary orbiters, landers, ascent vehicles, and earth return stages.

Work directed toward assembly of propulsion modules, including engines, tankage and control systems, is underway for both the oxygen difluoride-diborane and mixed fluorine-oxygen (FLOX) and methane propellant combinations. These two efforts are complementary, inasmuch as the pressure fed oxygen difluoride-diborane combination optimizes at a small size (1000 pounds thrust) and the pump fed FLOX-methane combination optimizes at larger sizes (more than 5000 pounds thrust). Complete propulsion systems will be tested in existing facilities which allow simulation of the space environment.

Auxiliary Propulsion - In addition to the small thrust requirements for attitude control of orbiting and planetary spacecraft, auxiliary propulsion requirements of the space shuttle vehicle have been shown to involve a number of very large thrusters. In order to simplify logistics problems and increase commonality, hydrogen-oxygen has been chosen as the propellant combination for both maneuvering propulsion and attitude control of booster and orbiter.

The problems with the auxiliary propulsion system of the shuttle are not in the thruster development but in the layout of the system itself. A large number of individual thrusters, approximately 40, must be supplied with cryogenic propellants carried to the extremities of the vehicle system. These thrusters must be capable of providing brief thrust pulses for attitude control and docking of the shuttle with a space station. They must also provide substantial changes in vehicle velocity, which requires long burning duration, in order to effect rendezvous, adjust orbital plane or altitude, and accomplish retro-orbit and reentry maneuvers.

System layouts to define the system characteristics have been undertaken by the Chemical Propulsion program. These studies along with hardware experimentation have the purpose of defining an adequate system in terms of system weight, redundancy, life, ease of refurbishment, and initial cost. Such work will be continued intensively.

Technology efforts in the field of cryogenic pressure vessels, valves, controls, insulation, pressurization systems, heat exchangers and thrusters will be supported. Several fundamental choices - between low pressure and high pressure systems for instance - will have to be made early in the overall layout of the shuttle vehicles.

Work will continue to demonstrate reliability and operational life of monopropellant and earth storable bipropellant auxiliary propulsion systems.

Solid Propulsion Research and Advanced Technology

The principal goal of the Solid Propulsion Research and Advanced Technology project during the next several years is to insure the proper utilization of solid propellant motors in the space environment. For some applications the use of solid propellant motors is exceptionally attractive because of their compactness and their relatively low development cost and short development schedules.

Emphasis will be placed on improving the technology base for variable thrust motors; for long burn time, low acceleration motors; for sterilizable systems; for wide temperature range capability; and for ten year storage life in space.

Major improvements in nozzles for hotter propellants, long duration motors and restartable systems are needed. Liner and insulation materials for new propellants will be studied.

Structural composite materials, insulating polymers and fuel polymers need improved polydirectional strength and better characterization to predict their behavior over long durations in space. Propellant development emphasis will be on binder development, processing and handling of more energetic systems, and mission suitability. Also required are lower rate propellants that do not sacrifice performance. These are important for planetary spacecraft application.

Combustion and kinetics research will be directed to better data on flame structures and processes, and on improved modeling to make the information available in a form useful to the design engineer.

Solid propellant application to emergency systems and ancillary applications--gas generation, auxiliary or emergency power generation, welding, and metal cutting, antenna and experiment deployment devices, and emergency jettisoning will be given attention.

Solid Rocket Experimental Engineering

This effort includes the advanced technology and vehicle systems technology necessary to bring solid motors to a point where enough data is available to allow development for specific missions.

The primary effort in FY 1971 will be toward improved planetary propulsion technology. The high energy restartable motor which was initiated last year will be continued to prove out the details of re-igniting a water quenched motor and then quenching it a second time. The program will be aimed toward a firing with a high expansion ratio nozzle at a simulated altitude facility. This motor, weighing 3,000 pounds with a 15,000 pound thrust level, will develop 10% more specific impulse than the solid motors currently being used in the spacecraft. The quench and restart capability should allow this motor a coast period to a higher altitude before re-ignition, thereby eliminating the need for an additional stage. These features are valuable to future spacecraft propulsion systems.

Another spacecraft propulsion system currently in prototype testing is the low thrust-to-weight, long burning system. This motor will be used in spacecraft that have deployed experiments and therefore are sensitive to acceleration. Technology advances are required to prove that high energy propellants can be burned efficiently at very low rates and at low combustion

pressure. The nozzles must be developed to withstand the high flame temperature for three or four minute burning duration. Typical of near-space system technology is the work to support efficient, low cost sounding rockets. A program has been started to test a prototype model of a dual thrust, single stage sounding rocket capable of boosting 250 pound payloads to altitudes of 230 statute miles. This system employs prior technology advances in nozzles, propellant, and case fabrication techniques. It will replace two stage systems. Such motors should be of value to the solar physics and astronomy experimenters.

Electro-explosives (pyrotechnic) devices are used extensively in almost all manned and unmanned flight programs. A part of this program is to improve their long term, severe environment reliability for future flight programs.

Mr. EVINS. In this program you are requesting $20.3 million. In 1969 you had $25.7 million and in 1970 you have $20.5 million.

Are there any questions, gentlemen?

AERONAUTICAL VEHICLES PROGRAM

If not, we will place in the record the "Aeronautical vehicles program," pages RD 17–1 through RD 17–14.

(The pages follow:)

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1971 ESTIMATES

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY AERONAUTICAL VEHICLES PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The role of the Aeronautical Vehicles program is to provide leadership in the application of principles developed in basic research programs for improvements in safety, efficiency and utility of all classes of military and civil aircraft. In order to provide this leadership necessary for the United States to retain its pre-eminent position in aeronautics, the NASA conducts a very broad program aimed at the application of vehicle oriented disciplinary technologies of aircraft aerodynamics, aircraft loads and structures, aircraft propulsion, operating environment problems and aircraft flight dynamics to the following classes of vehicles: general aviation aircraft, V/STOL aircraft, subsonic aircraft, supersonic aircraft and hypersonic aircraft - both civil and military. In the Advanced Research program, the disciplinary technologies are not focused on any one specific class of vehicle whereas in the Vehicle Technology program these disciplinary approaches are focused on specific vehicles. To further reinforce the research and to assist in ferreting out problems which may be overlooked or not evident in analytical and small scale experimental approaches, emphasis is placed, as required, on flight test programs and proof-of-concept or large scale experimental hardware evaluations. This combined disciplinary and experimental hardware approach provides the advanced data which may be applied by the aircraft industry and government agencies to the development of safer and superior civil aircraft, advanced aircraft concepts, regulatory criteria, new operational concepts and the integration of the pilot/aircraft system into the total air transportation network.

As has been noted in previous program justifications the XV-5A fan-in-wing aircraft, the tilt-wing XC-142A V/STOL transport and the variable-sweep wing F-111 are examples of promising NASA research concepts developed by the military into operational vehicles. In the recent past, the NASA has mounted a concerted effort to solve the aircraft noise problem and has provided the government and the aircraft industry with the background information necessary for aircraft steep approaches, optimized take-off and landing profiles and noise alleviation for four engine commercial transport aircraft, as well as the technology for quiet military helicopters and observation aircraft. Other promising major NASA aeronautical vehicles research programs now in progress and scheduled for continuation into FY 1971 include flight tests of a supercritical wing for improved performance and maneuverability, the design and construction of a quiet, experimental research engine, a rotating-cylinder flap system for improving the STOL performance of propeller driven aircraft and a jet-augmentor wing concept for jet powered STOL aircraft.

The total program is to be carried out by means of analytical studies, wind tunnel tests, simulation and flight investigations. Such studies are also used to aid in the solution of problems of a developmental nature in support of military and civil aircraft procurements and in response to requests for specific assistance from other government agencies. The studies of developmental problems are an essential element in NASA's research since, like the experimental hardware programs, they identify areas where further generalized research is required.

The aeronautical vehicles technology programs for FY 1971 will include the continuation of studies to improve the safety of general aviation aircraft, studies of lightweight propulsion systems and advanced propulsion concepts for STOL aircraft; studies of advanced rotors for helicopters and rotor-driven V/STOL's; continuation of quiet engine research into experimental hardware phases; studies of airbreathing propulsion systems and their integration and dynamic problems for application to supersonic and hypersonic aircraft, and flight dynamics studies for each class of vehicle to insure increased compatibility of the pilot-vehicle system, including terminal area and all-weather operations.

Experimental research and development aircraft and engineering test-pilot proficiency aircraft necessary to carry out and support the total aeronautics effort are included in this program.

SUMMARY OF RESOURCES REQUIREMENTS:

	1969	1970	1971
Advanced research	$16,857,000	$31,005,000	$31,565,000
General aviation aircraft technology	507,000	950,000	925,000
V/STOL aircraft technology	8,060,000	9,560,000	15,030,000
Subsonic aircraft technology	19,291,000	9,425,000	11,900,000
Supersonic aircraft technology	20,348,000	18,900,000	21,905,000
Hypersonic aircraft technology	9,685,000	6,060,000	5,775,000
Total	$74,748,000	$75,900,000	$87,100,000

Distribution of Program Amount by Installation:

Marshall Space Flight Center	$445,000	$1,225,000	$900,000
Jet Propulsion Laboratory	---	181,000	200,000
Ames Research Center	10,100,000	13,810,000	17,580,000
Electronics Research Center	---	200,000	---
Flight Research Center	12,220,000	7,800,000	10,465,000
Langley Research Center	27,460,000	23,167,000	27,135,000
Lewis Research Center	22,145,000	26,630,000	28,770,000
NASA Headquarters	2,378,000	2,887,000	2,050,000

BASIS OF FUND REQUIREMENTS:

Advanced Research

	1969	1970	1971
Aircraft aerodynamics.....	$2,461,000	$2,190,000	$2,350,000
Aircraft loads and structures.....	1,403,000	3,110,000	4,380,000
Air breathing propulsion.....	3,466,000	3,515,000	2,800,000
Aircraft operating environment....	3,373,000	6,057,000	6,205,000
Aircraft flight dynamics.....	1,456,000	830,000	1,310,000
Support of facilities and aircraft	4,698,000	15,303,000	14,520,000
Total.....	$16,857,000	$31,005,000	$31,565,000

Aircraft Aerodynamics

Advanced research information and techniques are required for better predicting and improving the aerodynamic characteristics of various aircraft types. A continuing in-house and contract activity is carried out, not only for achieving aerodynamic refinement of conventional airframes, but also for fostering advanced aerodynamic concepts leading to revolutionary aeronautical vehicles. The scope of the work includes critical investigation of the shock wave flow fields generated by supersonic lifting wings and wing-body combinations, of their propagation from the source through the atmosphere, and of minimizing their effects (sonic boom) on the earth.

Theoretical and experimental aerodynamic investigations of components and research combinations will be made throughout the speed range for useful atmospheric flight. Studies will be continued of subsonic and supersonic boundary layers, boundary layer separation on complex shapes, and vortex and interference flows. Particular attention will be devoted to the latter flow phenomena at transonic speeds where adequate theory is not available for solution of practical problems; for example, suppression of aircraft drag rise and buffet due to shock-induced boundary-layer separation and excessive transonic wave drag associated with bluff aircraft configurations.

Computer graphic techniques will be developed for rapid assessment of supersonic design variations with respect to their influence on performance, stability, and sonic boom characteristics. Ways of extending available methods to higher supersonic and hypersonic mach numbers will be sought. The effects of atmospheric turbulence and winds, and focusing due to terrain or aircraft maneuvers on sonic boom pressure signatures will be pursued. Research activity of sonic boom generation and propagation will be planned and coordinated closely with the Interagency Aircraft Noise Abatement Program (IANAP).

Aircraft Loads and Structures

Increased effort will be placed on attaining automation of the aircraft wing structural design process by utilization of large, high-speed computers. The necessary computer programs are being developed to furnish minimum weight

designs which simultaneously satisfy requirements of static and dynamic strength, stiffness and freedom from flutter. The development of similar automated programs for other aircraft components such as the fuselage will also be initiated. The longer range goal is the achievement of automated structural design of the entire airframe on a rational, efficient basis.

Prevention of flutter is a design problem for all aircraft and in most designs entails compromises and structural weight penalties. Analytical and experimental studies will be continued, directed toward improved understanding and representation of the aerodynamic forces and moments on oscillating lifting surfaces, with particular emphasis on the transonic speed range, and on more accurate means for predicting the static and dynamic behavior of aircraft structures.

Research studies will be continued to develop the technology whereby the airplane control system can be used to suppress or alleviate the dynamic structural response for flight through turbulence. Such suppression, particularly for large airplanes, will greatly reduce pilot and passenger discomfort and increase structural reliability. In addition to studies to develop improved analytical methods of calculating aircraft response, wind tunnel tests of a flexible, dynamically scaled model will be made in a wind tunnel in which the model will be subjected to a gust environment.

Basic structural studies of high strength and high stiffness boron filaments bonded to conventional metallic structures have confirmed the promising weight saving potential of this concept. This research will be extended to include design and manufacturing of representative aircraft components to obtain realistic assessment of the fabrication, reliability and cost aspects.

Research on the engineering aspects of structural fracture under repeated loadings (fatigue) will be continued. The emphasis will be on crack propagation and residual strength of sheet-stiffener configurations typically used in airplane construction as affected by loading, choice of material, structural geometry and the atmospheric environment. Studies will also be undertaken of the fatigue characteristics of metallic structures reinforced with boron or graphite filaments.

Air Breathing Propulsion

The objective of the research in this program area is to examine advanced energy conversion processes and problems either identified over a broad range of aircraft applications or else not readily identified with specific aircraft applications. Analytical and experimental studies will be conducted on advanced bearings and lubrication systems, high speed shafting and gearing, and engine seals. Limited research will be conducted on selected engine components, where the emphasis will be on safety and reactor containment, to provide the information necessary for a technological assessment of nuclear power for aircraft use. Advanced propulsion system concepts will also be examined to verify the feasibility of small gas turbine engines, which indicate promise for good performance, simplicity and low cost.

Aircraft Operating Environment

The programs in this research area are aimed at solving problems related to runway surface and atmospheric environment, operational hazards, flight instrumentation, noise and sonic boom effects. They involve theoretical analyses and laboratory and flight test experiments to validate current engineering procedures and to explore solutions to aircraft operational problems. The results will provide both the basic technology for safer and quieter aircraft operations and the basic environmental data for application to design of specific classes of aircraft.

Atmospheric environmental research includes laboratory studies and theoretical investigations of warm fog modification concepts, the analysis and correlation with atmospheric parameters of turbulence and temperature data collected on test aircraft and from satellites, and the electromagnetic characteristics of severe storms. Runway surface research includes tire traction experiments planned to assess the ability of various surfaces, tire construction and braking devices to improve aircraft braking and aircraft control on the ground.

In the operational hazards area, protection schemes to avoid critical airplane structural damage from jet engine rotor disk failures will be evaluated. The effects of lightning strikes on aircraft electrical systems will be assessed in laboratory experiments. Research is planned to provide a capability to measure atmospheric winds from a remote location and these research results are expected to have application to the alleviation of the trailing vortex and clear air turbulence hazards.

NASA aircraft noise research is a continuing effort directed primarily at means of minimizing engine noise at its source. A better understanding of the fundamentals of compressor and fan noise generation is sought. Fundamental information on the generation and propagation of noise from the exhaust jets of turbofan engines having high ratios of bypass to primary mass flows will be obtained. Particular emphasis will be placed on the low exhaust velocity range where the turbulence level of exhaust jets may be a dominant factor in noise generation. The experimental studies will be conducted under carefully controlled laboratory conditions with jet velocity and jet turbulence level as the main variables.

Research aircraft often need new or improved sensors to measure the required parameters and a program for the design, development and testing of advanced sensors for flight research programs is planned. Examples of needed sensors are altimeters for use at high speeds and altitudes, miniature pressure transducers to withstand high stagnation temperatures, and instruments to measure pressure and flow direction in a dynamic environment.

The sonic boom research will identify and quantify detrimental effects of the overpressure on ground structures and equipment. Sonic boom induced vibrations, noise transmission and building structure damages due to repeated

loads are of particular concern. Theoretical studies, and laboratory simulator experiments will be used to acquire the needed data. The information will be useful in future structural designs and in the development of operational procedures devised to minimize detrimental effects.

Aircraft Flight Dynamics

Research in this area is aimed at achieving increased knowledge and understanding of the basic elements which influence aircraft handling qualities and piloting performance, at obtaining expanded fundamental knowledge on the flight behavior of aircraft, and at developing, evaluating and applying improved theories, control techniques and piloting aids pertinent to a variety of aircraft types. This research involves theoretical analyses, ground based simulator tests, wind tunnel studies and in-flight investigations with variable stability aircraft. The research program also includes studies to evolve improved flight-test analysis techniques and continued compilation and codification of aircraft flight dynamics characteristics and handling qualities data.

Among the studies planned are investigations to determine the effects of motion cueing on pilot performance during instrument and visual flight rule operations, to establish the influence of erroneous motion and visual cues and control system dynamics on the effectiveness of variable-stability aircraft, and to evaluate the usefulness of an active vibration isolation system in mitigating adverse effects of vibration on pilot performance. Studies of the flight behavior of aircraft will include analysis of optimum maneuvers for tactical aircraft using differential game theory and gradient techniques, and continued investigation of the fundamental nature of aircraft spins. Piloted simulator tests will be made to determine the effects of unsymmetrical aerodynamic characteristics, degraded stability and gyroscopic cross-coupling on aircraft flight at and beyond stall. New control techniques and piloting aids will be studied for improving aircraft flight behavior and piloting performance in severe atmospheric turbulence, and research on the basic interactions of turbulence, aircraft responses and handling qualities will be continued. Theories related to pilot vehicle dynamic response behavior will be evaluated to develop improved simulation techniques and optimum motion wash-out systems.

Support of Facilities and Aircraft

In addition to the advanced research, specific wind tunnel, propulsion and simulation tests are conducted in support of other government agency programs and these require the expenditure of funds for model instrumentation, changes in tunnel and balance configurations, displays and computer programs for simulation and occasionally special flight or model drop tests. NASA support of Department of Defense new military aircraft and missile systems, testing related to Department of Transportation high speed ground transportation programs, and aeronautics support to FAA are covered in this funding category.

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NASA's aeronautical research facilities are key to the research effort as well as being essential for the support of other agencies. Thus it is necessary to continue to provide for the upgrading of these facilities in terms of new equipment, instrumentation, and computerization of data acquisition reduction and analysis.

The NASA research centers use various aircraft in direct support of advanced research and technology programs. The maintenance, spare parts and ground support equipment for these R&D aircraft and chase and proficiency aircraft which are used for various missions are also included in this funding category.

General Aviation Aircraft Technology

	1969	1970	1971
Disciplinary technology.....	$507,000	$950,000	$925,000
Total.....	$507,000	$950,000	$925,000

The emphasis in the general aviation technology effort is on aerodynamics, flight dynamics and design, with specific attention being paid to safety aspects. The major thrust of the effort continues to be on flight dynamics to improve handling characteristics of future general aviation aircraft. Studies will be made of the effect of decoupling and/or suitable recoupling of lift, drag, thrust and longitudinal control on the ease of flare and precision of touchdown. The approach to be used is to equip a Navion airplane with variable stability equipment to provide various longitudinal coupling modes and to investigate a variety of flight conditions and coupling modes in flight during approach and landing.

The levels of stability and control and handling qualities that are needed to allow the general aviation pilot to complete a mission safely will be defined, based upon extensive flight testing of a typical light, twin-engine aircraft equipped with a variable stability system, as well as other selected general aviation aircraft.

A flight investigation to establish the characteristics of a typical executive jet aircraft will be conducted using the NASA Lear Jet which, during FY 1970, has been instrumented to provide documentation of both static and dynamic flight characteristics. Special attention will be directed to determining the effects of turbulence for all normal flight regimes. Advanced flight displays will be studied for their potential in providing significant reduction in pilot workload.

In the aerodynamics and design area, analysis and wind tunnel tests of airframe configurations unique to the general aviation class of aircraft will be conducted, and broad summaries of all information from related aerodynamic tests will be prepared for use by the industry.

Flight tests of pilot warning indicator systems will be continued and accelerated as the equipment developed in the avionics program becomes available.

V/STOL Aircraft Technology

	1969	1970	1971
Disciplinary technology	$6,700,000	$5,950,000	$11,230,000
Experimental hardware:			
Rotating-cylinder flap	1,150,000	300,000	350,000
Jet augmentor wing	210,000	1,500,000	2,500,000
Advanced lift fan	---	600,000	250,000
DO-31 aircraft	---	810,000	---
Tilt rotor aircraft	---	300,000	---
Jet-flap rotor aircraft	---	100,000	---
Externally-blown flap	---	---	500,000
Rotor test vehicle	---	---	200,000
Total	$8,060,000	$9,560,000	$15,030,000

In the disciplinary technology area, emphasis is being shifted to increase basic experimental and analytical studies leading to improved understanding of helicopter rotor performance, loading, and flutter characteristics. These studies, initiated partly in response to operational problems encountered by the Army, include examination of improved airfoils--such as the supercritical profile, being considered for other conventional aircraft applications--rotor platform and geometry, and new rotorcraft configurations. Effort on advanced rotorcraft concepts enabling performance higher than that possible with a "pure" helicopter will also be increased. Some additional models of VTOL configurations utilizing the lift fan--expected to provide a good compromise between the requirements of high speed cruise, good hover capability, and low noise--will be tested at large scale in the NASA 40- by 80-foot wind tunnel.

In the flight dynamics area, studies recently initiated to examine VTOL operational problems in the descent and landing phases of flight will be augmented. This research is aimed at providing designers and users with information on vehicle control and handling qualities plus stability augmentation and pilot display equipment required to permit safe landings under poor visibility weather conditions, in as short a time as possible to minimize fuel expenditure and reduce use of congested airspace near the terminal, and with acceptable pilot workloads. Primary new vehicles planned to be used include the X-22 tilt-duct aircraft (in a joint program with the Navy and Air Force) whose power and size enable consideration of new research areas; and the CX-84 aircraft (in a joint program with the Canadian Government), which will enable extension of study of the tilt-wing concept and also provide a suitable carrier for planned studies of pilot display requirements, and of examining components of avionics systems aimed at providing an eventual automatic landing capability.

Continued research is planned in the loads and structures area, investigating in particular the aeroelastic stability and control characteristics of hingeless rotors. Related studies of the tilt rotor, the stopped-and-fold rotor, and the variable geometry rotor will also continue. In the area of

V/STOL propulsion research, emphasis is being placed on advancement of the technology base for lift fans. Study of direct-lift jet engines will also continue, particularly to provide an understanding of adverse recirculation effects and methods of avoiding them.

The jet-augmentor wing program is aimed at providing technology applicable to the design of improved STOL transports with both civil and military missions. Based on the promise shown by the results of previous wind tunnel tests and design feasibility studies, a joint program with the Canadian Department of Industry, Trade and Commerce will be continued to provide a research aircraft to demonstrate the validity of the wind tunnel tests and to uncover possible operational problems. In this program, Canada will provide the required propulsion system and the NASA will modify its CV-7A aircraft to incorporate an augmentor wing and the Canadian propulsion package. It is anticipated that about 90 percent of the NASA funding needed for the modification will be required in FY 1970 and 1971, with the remainder in FY 1972. The flight research program will be carried out jointly at the NASA Ames Research Center beginning in FY 1973. Another jet STOL concept which provides less STOL performance capability than the augmentor wing but which may have other installation and cost advantages is the externally-blown flap now receiving extensive wind tunnel model study. Based on the promising results of these tests, a design feasibility study will be conducted in FY 1971 of the possibility of modifying an existing transport aircraft to provide a research vehicle for NASA evaluation.

The objective of the advanced lift-fan aircraft program is to advance information on lift-fan technology to the point where design of a commercial lift-fan V/STOL transport can be initiated with confidence. Results of previous NASA sponsored lift-fan design studies indicate that technology is available to enable the design of the advanced high pressure, low noise level, lift-fans required for such transports. In FY 1971, design studies will be undertaken to indicate the feasibility of modifying a small transport aircraft to incorporate lift-fans to validate the previous wind tunnel and static, ground tests of the fans and to investigate the integration of lift-fans into practical transport design.

In order to obtain realistic, final evaluations of the characteristics of the advanced rotor concepts evolved from wind tunnel model and whirl tower studies, flight investigations will be required. Based on a feasibility study supported in FY 1971, it is planned that an existing helicopter will be modified in FY 1972 to provide this capability.

Subsonic Aircraft Technology

	1969	1970	1971
Disciplinary technology.....	$3,721,000	$855,000	$1,400,000
Experimental hardware:			
Acoustic treatment.....	8,070,000	1,500,000	250,000
Quiet engine.....	7,500,000	5,900,000	10,000,000
Supercritical wing.....	---	1,170,000	250,000
Total.....	$19,291,000	$9,425,000	$11,900,000

As during the past several years, the primary concentration in subsonic aircraft technology is on reduction of noise, with a continuing but modest effort maintained in the remaining subsonic disciplines. The noise reduction programs have successfully demonstrated substantial alleviation by nacelle acoustic treatment and provided valuable data for design as well as regulatory purposes. Design and development of the experimental quiet engine are progressing satisfactorily. Vigorous concentration will be maintained on the combined activity in this vital area. Irrespective of the SST developments, a substantial portion of passenger and cargo transport over the next two decades will be in subsonic jet transports. It is essential that U.S. aircraft continue to show superiority in this field to capture a healthy share of the world market.

Progress in development of the supercritical wing concept has warranted a concerted effort to integrate this technology along with new structural and propulsion concepts into an overall supercritical design technology applicable to a new family of near-sonic transports. Analysis and wind tunnel investigations will be directed toward this end, and will lead subsequently to system studies permitting the determination of experimental hardware requirements for establishing feasibility of new concepts in the flight environment. The near-sonic transport offers the promise of increased aircraft productivity and lower operating costs.

Preliminary study is being directed to the possibilities of improvement in low speed flight capability and precision flight-path control to reduce runway length requirements and improve the safety of all weather operation under congested conditions. Analytical programs in this area, to be followed eventually by wind tunnel and flight research and simulation, will cover means of increasing high lift capability, low speed control effectiveness, and integrated control/display/guidance capability for both automatic and manual flight.

Supersonic Aircraft Technology

	1969	1970	1971
Disciplinary technology	$13,993,000	$17,510,000	$16,795,000
Experimental hardware:			
XB-70	3,020,000	---	---
F-111	550,000	550,000	500,000
YF-12	2,785,000	840,000	4,610,000
Total	$20,348,000	$18,900,000	$21,905,000

The design of advanced military and commercial supersonic aircraft with high performance level is dependent upon factors such as increased aerodynamic efficiency, decreased structural weight, improvement of power plant characteristics (by decreasing consumption of fuel and the specific weight of the engine), and improving the dependability of all the systems. A wide range

of research activity in the various technologies is being carried out to achieve these goals and to provide the knowledge for the conception of advanced supersonic vehicles.

Analytical and experimental studies of the aerodynamic characteristics of promising configurations and components of proposed supersonic transports will be continued over the range of speeds from subsonic to a Mach number of 3. Performance, stability and control characteristics of supersonic transports at subsonic speeds will be explored to obtain satisfactory take off and landing characteristics by adjustment of aircraft geometry and by the use of artificial stabilization equipment.

A continuing research effort is concerned with providing the aerodynamic technology needed for the conception and design of advanced and highly maneuverable military aircraft. Aerodynamic data will be derived on such items as high lift devices, effects of engine power, engine-airframe integration, buffet, and effects of variations in wing geometry.

A number of metallic and nonmetallic materials that may be suitable for use in supersonic aircraft structural applications are being investigated. This research involves long-time elevated temperature tests of current and advanced materials to determine stability and oxidation resistance under a simulated supersonic aircraft environment. Structural specimens of titanium reinforced with boron or graphite fibers will also be subjected to an experimental program including loading and environmental exposure.

The development of propulsion system technology for advanced military and commercial aircraft will continue. In the area of inlets and nozzles, particular emphasis will be placed on the stability problems of these high performance components at their design speed, on the performance and variable geometry configurations during off-design operation, and on the mutual interaction problems that result when integrating these components into a complete airframe and propulsion system. At transonic speeds, the ground test facilities are complemented by a flight test program which uses a F-106 aircraft with unique modifications for inlet and nozzle research.

Several approaches to reduce compressor and fan component weight and improve performance will be investigated. These components must provide efficient compression, the necessary stall margin and distortion tolerance over the range of flow rates imposed by various flight conditions. Compressor blades will be designed to operate at higher flow Mach numbers encountered at increased rotational speeds made possible by improved materials. Various approaches to delay end wall stall will be studied. Multistage compressors will incorporate the most promising advanced concepts investigated in single stage compressors.

Research will continue in the areas of primary combustors, augmenting burners and fuels for advanced engines. Primary combustors will be designed to give rapid mixing and intense burning in the forward end to provide shorter, more durable liners with low smoke and uniform high temperature profiles at

the combustor exit. The afterburner research program will evaluate and improve the performance, stability, and life of afterburners designed for high temperature engines. Research on fuels will be directed toward utilizing them as heat sinks for cooling hot engine components.

The turbine is undergoing a greater change than any other component in modern engines. The turbine inlet temperatures are steadily increasing and hig. work turbines are being introduced in order to reduce turbine weight and size. Under the turbine aerodynamics research programs, investigations will be made on the effects of cooling air discharge on turbine performance for both single and multistage turbines, on the performance of both fixed and variable geometry turbines, and on a number of methods of increasing blade loading in order to reduce turbine size and heat transfer surface area. Turbine cooling research is directed at developing methods for predicting the cooling performance of air cooled turbine blades cooled by a variety of methods.

Flight dynamics research is being conducted to develop criteria for aircraft systems that will allow the pilot to easily, economically, and safely control and maneuver supersonic aircraft in accordance with operational requirements. Specific research is directed at the improvement of aircraft under design such as the supersonic transport, and the F-14 and F-15 supersonic fighters. Also, a cooperative research program is directed to providing the information necessary for the FAA to establish certification regulations for supersonic transports and for developing revisions in certification test maneuvers.

An F-111A aircraft is being flown to provide flight dynamics information applicable to the design and development of advanced military aircraft. The program consists of three separate investigations. The first pursuit is concerned with a handling qualities flight control system study with different levels of stability augmentation system sophistication.

The second objective will establish the relative importance of various landing approach variables including direct lift control and approach power compensation on the landing task of a high performance aircraft. The third study will evaluate the effects of various factors such as buffet, buffet intensity, and stability augmentation complexity on piloting precision of closed-loop tracking capability.

The NASA-USAF YF-12 flight research program is obtaining design information applicable to aircraft that have a high sustained supersonic Mach number capability. Air Force interests are oriented primarily toward a further definition of the tactical performance and support requirements of an advanced interceptor. The NASA programs are obtaining data in areas such as airplane structural characteristics, flight loads and deformations, aeroelastic effects on stability and control, propulsion airframe interaction, internal diffuser dynamics, and aerodynamic boundary layer characteristics. Throughout the course of these studies, it is expected that equipment and instrumentation changes and alterations as well as modifications to the aircraft will be required.

Hypersonic Aircraft Technology

	1969	1970	1971
Disciplinary technology.....	$3,085,000	$4,060,000	$3,775,000
Experimental hardware:			
Hypersonic research engine.....	6,600,000	2,000,000	2,000,000
Total.....	$9,685,000	$6,060,000	$5,775,000

The technology is being developed from continuing theoretical and experimental studies in the various disciplines for long range hypersonic aircraft systems suitable for transports and reuseable boosters. Basic experimental data have been obtained on an early generation of hypersonic air-breathing configurations, on promising lightweight structural concepts, and in the areas of fuel injection and combustion. These data are being used to verify the adequacy of the theories. These analyses and tests further serve the highly useful purpose of exposing problems and of formulating a plan to solve these and other problems.

The program in prediction techniques will be expanded whereby current theories will be improved and new ones developed and corroborated with appropriate experiments. The theoretical and experimental evaluations of airframe-inlet-engine integration effects will be continued and various simulated propulsion systems in combination with wing-body models will be tested. Initial studies of cooling systems have identified attractive methods to reduce both the structural weight and aerodynamic drag of hypersonic aircraft. Further analytical and experimental research are required to evaluate these methods when applied to complete aircraft.

Because of the extremes in temperature, -423°F in the cryogenic fuel tanks, near 1500°F over major portions of the surface, and up to about 4000°F in stagnation regions, various concepts for structures and thermal protection are being explored. Conceptual designs for wing leading edges will be tested in the tunnel and in the structures laboratory. Tests of a carbon dioxide frost thermal protection concept will be continued using liquid nitrogen to simulate cryogenic fuel. As a follow-on to an indepth study of wing structures, an experimental program will be initiated to evaluate promising concepts for wing panels under realistic heating and loading.

Experimental and analytical research programs on the technology of air-breathing hypersonic propulsion engines will be broadened emphasizing supersonic combustion and studies of the associated aerothermodynamic process. Both large and small scale supersonic combustor tests will be conducted. A significant portion of the inlet research effort will be directed to the development of design techniques suitable for high performance systems and to the assessment of the performance potential of various configurations. The feasibility of reducing combustor lengths by injecting fuel on the inlet compression surfaces will be studied experimentally.

The Hypersonic Research Engine program has progressed through the definition and design of all of the components. Assembly of both the aerothermodynamic integration model which has internal passages designed for high propulsion efficiency, and the structural assembly model, which has regeneratively cooled surfaces designed to maintain structural integrity at high operating temperatures, is continuing.

The aerothermodynamic integration model will be water cooled, and will be investigated at the Lewis Research Center's Plum Brook facility to demonstrate overall operating performance and stability with hydrogen fuel injection and either subsonic or supersonic combustion.

The structural assembly model will have liquid hydrogen regeneratively cooled surfaces, and will be tested without combustion in the Langley Research Center's 8-Foot High Temperature Structures Tunnel to determine the structural adequacy of this type of construction when operating in a hypersonic environment.

INCREASE FUNDING

Mr. EVINS. You have an increase from $75.9 million in 1970 to $87.1 million in 1971 in the aeronautical vehicles program. Tell us what you are proposing here and why the increase?

Mr. NICKS. Mr. Chairman, the increase is to move promising concepts out of the research laboratory and into proof tests leading to applications. It is for flight tests of the supercritical wing, which was mentioned as a new means of getting higher performance for subsonic aircraft. It is for doing tests on rotorcraft using rotors that would tilt that would replace the helicopter. It is for beginning work on a short takeoff and landing configuration with the blown flap that I mentioned earlier and which uses the thrust of the jet engine to help lift the airplane and make the takeoff run shorter.

Those are the principal activities that cause the fund increase.

We also are continuing our supersonic program this year with a joint effort with the Air Force on the YF–12, which is a supersonic airplane that will be used for research useful for determining the handling characteristics of supersonic transports.

AVAILABILITY OF RESULTS TO INDUSTRY

Mr. EVINS. Are the results of these research programs generally made available to the aircraft industry?

Mr. NICKS. Yes, sir, they are; that is a part of our responsibility. We are in very close cooperation to all the aviation industry and the FAA and Department of Transportation.

Another point which I think will be important in the future: We just this past year completed a flight simulator at Ames Research Center which can simulate for pilots the characteristics of a supersonic transport or any advanced or large airplane. You heard this mentioned last year, but the thing that is interesting is that it shortly after being placed in operation became scheduled ahead for 3 years.

It is very much needed and it looks as if it will help not only in training pilots and the techniques for flying such large machines, but will also help in the design of them. You can put different kinds of aircraft characteristics such as for roll rates, into this simulator, and the computers and equipment produce the resulting motions and you can see if the characteristics you set can cause trouble when they are flown.

V/STOL AIRCRAFT

Mr. EVINS. Who has made the greatest contribution in the V/STOL aircraft, the aircraft industry, NASA, or the Air Force? Everybody has been concerned about it.

Dr. PAINE. The U.S. Army should also be mentioned. They have done a great deal to improve Army mobility through helicopters and have a fine program in this area. I think the correct answer would be all these various groups are working closely together on this and contributions have come from many different areas.

Mr. NICKS. My deputy for aeronautics is with such a coordinating group at this minute; otherwise he would be with me.

Mr. EVINS. You are almost doubling your appropriation for V/STOL technology, from $8 million in 1969 to $15 million in 1971.

Mr. NICKS. Yes, sir.

SONIC BOOM TESTS

Mr. BOLAND. Do you anticipate any actual tests on the sonic boom this year? Do you actually fly aircraft at supersonic speeds to determine what the effect is upon building structures, as you have indicated on page 17–5?

Mr. NICKS. The YF–12 does give us that supersonic capability, Mr. Boland.

I am not sure the program this year calls for it to be flown in these kinds of experiments. We are doing a lot of analysis work on this and research work in the laboratory.

AIRCRAFT PROGRAM WITH CANADA

Mr. EVINS. You refer to a joint program with the Canadian Department of Industry, Trade, and Commerce, which will be continued to provide a research aircraft to demonstrate the validity of the wind tunnel tests and uncover possible operational problems.

Is it an American aircraft?

Dr. PAINE. No, Canadian. We are now going to test to make sure we know how the wind tunnel tests relate to the flight characteristics so we can upgrade our wind tunnel tests.

Mr. NICKS. This is an Army aircraft; that is, the U.S. Army buys this aircraft from the Canadians.

It is being modified for the characteristics suitable for this jet lift principle.

Dr. PAINE. It is an ideal plane to check out this new NASA innovation.

Mr. EVINS. This is very fine.

Dr. PAINE. I might mention that although we are spending a considerable amount of money in this aeronautics research area, the present backlog of aircraft orders with the U.S. industry is over $8 billion. So this is a very important part of our economy.

OART BREAKDOWN

Mr. EVINS. How much of the $264 million for the advanced research and technology programs is by contract and how much by NASA facilities? How does it compare with 1969 and 1970?

Mr. NICKS. Mr. Chairman, our personnel at the NASA centers are not included in this cost. They amount to about $201 million.

Mr. EVINS. Give us a breakdown for 1969, 1970, and 1971.

Mr. NICKS. Approximately 62 percent of it goes to industry, about 5 percent to universities, and 33 percent buys materials, supplies, and so forth, for our research in-house activities.

Mr. EVINS. Give us a breakdown for the record of this.

(The information follows:)

OART PROGRAM IMPLEMENTATION

[Dollar amounts in millions]

	Fiscal year 1969		Fiscal year 1970		Fiscal year 1971	
	Amount	Percent	Amount	Percent	Amount	Percent
Industry	$172	62	$172	62	$150	57
Universities	14	5	15	5	15	6
In-House R. & D.[1]	92	33	90	33	99	37
Total	278	100	277	100	264	100

[1] This includes research equipment, models, instruments, materials, supplies, and R. & D. service contracts.

Tracking and Data Acquisition

Mr. Evins. Let's turn to the "Tracking and data acquisition program" and place in the record pages RD18–1 through RD18–18.

(The pages follow:)

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1971 ESTIMATES

OFFICE OF TRACKING AND DATA ACQUISITION

TRACKING AND DATA ACQUISITION PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The purpose of this program is to provide responsive and efficient tracking and data acquisition support to meet the requirements of all NASA flight projects. In addition, support is provided, as mutually agreed, for projects of the Department of Defense, other Government agencies, and other countries and international organizations engaged in space research endeavors.

Support is provided for manned and unmanned flights; for spacecraft, sounding rockets, and research aircraft; for earth-orbital and suborbital missions; for lunar and planetary missions; and for space probes.

Types of support provided include: (a) tracking to determine the position and trajectory of vehicles in space, (b) acquisition of scientific data from onboard experiments, (c) acquisition of engineering data on the performance of spacecraft and launch vehicle systems, (d) transmission of commands from ground stations to spacecraft, (e) communication with astronauts and acquisition of medical data on their physical condition, (f) communication of information between various ground facilities and mission control centers, and (g) processing of data acquired from the space vehicles. Such support is essential for achieving the scientific objectives of all flight missions, for executing the critical decisions which must be made to assure the success of these flight missions, and, in the case of manned missions, to insure the safety of the astronauts.

Tracking and data acquisition support is provided by a worldwide network of NASA ground stations supplemented by appropriate instrumentation ships, aircraft, and ground stations of the Department of Defense. These facilities are interconnected by a network of ground communications lines, undersea cables, high frequency radio links, and communication satellite circuits which provide the capability for instantaneous transmission of data and critical commands between spacecraft and the control centers in the United States from which the flights are directed. Facilities also are provided to process into meaningful form the large amounts of scientific and engineering data which are collected from flight projects. In addition, instrumentation facilities are provided for support of sounding rocket launchings and flight testing of research aircraft.

The Research and Development appropriation provides funds: (a) for the operation and maintenance of the worldwide facilities; (b) for the procurement

of equipment and for modifications to facilities to support continuing, new, and changing flight project requirements; and (c) for the investigation and development of advanced tracking and data acquisition equipment and techniques. The subsequent sections describe plans and related funding requirements to continue the Tracking and Data Acquisition program in each of these areas during FY 1971.

SUMMARY OF RESOURCES REQUIREMENTS:

	1969	1970	1971
Operations	$229,354,000	$233,400,000	$229,600,000
Equipment	39,162,000	32,200,000	55,500,000
Supporting research and technology	11,156,000	12,400,000	12,900,000
Total	$279,672,000	$278,000,000	$298,000,000

Distribution of Program Amount by Installation:

Manned Spacecraft Center	$5,300,000	---	---
Marshall Space Flight Center	300,000	$1,660,000	$400,000
Goddard Space Flight Center	208,221,000	206,405,000	212,127,000
Jet Propulsion Laboratory	47,694,000	51,150,000	66,143,000
Wallops Station	5,409,000	5,985,000	6,240,000
Electronics Research Center	100,000	60,000	---
Flight Research Center	2,000,000	1,875,000	1,630,000
Langley Research Center	1,450,000	845,000	1,160,000
NASA Headquarters	9,198,000	10,020,000	10,300,000

BASIS OF FUND REQUIREMENTS:

Operations			
Manned space flight network	$83,493,000	$86,380,000	$79,200,000
Satellite network	43,520,000	42,370,000	44,000,000
Deep space network	32,231,000	36,000,000	39,800,000
Other instrumentation	5,627,000	6,090,000	5,300,000
Communications	48,480,000	45,080,000	42,800,000
Data processing	16,003,000	17,480,000	18,500,000
Total	$229,354,000	$233,400,000	$229,600,000

Manned Space Flight Network Operations

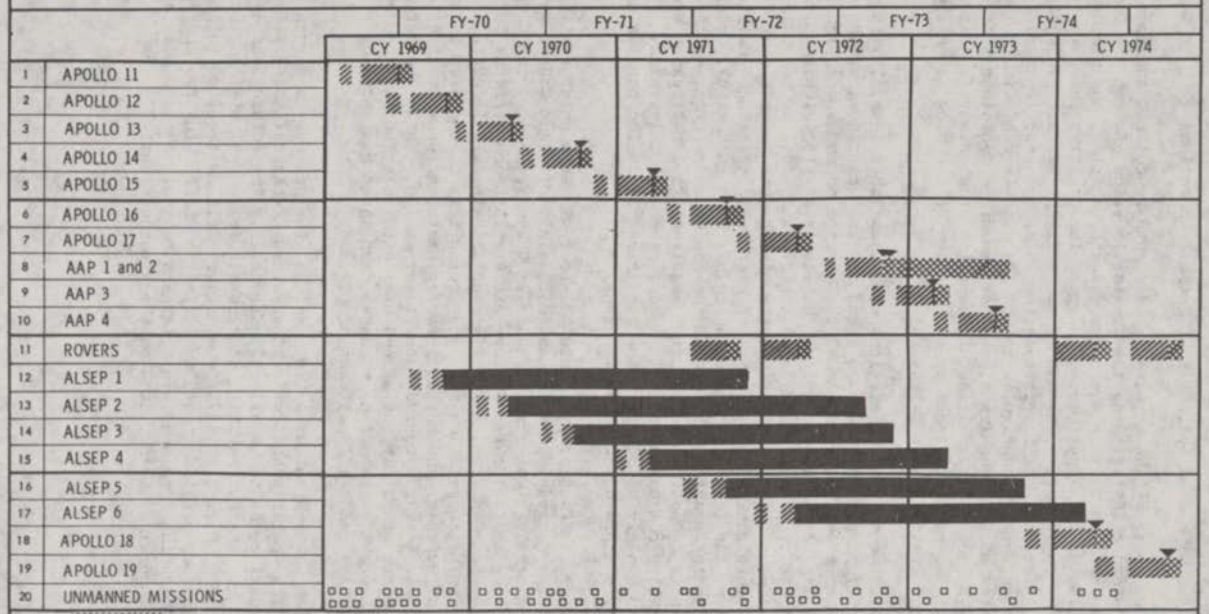
The Manned Space Flight Network was designed to collect and communicate real-time information regarding the precise location of both the Command and Lunar Modules as well as the Saturn launch vehicles, the status of the onboard equipment and experiments, and most importantly, the physical condition of the astronauts. The Manned Space Flight Network presently consists of 12 prime stations, one instrumentation ship, and four instrumented jet aircraft. The network is configured to provide data in real time to the Mission Control Center at Houston, Texas, so that immediate decisions affecting the mission may be made. In addition, information from scientific experiments both onboard the spacecraft and on the surface of the moon is collected and processed for post-flight analysis.

This worldwide network of stations was established initially for support of the Mercury program in early 1959 and has been continually updated and modified to meet the requirements of the several manned space programs. As the programs became more complex, the levels of precision involved in program support required increases in the overall level of capability and operations in the network. Consequently, the Manned Space Flight Network has evolved into a highly sophisticated electronic tracking, command, communication, and telemetry system which has been successfully operated in an outstanding manner. Throughout the manned space program, the network has continually supported the exacting requirements for tracking accuracy and high quality communications, including real-time television. This accuracy and quality has contributed significantly to the precise navigation required for the pin-point lunar landings.

The network consists of: (a) nine 30-foot-diameter antenna stations located at Cape Kennedy; Bermuda; Ascension Island; Grand Canary Island; Carnarvon, Australia; Guam; Kauai, Hawaii; Guaymas, Mexico; and Corpus Christi, Texas; and (b) three 85-foot-diameter antenna stations located at Madrid, Spain; Canberra, Australia; and Goldstone, California. In addition, one instrumentation ship and four aircraft, operated by the Department of Defense, and three 85-foot-diameter antenna stations of the NASA Deep Space Network provide support for Apollo. While the network provides support primarily for manned missions, selected stations of the network also provide support to unmanned deep space and earth orbital projects of NASA and the Department of Defense.

Along with the scheduled Apollo missions, the network is currently supporting the Apollo Lunar Surface Experiment Package (ALSEP) left on the moon's surface by the Apollo 12 astronauts. The future landing missions will also carry ALSEPs resulting in a continuing and significant workload on the network. During FY 1971, the network will be required to support two lunar landing missions, each including an ALSEP, plus two ALSEPs left by previous landing missions, and a large number of unmanned missions. This overall workload is depicted on the attached chart.

MANNED SPACE FLIGHT NETWORK WORKLOAD



NASA HQ TN70-15284
Rev. 1-14-70

Network Operations during FY 1971 will be at a reduced level from FY 1970. Operations experience gained through the lunar missions to date has allowed a phaseout of three instrumentation ships, four aircraft, and two land stations. The effect of these decreases is somewhat offset by allowances for cost-of-living increases.

Satellite Network Operations

The principal function of the Satellite Network is to support NASA's unmanned scientific and applications satellite programs. The network includes the electronic stations of the Space Tracking and Data Acquisition Network (STADAN) operated by the Goddard Space Flight Center, supplemented by the optical tracking network operated by the Smithsonian Astrophysical Observatory. The STADAN stations provide a ground system which (a) tracks each satellite, (b) determines the status of onboard systems, (c) commands the satellite functions, and (d) acquires stored or real-time data from the satellite. The optical stations provide specialized services in precision orbital tracking.

The STADAN consists of ten ground stations located at Fort Myers, Florida; Mojave, California; Rosman, North Carolina; Fairbanks, Alaska; Quito, Ecuador; Santiago, Chile; Winkfield, England; Johannesburg, South Africa; Tananarive, Madagascar; and Orroral, Australia.

Fiscal year 1970 and prior year budget constraints have resulted in the curtailment and cessation of operations at several locations. The STADAN stations at Lima, Peru, and Toowoomba, Australia, have been closed and the station at St. John's, Newfoundland, will be closed in March 1970. Staffing at the Mojave and Rosman stations in support of ATS has been reduced. In addition, the optical network has been severely cut back in both capability and level of operations.

These reductions and curtailments have been made possible by a continuing review of the scientific requirements for the acquisition of data from the spacecraft. As a result of this review, data acquisition from a number of healthy but lower priority satellites has been either completely terminated or severely curtailed.

The current network workload, consisting of some 45 satellites, continues to require around-the-clock operations. Ten new satellites scheduled for launch in FY 1971 will further impact the overall workload and will necessitate continuing adjustments in support priorities within the constrained network capability.

During FY 1971, initial activity associated with the ERTS control center and support of OAO-B will be undertaken. These project-unique requirements, as well as an allowance for cost-of-living increases, are included in the FY 1971 request for funds to operate the network at the currently constrained level.

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Deep Space Network Operations

The primary function of the Deep Space Network is to support lunar and planetary space flight missions. The network: (a) provides tracking data which are used to determine and make corrections and changes to spacecraft trajectories, (b) acquires engineering telemetry data concerning performance of the spacecraft, (c) transmits commands to the spacecraft, and (d) receives and records the scientific data which are acquired from the spacecraft. The network stations are located at Goldstone, California; Woomera and Canberra, Australia; Madrid, Spain; Johannesburg, South Africa; and Cape Kennedy, Florida.

The control center for the Deep Space Network is the Space Flight Operations Facility (SFOF) located at the Jet Propulsion Laboratory in Pasadena, California. The SFOF: (a) receives information transmitted via ground communications from stations of the Deep Space Network, (b) processes the data, (c) displays the resulting information so that mission directors and associated project personnel can analyze mission performance and make critical decisions in near-real-time concerning functions to be executed by the spacecraft, and (d) sends instructions to the stations for commands that must be transmitted to the spacecraft.

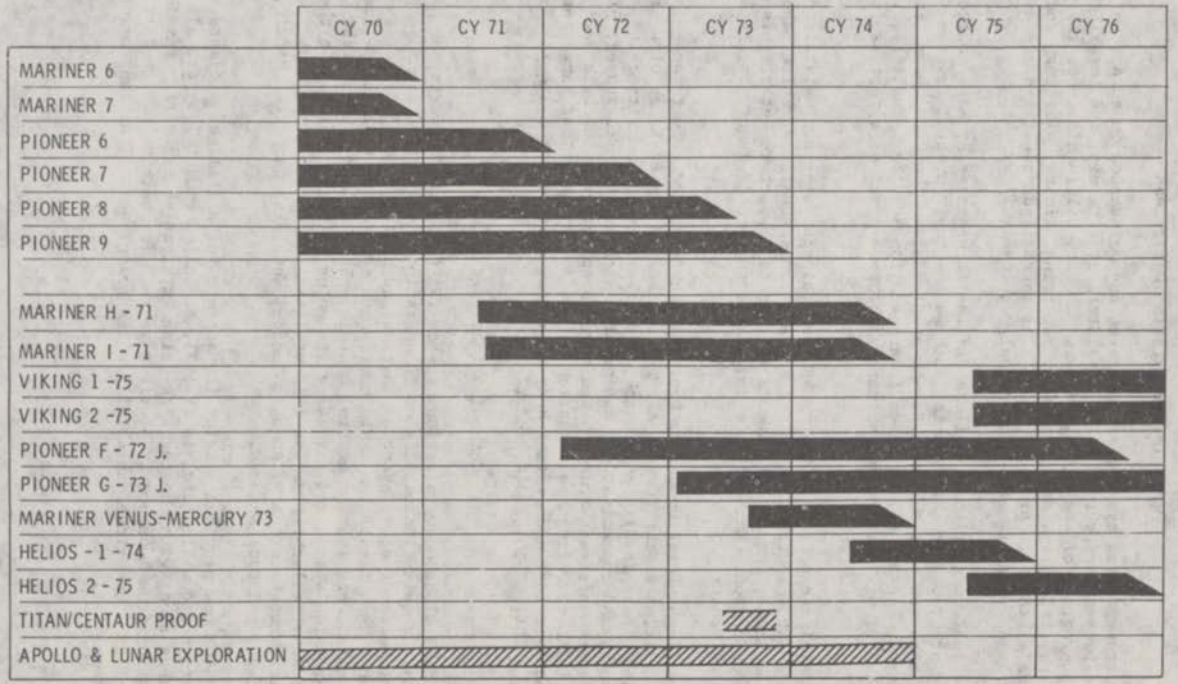
During FY 1970 the Deep Space Network is supporting four Pioneer spacecraft, the two Mariner 1969 spacecraft in the extended mission phase, and the Apollo manned lunar missions. This on-going workload, reflected in the attached workload chart, will continue on into FY 1971 along with preparation for support of the Mariner 1971 launch.

Extensive network engineering, programming, and computational support is necessary to meet the support requirements of Mariner 1971. The complexity of this support is related to the requirement for the network to support two orbiting spacecraft simultaneously for an extended period of time and at extreme distances. Substantial amounts of visual imaging and other scientific data must be acquired from the spacecraft as they orbit Mars. In addition, precise orbit information must be available in real-time for both spacecraft. The handling and selective display of this data requires significant programming and computational support particularly in the SFOF. Correspondingly, the engineering effort associated with equipment changes, modifications, and implementation will require increasing emphasis in FY 1971.

The FY 1971 request includes funds for the increased support for Mariner 1971. It also includes funds for the engineering and computational support in preparation for the Pioneer F and G missions to Jupiter and the Venus/Mercury 1973.

DEEP SPACE NETWORK LOAD

OFFICE OF TRACKING AND DATA ACQUISITION



NASA HQ TN70-15285
Rev 1-13-70

Other Instrumentation Operations

Instrumentation systems are operated and maintained in support of sounding rocket programs conducted by Wallops Station, Virginia; and for flight research programs of the Flight Research Center, California. General purpose tracking, telemetry, data handling, recording, timing, plotting, and communications systems are provided as well as special purpose fixed and mobile optical and sound ranging (acoustical) equipment.

The instrumentation at Wallops Station is operated by NASA contractors and by other Government agencies such as the Environmental Science Services Administration, the National Bureau of Standards, the U. S. Navy, the U. S. Air Force, and the Military Sea Transportation Service. Funds required for FY 1971 will permit approximately the same level of effort as in prior years.

Specialized mobile telemetry and optical equipment are maintained and operated at selected sites along the eastern seaboard, at White Sands Missile Range, and on the Bermuda Islands to support rocket flights from Wallops Station. Much of this down-Range support is funded by the Langley Research Center.

The Flight Research Center operates the Aerodynamic Test Range consisting of facilities at the Edwards Air Force Base and the up-Range site at Ely, Nevada. These facilities are composed of precision radar tracking, telemetry and communications equipments which are used to support high performance aircraft research and development programs of both NASA and the Air Force. Programs supported by the Aerodynamic Test Range include various aircraft and lifting body projects, some of which are the F-111, C-5A, F-104, HL-10, X-24A, and YF-12.

Communications Operations

NASA's global communications system (NASCOM) interconnects the NASA tracking and data acquisition facilities in operational support of all NASA projects and projects of other agencies that are supported by NASA networks. It interconnects such facilities as telemetry and command control sites, launch areas, test sites, and mission control centers. The Goddard Space Flight Center operates the system and serves as its major switching point. In the interest of economy, reliability, and full utilization of circuitry, subswitching centers have been established at London, Honolulu, Canberra, Madrid, Guam, Pasadena, and Cape Kennedy.

NASCOM has provided outstanding support for all flight projects since its inception and will again, in FY 1971, be called upon to support all new launches along with the large on-going workload of spacecraft remaining in operation from launches in previous years. The network continues to make use of new communications satellite technology as well as conventional means of communications.

The FY 1971 communications budget shows an overall decrease from the FY 1970 budget. Although a scheduled private line rate increase will significantly impact NASCOM's domestic circuits, other economies in the network result in a lower overall budget. During FY 1971, two Apollo missions will be supported whereas in FY 1970 three Apollo missions are being supported. Station closures have also contributed to the reduction.

Data Processing Operations

Information received in the form of tracking and telemetry data from satellites and space probes must be processed into a form that is useful both to those performing the real-time control of the space vehicle and those responsible for analyzing the scientific data acquired by the spacecraft. Support must be given to a wide variety of programs which vary from the small Explorer satellites to the large and complex Solar, Geophysical, and Astronomical Observatories, and Applications Technology Satellites.

Tracking data are processed to provide orbital elements which are used to supply stations with predictions on future passes of the spacecraft, and to provide position information that can be used by the scientific experimenters to determine where in the trajectory the scientific measurements were made.

Telemetry data must be processed to: (a) separate the information obtained from the various scientific experiments aboard the spacecraft, (b) consolidate information from each experiment, (c) apply the necessary scaling factors and calibrations, (d) determine spacecraft attitude, and (e) correlate these measurements with the position data mentioned above. Processed data are the primary product of the spacecraft missions and it is through reduction and analyses of these data by the experimenters that a better understanding of earth and space is achieved.

Upcoming projects, particularly those in the observatory, radio astronomy, and geodetic classes, require extensive premission orbit studies, including spacecraft position predictions and mutual visibility analyses. Studies are also required to work out operational methods and procedures to be used during the actual mission operations.

The FY 1971 budget request is based upon the workload which will result from previously launched satellites that will require continued support, plus additional satellites that are scheduled to be launched during the period. This workload includes an increase in the number of high data rate satellites such as the Nimbus-D, OAO-B, OSO-H, and IMP-I, which will result in additional telemetry data processing and mission related computer support. There will also be an increase in orbit and attitude computations due to greater spacecraft complexity.

The data processing workload is under continuing scrutiny along with the scientific requirements for acquisition of data from spacecraft. During the first half of FY 1970 data acquisition from a number of healthy but lower priority spacecraft was either completely terminated or severely curtailed as a result of this continuing review. These reductions will allow for support of ten new satellites to be launched in FY 1971 without major increases in data processing capability.

Equipment

	1969	1970	1971
Manned space flight network.....	$9,223,000	$7,600,000	$9,800,000
Satellite network.....	8,676,000	8,800,000	16,400,000
Deep space network.....	14,291,000	10,100,000	21,700,000
Other instrumentation.....	3,439,000	3,000,000	3,100,000
Communications.....	1,742,000	1,700,000	2,800,000
Data processing.....	1,791,000	1,000,000	1,700,000
Total.....	$39,162,000	$32,200,000	$55,500,000

Manned Space Flight Network Equipment

The Manned Space Flight Network equipment program encompasses the procurement of equipment and services necessary for incorporation of additional systems in the existing network to meet new requirements for manned space flight missions and appropriate unmanned missions, for modification of existing equipment to improve the network's operational effectiveness and efficiency, and for sustaining the network's continuing capability for reliable mission support.

During FY 1970, the network has been heavily engaged in Apollo mission support. Activity in the equipment program has been solely devoted to maintaining the network in a continuing state of readiness for support of changing Apollo mission requirements as the program has progressed from the successful accomplishment of the first manned lunar landing to the more varied activities of lunar exploration. Fiscal year 1970 funding requirements were reduced from the original plan as a result of the postponement of AAP and through utilization of equipment which became available as a result of ship deactivations following the successful Apollo 11 mission. This equipment has been used in lieu of planned procurements of spares and of replacements of obsolete systems.

The network's support of Apollo lunar missions will continue in FY 1971 and, in addition, virtually continuous operations will be required in support of the Apollo Lunar Surface Experiment Packages (ALSEP). Although provision of the basic capability for this support has been

completed in prior years, a continuing effort will be necessary to maintain a reliable support capability throughout the year. Accordingly, funds are requested for equipment to be used in verification of system performance, for correction of operational deficiencies, for replacement of failure prone equipment with more reliable units, and for some minor facility modifications and repairs. Funds are also requested for the engineering effort required in system performance evaluation, for provision and modification of test equipment, for continuation of the Test and Training Satellite capability, and for equipment modifications resulting from changes in support requirements from one mission to the next.

Apollo Applications missions will involve a sequence of revisit missions, each requiring network support of the orbiting workshop simultaneously with support of manned rendezvous spacecraft. Network support of ALSEP experiments will be required at the same time. Since the data systems employed on the workshop, the rendezvous spacecraft, and ALSEP differ functionally, changes will be required in station support configuration. Also, since individual network stations will be required to support the AAP vehicles and ALSEP in rapid sequence, the capability for rapid reprogramming and quick configuration turn around will be required in the network stations. Provision of systems to provide these capabilities was initiated in FY 1969; however, the delay in the Apollo Applications mission schedule and funding reductions resulted in a stretch-out of part of the effort. Accordingly, funds are requested for completion of these capabilities in FY 1971.

The Apollo Applications schedule delay also permitted postponement of the procurement of additional pulse code modulation (PCM) decommutation systems required to meet the increased data handling needs of the AAP missions. Pulse Code Modulation decommutators are used in the network stations to prepare data for input to the telemetry data processing systems where flight control parameters are selected and formatted for communication to the Mission Control Center. Accordingly, it is requested that funds be provided for these systems in FY 1971.

Satellite Network Equipment

As in previous years, the equipment program for the Satellite Network in FY 1971 is divided into three major categories with the following objectives: (1) sustaining the basic capability of the network to support on-going missions, (2) improving the utilization of existing equipment to increase operating efficiency, and (3) adding network systems to meet new requirements of approved missions.

Under the sustaining category in FY 1971, funds are requested for the completion of command system replacements which were deferred from FY 1970 due to fund constraints. Operating experience has shown the need for command systems with multi-mission capability which can generate and verify a wide variety of commands that must be sent to the spacecraft

by the network stations. Commands are necessary to maneuver the spacecraft, to switch scientific experiments on and off, and to issue corrective instructions to onboard electronic systems.

Complementary wideband receiving and data handling subsystems are also planned for procurement in FY 1971. As the spacecraft have become more complex in terms of data rates and onboard experiments, the receiving and data handling functions of the stations have also become more complex in order to receive and handle increasing amounts of both recorded and real-time data from the spacecraft. The requirement for real-time data has been significantly increasing due to the more sophisticated onboard experiments which necessitate that quick look data be transmitted from the stations to the control center in real-time for status monitoring and decision making purposes.

In FY 1971, funds are included for the on-going functions associated with maintaining a global network. These include the procurement of test and calibration equipment necessary to insure a high performance level of the electronic systems and subsystems, provision for minor facility repairs and alterations, procurement of specialized nonexpendable spare components and modules, and procurement of station maintenance vehicles such as antenna service cranes.

To improve the utilization of existing equipment, Station Technical Operations Control (STOC) consoles will be procured in FY 1971. Although this item has been deferred by funding constraints in prior years, the need for this operational improvement continues to increase as support requirements grow in complexity. Station technical operations control will provide this improvement by centralizing routine operations at stations and providing a rapid checkout capability. It will also allow station equipment to be made available more quickly to support successive satellite passes, thereby increasing the utilization of existing equipment.

The new capability category includes those equipments which are needed to meet new requirements for recently approved projects. In FY 1971, augmentation for ERTS will be essentially completed with the purchase of control center peripherals, display and control equipment, and on-site wideband recorders to handle both PCM and video signals. Also, in FY 1971 low noise RF equipment and special decoding equipment will be purchased for the lunar RAE-B mission. Similarly, funds are requested for modification of existing station equipment for Nimbus D and for new or modified displays, computer interface equipment, and operations consoles in the control centers for OAO-C and OSO-I, J, and K.

Deep Space Network Equipment

In FY 1971, continued emphasis will be placed on providing the Deep Space Network with a multi-mission support capability for planetary projects in the early to mid-1970's. Initiated in FY 1970, this capability is incrementally phased to meet the support requirements of such approved

projects as Mariner 1971, Pioneer F and G, Venus/Mercury 1973, Helios, and Viking. As in FY 1970, the FY 1971 request also contains the necessary funding for sustaining the existing network which is currently supporting four Pioneers, two Mariners, and the on-going Apollo missions.

Approximately three-quarters of the FY 1971 request is keyed to providing a combined multi-mission support capability for upcoming missions. The workload associated with these missions is characterized by requirements for the network to work with spacecraft at extreme distances (up to 550 million miles), to simultaneously handle critical events from more than one spacecraft, and to acquire large amounts of visual imaging and other scientific data.

To meet such requirements, general purpose command and data handling systems which can work with a variety of spacecraft are being implemented in the network. Implementation of the network systems needed for the Mariner 1971 program was initiated in FY 1970. This included the provisioning of the 210-foot antenna at Goldstone with dual receivers and data handling systems to work with both Mariner 1971 spacecraft simultaneously. This initial implementation phase will be completed with FY 1971 funds, including completion of the 210-foot antenna high power transmitting system which was partially deferred from FY 1970.

In addition, the FY 1971 request contains funds for the second implementation phase which consists of providing general purpose data handling systems at the two 210-foot overseas antennas which are presently under construction. The remaining 85-foot antennas are being augmented to support the on-going programs, including pioneer F and G, Venus/Mercury 1973, and Helios. This equipment will also provide the base to which future systems can be added to provide support to Viking missions.

Concurrently with the station augmentations, a phased implementation plan is also underway at the network control center at Pasadena, California. Initially required for Mariner 1971, equipment augmentations are being made to provide the capability for simultaneously computing precision orbits for the two spacecraft, to retrieve and display TV data, and to process and display information on the attitude and condition of the two spacecraft. Fiscal year 1971 funds are required to complete this initial phase and to provide the additional capability needed for simultaneous support to the planetary missions planned during the 1972-75 time period.

During FY 1971, a long lead time development effort will be undertaken to provide for the eventual operation of the Goldstone 210-foot antenna at X-band frequencies. The X-band is a higher region of the radio frequency spectrum, around 8,000 megahertz, compared with our presently used S-band frequencies around 2,200 megahertz. We can achieve significant improvements in space communications by use of the X-band frequencies in terms of greater quantities of data over greater distances. While this capability will be used initially in the 1973-74 period, it will have particular significance

for later missions to the outer planets. With the potential for the transmission of data at very high densities, the scientific return on planetary missions could be substantially improved with this capability. Funds are included in the FY 1971 request for initial antenna and receiver modifications at Goldstone for this effort.

Also contained in the FY 1971 request are funds for sustaining the network in support of the on-going program consisting of several Pioneers, Mariner 6 and 7 in the extended mission phases, and for Apollo. With the advent of prolonged periods of critical mission support such as the Mariner 1971 Mars orbital flight, there will be an increasing dependency on the integrity of the network. This requires a continuing program to replace obsolete or high maintenance components, modules, and subsystems, and to update equipment to provide the necessary reliability. Among the items normally procured for this effort are test and calibration equipment, cabling assemblies, power distribution equipment, and electronic modules and assemblies for the major equipment systems. This effort also provides for module spares provisioning, minor mission-to-mission changes, and simulation equipment for mission checkout and training purposes.

Other Instrumentation Equipment

A wide variety of fixed and mobile equipment is used to provide instrumentation support of sounding rockets and re-entry vehicles launched from Wallops Station and other locations, and for flight research projects conducted by the Flight Research Center and Langley Research Center.

At Wallops Station, these funds in FY 1971 are required to sustain existing capability by the provision of maintenance and spare parts, the procurement of nonrecoverable flight hardware (antennas, transponders, support instrumentation) and the accomplishment of the last phase of the S-band telemetry conversion scheduled for completion in FY 1971, including stabilization for the telemetry antenna on board the Range Recoverer ship.

Two telemetry ground stations are required by the Langley Research Center to support aeronautical research programs such as collision avoidance and noise abatement. The aircraft used in these programs are flown from the Wallops and Langley airfields. Funds are requested in FY 1971 to complete the procurement of these stations.

The Aerodynamic Test Range consists of stations at Edwards, California, and Ely, Nevada, which support various aircraft and lifting body projects such as the F-111, C-5A, F-104, HL-10, X-24A, and YF-12.

During FY 1971, funds will be required for the procurement of maintenance and repair parts and for equipment modifications. Radar and telemetry display equipments require continuing modifications during the course of flight test programs due to changing requirements.

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Communications Equipment

The FY 1971 budget request contains funds for the on-going sustaining effort required to maintain the integrity and reliability of the NASA Communications Network (NASCOM), and to meet new requirements for approved projects.

The sustaining effort includes replacement spares, computer peripherals such as tape units and core modules, computer interface equipment, test and calibration equipment, and error detection equipment for routine monitoring of data circuits.

In the category of meeting requirements for approved projects, high data rate modems will be procured in FY 1971 for the Deep Space Network to meet Mariner 1971 requirements. These high data rate modems will permit NASCOM to handle up to three times as much data with the existing overseas circuits to the DSN sites. Also, for Mariner 1971, funds are required for peripheral equipment at JPL for the communications processor and for the procurement of voice, teletype, and video equipment.

The FY 1971 request also includes funds to initiate conversion of NASCOM to the eight level American Standard Code for Information Interchange (ASCII). This is a government-wide effort to achieve standardization of communication line terminals. This item was deferred from FY 1970 due to budget constraints.

Data Processing Equipment

The operational data processing equipments require a continuing program of minor redesign, modification, and improvement, as well as normal maintenance and repair. While the data processing lines are designed to be as flexible as possible, changes and updating are necessary to meet the new requirements of approved flight projects and to accommodate mission-to-mission changes within existing projects. Some additional changes are required to improve the processing speed of the data processing systems and thus minimize the need for acquisition of new processing equipment. The FY 1971 budget includes funds to provide the components necessary for these modifications and to provide for normal sustaining items such as logic modules and components, replacement spares, and modifications associated with equipment reconfigurations.

Supporting Research and Technology

	1969	1970	1971
New systems	$387,000	$1,250,000	$1,700,000
Integrated systems analysis, development and test	2,367,000	3,370,000	3,280,000
Antenna subsystems	1,420,000	1,220,000	1,260,000
Receiving and transmitting subsystems	2,457,000	2,350,000	2,200,000
Data handling and control	1,619,000	1,440,000	1,410,000
Data processing and reduction	1,001,000	1,220,000	1,200,000
Spacecraft subsystems	1,173,000	980,000	1,260,000
Network performance and operations technology	732,000	570,000	590,000
Total	$11,156,000	$12,400,000	$12,900,000

The Tracking and Data Acquisition Supporting Research and Technology (SRT) program provides funds for the advancements in telecommunications technology needed for tracking and data acquisition support of future space missions. The program is planned to provide the studies and developments of advanced systems and techniques which are required for an orderly evolution of network capability to support future missions and to achieve increased reliability and economy in network operations.

The effort planned for FY 1971 will emphasize developments for the improvement in the overall telecommunications capability of the Deep Space Network and for more cost effective approaches in providing the capabilities needed in the Satellite and Manned Space Flight Networks for future mission support. The primary objectives in deep space telecommunications are to provide the capability to receive spacecraft telemetry at higher rates and at greater distances than now possible, to receive planetary lander telemetry data directly from the lander spacecraft, to allow for simultaneous operation of several spacecraft, and to provide the techniques for obtaining greater tracking accuracies needed for advanced planetary missions. In the Satellite and Manned Space Flight Network areas work will continue on techniques for automation of station operations, on methods for onboard data handling and processing, and on development of network subsystems to meet specific mission needs.

The FY 1971 request is based on continuation of a constrained level of SRT with a small increase for studies of a Tracking Data Relay Satellite System (TDRSS) and for support of an X-band telecommunications experiment in the 1973 time period.

The program for SRT comprises effort in eight task areas as follows:

New Systems

The effort in this category consists primarily of studies to define the configuration and operation of a Tracking Data Relay Satellite System (TDRSS) and to identify potential needs for technology development. The TDRSS would use relay satellites in synchronous orbit to gather data from lower altitude earth-orbiting spacecraft to augment the capability and improve the efficiency of the NASA tracking and data acquisition networks. Studies will continue and expand in FY 1971 to define a system which can economically and reliably satisfy support requirements of NASA flight programs projected for the mid to late 1970's. These studies include appropriate technical and cost trade-off analyses to define the TDRSS such as the number, location, and performance specifications of relay satellites and supporting ground stations, and the characteristics of the telecommunications subsystems of mission spacecraft for which the TDRSS is to provide support.

Integrated Systems Analysis, Development and Test

The main purpose of this effort is to prove the acceptability of hardware models and software concepts in a real or simulated network operating environment before they are committed to field operation of the network stations, control centers, and other facilities. To be continued in this task area in FY 1971 is the development of techniques and computer programming for more precise orbit determination. Effort will also continue on the use of shorter wavelengths for planetary radar and telcommunications experiments and on radio frequency interference problems.

Antenna Subsystems

Effort in this category for FY 1971 is aimed at three primary objectives: to develop the technology for an X-band telecommunications capability at a Deep Space Network station for support of radio science and tracking experiments; to develop multiple purpose antenna feed systems along with the necessary control and monitoring techniques that allow rapid changeover of antenna modes from one mission operation to another; and to conduct trade-off and design studies on the use of arrayed steerable antennas versus single larger antennas for support of future missions to the outer planets.

Receiving and Transmitting Subsystems

The objectives of this category are to design, construct, test, and demonstrate prototype versions of transmitters and receivers needed to meet the requirements of approved flight missions. Most of the effort in FY 1971 is focused on the deep space mission requirement for providing

simultaneous two-way radio communications with orbiting spacecraft and lander vehicles at extreme distances. Development effort will include work on elements of S-band and X-band receiver modules and calibration instrumentation.

Data Handling and Control Subsystems

The objective of this effort is to develop the necessary data handling techniques to improve the flexibility for network managers and mission directors in support of the flight missions. Effort in FY 1971 will be directed to the central monitoring and control of functions of the Satellite Network and Deep Space Network stations. These functions include telemetry, command, tracking, ranging, timing, scheduling, and communications. Primary objectives are: more efficient use of subsystems and manpower in the networks, optimum use of NASCOM broad-band communications links to the stations, and the application of computer technology to the various station functions.

Data Processing and Reduction

The objectives of this task area are to develop the data subsystems needed to perform the telemetry, command, ranging, and tracking functions. The effort in FY 1971 will include the development of digital techniques for detecting and synchronizing extremely low level signals, and the development of new signal decoding techniques to support future missions characterized by higher bit rates and extreme planetary distances. Work will continue on obtaining more efficient methods of displaying, reducing, and processing large volumes of data. Investigations will also be made of techniques for real-time conversion of electrical signals to an optical format using optical data processing equipment.

Spacecraft Subsystems

The main objective of this effort is the development of common usage spacecraft telecommunications subsystems that are compatible with the ground stations and which represent optimum spacecraft/network trade-offs. Development of general purpose spacecraft subsystems will continue in FY 1971, primarily in the area of onboard information processing and control, and on a unified data and radio frequency subsystem for earth satellites. Work will continue on miniature S-band and X-band spacecraft transponders required for future missions.

Network Performance and Operations Technology

The objectives of this task area are to determine the performance and limitations of the networks as a whole and to identify ways of reducing recurring operations costs. In FY 1971, effort will continue on improved techniques for post-flight analysis of tracking data, and on the metric evaluation and calibration of tracking systems used in the networks.

Mr. EVINS. We know generally what you do here.

In 1969, the year men landed on the moon, you had an appropriation of $279,672,000. In 1970, you have $278 million, which is less than 1969, but in 1971 it jumps up to $298 million.

The question naturally arises, why you need $20 million more after having made this accomplishment.

Mr. TRUSZYNSKI. Yes, sir, Mr. Chairman.

Mr. EVINS. Mr. Truszynski is a good man, well and favorably known to this committee—but he wants $20 million more.

Dr. PAINE. We all have our weak side.

TRACKING WORKLOAD INCREASING

Mr. TRUSZYNSKI. Mr. Chairman, while it may appear that our workload in tracking and data acquisition should be going down, we actually are going to have a very busy year in 1971.

For example, we will be launching 10 new satellites which we will have to continue to track. Also, while the Apollo missions are being launched at a lesser rate of two a year, the astronauts are leaving behind on the moon, as you know, experimental equipment that we have to continue to track with our networks. So the actual workload that we will be facing in 1971 will be larger than it is in fiscal 1970.

PLANETARY PROGRAMS

I might point out that in addition to an increasing operational workload on our satellite network, we have to prepare the Deep Space Network with additional equipment for the upcoming planetary programs, such as the 1971 mission to Mars, the pioneer missions to Jupiter, and the Venus-Mercury mission described earlier by Dr. Naugle.

The major part of the increase requested in 1971 is for additional equipment to prepare for these upcoming planetary missions.

Dr. PAINE. I think it might be well if Mr. Truszynski said a few words about some of the economies he has been effecting in the network, laying up some of our ships and so forth, because we have had some reductions even though there is a net increase.

NASA NETWORK ECONOMIES

Mr. TRUSZYNSKI. Yes, as a result of the experience gained during the early Apollo missions and after the first lunar landing, we took a thorough look at the future mission plans and the associated network support. By being able to launch the missions exactly on time and through restricting some of the launch corridors, we were able to eliminate the requirement for certain of our tracking ships and tracking aircraft, as well as phase out two of our land stations.

These actions are in process and will be completed in this fiscal year. So there has been a net reduction in the operations, as you will notice, in the Manned Space Flight Network line item. This reflects the kind of reductions we have been able to effect, and we have a more efficient network at this point.

REDUCTION IN OPERATIONS FUNDING

Mr. EVINS. There is a slight reduction in funding for operations, but your equipment goes up from $32.2 million in 1970 to $55.5 million in 1971 and supporting research and technology goes from $12.4 million in 1970 to $12.9 million in 1971.

You made only a slight reduction in operations.

Mr. TRUSZYNSKI. Yes, sir.

Mr. EVINS. Does this mean you will have less personnel, less contracts, and less work?

Mr. TRUSZYNSKI. Yes, indeed.

It represents the savings which result from a reduction of the personnel from the ships, aircraft, and land stations we were able to delete from the network.

LIFE OF EQUIPMENT ON MOON

Mr. CLAWSON. In connection with the tracking of the equipment you are going to leave on the moon, or any other planets, is this communication going to be a continuing expense?

What is the anticipated life of the equipment left on the moon?

Mr. TRUSZYNSKI. The equipment that is being left on the moon by the astronauts has a nominal two-year lifetime. These experiments will be supported for that general period of time.

The reason that these require continued tracking is that one of the experiments is to measure the phenomena of seismic activity on the moon. Since one does not know exactly when this occurs, the network must continuously monitor these experimental instruments to obtain this data.

DEPLOYMENT OF ADDITIONAL INSTRUMENTS

Mr. CLAWSON. When you get even more sophisticated equipment on the moon's surface, that will continue to increase this cost, will it not?

Mr. TRUSZYNSKI. The cost will increase as we deploy more instruments on the moon, yes, sir.

But we do not anticipate this to be an extremely large increase. The basic capability needed for receiving the information is already in the network.

Mr. EVINS. Those instruments on the moon that Mr. Clawson is talking about are not overtaxing your tracking facilities, are they?

Mr. TRUSZYNSKI. No, sir. We are able to support these with the network as it is now configured.

Mr. CLAWSON. As long as they get $20 million more.

TRACKING OF OLD SATELLITES

Mr. EVINS. You are going to have less launches next year, isn't that right?

Mr. TRUSZYNSKI. No, sir.

As I mentioned, there will be 10 new satellites launched next year.

Mr. EVINS. You had 12 the year before and 12 the year before that. You are going to have less. We went over that a while ago.

Dr. PAINE. The point here is that Mr. Truszynski is charged with continuing to monitor the old satellites as well as the new ones. So

each year that NASA has launches adds more work for Mr. Truszynski's tracking people.

We do turn off the old satellites and we do not monitor them forever, but his workload goes up each time we send up a new batch.

NUMBER OF TRACKING STATIONS

Mr. EVINS. In how many countries do we have tracking stations?

Mr. TRUSZYNSKI. There are 10 foreign countries in which we have stations located.

Mr. EVINS. What is the average payment to these countries for having these tracking stations on their soil?

Mr. TRUSZYNSKI. The arrangements we make with these countries, Mr. Chairman, are, in general, such that there is no payment required to establish stations in the country.

For example, most of the countries supply the land free of charge. There is an exception to this only in a very few cases where land in a suitable location has not been able to be provided at no cost by the host country.

But in general, there is no payment required for the establishment of our stations.

Mr. EVINS. The cost then is for personnel stationed there.

Are the employees of these tracking stations nationals of these countries or American citizens?

Mr. TRUSZYNSKI. It is a mixture, Mr. Chairman.

In some countries our stations are operated for us entirely by host country personnel, such as in Australia.

In other countries they are operated by American contractor personnel with host country personnel employed in certain activities also.

INFLATIONARY FACTOR

Mr. EVINS. Is the cost of these contracts going up? In renegotiation with them, are you able to bring them down a little bit?

Mr. TRUSZYNSKI. We are in the process of renegotiating some of our contracts or will be this fiscal year.

However, since most of the effort is performed by contract personnel, we have faced a general inflation factor that we have had to provide for in the course of our operations. This is one factor that we anticipate will be a problem for us.

CONTRACT COST

Mr. EVINS. What is the average cost of maintaining a station in one of these countries by contract?

Mr. TRUSZYNSKI. On a per-station basis the operations cost is of the order of $3.5 million per year. This represents personnel costs and the spare parts necessary to maintain the station.

Mr. EVINS. All right; $3.5 million per year, you have 10 countries, that is $35 million.

Mr. TRUSZYNSKI. No, sir. There are 10 countries, but there is a larger number of stations than 10.

Mr. EVINS. That is 10 countries in which we have these facilities located. We have a lot in the United States, don't we?

Mr. TRUSZYNSKI. Yes, we do. There are individual facilities in this country, too.

Mr. EVINS. Are the contracts in the United States higher than the contracts abroad?

Mr. TRUSZYNSKI. No, not significantly higher on a per-station basis. I might add here that the operations line item include considerably more than just the personnel cost, Mr. Chairman.

It includes the communications cost to tie the stations together and to bring the information back to the United States; it includes the necessary supplies, spare electronic parts; it includes the necessary training of personnel. In summary, the operations line item includes the total activities associated with the opeartion of a station.

Mr. EVINS. Every one of these contractors want to increase it. I do not want you to let them outbargain you, Mr. Truszynski, I want you to represent the public interest.

Mr. TRUSZYNSKI. We will certainly do that.

NETWORK WORKLOAD

Mr. EVINS. Explain the chart on page RD 18–4.

Mr. TRUSZYNSKI. This is a chart on which we illustrate the kind of workload we will be facing in the Manned Space Flight Network.

You will notice, under the calendar year 1970 column for example, you will see there are two new launches in calendar year 1970, Apollo 13, soon to be launched, to be followed by the launch of Apollo 14 in the latter part of this year. If you proceed down in that same column, you will notice at the same time we are supporting the launches of Apollo 13 and 14, we are also supporting the ALSEPS, the experimental packages that have been left on the moon. These have been illustrated by the dark lines. These dark lines span some 2 years, which is the total length of support required.

Mr. EVINS. After the satellites are up, you have to support them for about 2 years, don't you?

Mr. TRUSZYNSKI. Yes, these experimental packages on the moon will be alive for about 2 years.

Dr. PAINE. These are nuclear power sources that should provide the power after that time.

TRACKING STATION MAINTENANCE

Mr. EVINS. Do these contractors maintain your equipment, or do we have to also pick up the tab for these costs?

Mr. TRUSZYNSKI. Yes, sir, to a certain extent the contractors also maintain the equipment. They maintain all of the electronic equipment as well as operate it during the flight time.

To the extent there are any structural or mechanical problems on the antennas, they are also engaged in those activities.

Mr. EVINS. While they are supposed to do this, our costs increase too.

The equipment for the Manned Space Flight Network program goes up from $32.2 million in 1970 to $55.5 million in 1971. I thought there was to be a decrease in activity. The Manned Space Flight Network equipment program encompasses the procurement of equipment and services necessary for incorporation of additional systems into the existing network.

Mr. TRUSZYNSKI. Yes.

As you notice from Mr. Myers' testimony, he is getting ready to launch Skylab. Some of the equipment requested will be installed to meet the requirements of the Skylab program.

Mr. EVINS. My question is, if we have contracts and their costs are going up, why do we have to have our costs go up too?

Can you not have this all covered under contract?

If you are contracting with them to maintain these facilities, our equipment costs should go down.

EQUIPMENT FOR ADDITIONAL REQUIREMENTS

Mr. TRUSZYNSKI. This equipment is for additional requirements, such as the increased requirements of the Skylab. It is not the kind of equipment that is currently installed in the stations, but additional equipment for approved future programs.

Mr. EVINS. Is the equipment we purchase acquired through competitive-negotiated bid?

Mr. TRUSZYNSKI. In general, our equipment systems are procured on a competitive fixed price basis.

SMALL BUSINESS SET-ASIDES

Mr. EVINS. What percentage of your procurement goes to small business and how much to the big business interests?

Mr. TRUSZYNSKI. Much of our equipment is the type that is amenable for small business activity.

Mr. EVINS. Have there been any set-asides in cooperation with the Small Business Administration for a certain amount of your procurement?

Defense sets aside a certain amount and GSA sets aside a large amount. What does NASA do?

Dr. PAINE. We do have this program. I would have to furnish for the record just how much set-aside.

Mr. EVINS. Sixteen percent by the Defense Department of all their procurement goes to Small Business; GSA, 48 percent.

Does anybody in NASA know what percentage of their contracts go to small business?

Dr. PAINE. I do not know what the number has been. Do you?

Mr. LILLY. No, I do not.

Dr. PAINE. I would furnish that for the record.

(The information follows:)

In fiscal year 1969, NASA prime contract awards to small business amounted to $162.8 million or 5.4 percent of the total awards to business firms. Of the $162.8 million to small business, $31.4 million represented small business set-asides. These set-asides constituted 19.3 percent of the small business awards in fiscal year 1969. In the first quarter of fiscal year 1970, 26.2 percent of small business awards resulted from set-asides.

The technical sophistication of NASA's requirements and the magnitude of the industrial capability required to fulfill them have a limiting effect upon the extent of small business participation in the prime contract area. This naturally reduces the small business set-aside opportunities in our major procurements, and, too, the fact that NASA does not buy production-run quantities of common items virtually eliminates partial set-asides for small business.

I would like to point out that the fiscal year 1969 figures discussed up to now represent only the direct awards made by NASA to small business. We actively

promote small business participation through subcontracts placed by our larger prime contractors. These subcontract awards made by NASA prime contractors must be considered to determine the total amount of NASA procurement dollars received by the small business community. For instance, small business direct awards from NASA totaled $162.8 million. In addition, subcontract awards to small business as reported by the 86 NASA prime contractors participating in the NASA small business subcontracting program totaled $164.8 million. This makes a total of $327.6 million identifiable prime and subcontract awards from NASA funds placed with small business firms, or 10.8 percent of total NASA procurement dollars awarded in fiscal year 1969.

The above subcontracting and total figures do not include the subcontract awards made by an even greater number of NASA prime contractors who are not participating in the NASA small business subcontracting program and therefore do not report subcontracts placed with small business firms.

Mr. EVINS. I wish you would be more active in this field to set aside a certain portion of this for small business. They employ a lot of people, they pay taxes, they are the seedbed for growth. We do not need to give all the contracts to the big fat contractors.

Any questions, gentlemen?

Dr. PAINE. Mr. Chairman, I do have that number The small business set-aside program for NASA as a total resulted in 26.2 percent of our small business direct awards. I will supply a further statement for the record.

Mr. EVINS. Very good; I commend you. That beats the Defense Department.

Dr. PAINE. Much of this is in Mr. Truszynski's area. He should receive most of the credit.

Mr. EVINS. Mr. Truszynski, your stock went up several points. The Administrator came to your rescue.

Mr. BOLAND. I do not know that your funding will go up, but your stock has.

TECHNOLOGY UTILIZATION PROGRAM

Mr. EVINS. Mr. Reporter, place in the record pages RD 19–1 and RD 19–2.

(The pages follow:)

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1971 ESTIMATES

OFFICE OF TECHNOLOGY UTILIZATION — TECHNOLOGY UTILIZATION PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The primary objectives of the NASA Technology Utilization program are: (1) to increase the return on the national investment in aerospace research and development by encouraging additional uses of the knowledge gained in those programs; (2) to shorten the time gap between the discovery of new knowledge and its effective use in the marketplace; (3) to aid the movement of new knowledge across industry, disciplinary, and regional boundaries; (4) to contribute to the knowledge of better means of transferring technology from its points of origin to its points of potential use.

New technological developments of use to the aerospace industry are applied almost automatically within that industry. Many of these innovations have potential benefit as well to the nonaerospace community. It is the primary purpose of this program to establish systems and mechanisms to identify, evaluate, publish, and transfer these technological innovations to the general public. This program provides a similar service with regard to management techniques developed for large scale complex research and development activities by creating awareness of and giving wide spread dissemination to new systems and concepts in this area.

SUMMARY OF RESOURCES REQUIREMENTS:

	1969	1970	1971
New technology identification and evaluation	$1,350,000	$1,300,000	$800,000
Publication	550,000	1,100,000	900,000
New technology dissemination	1,900,000	2,200,000	1,900,000
Program evaluation	---	400,000	400,000
Total	$3,800,000	$5,000,000	$4,000,000
Distribution of Program Amount by Installation:			
NASA Headquarters	$3,800,000	$5,000,000	$4,000,000

BASIS OF FUND REQUIREMENTS:

New Technology Identification and Evaluation

Technology Utilization Officers at NASA field installations and specialists from universities, research institutes, and private industry identify and

document those inventions, innovations, improvements, and discoveries that have potential utility to the nonaerospace sector of the economy.

Publication

Transfer of technology is accomplished through publications ranging from reports of single innovations to surveys of contributions to the state-of-the-art in broad technology areas. These are prepared by both private and nonprofit contractors.

New Technology Dissemination

Regional dissemination centers store, retrieve, and interpret the new technology developed by NASA for local industry. Biomedical application teams are also employed to assist researchers in defining and solving medical problems by adaptation of NASA technology. In addition, government-developed computer software is evaluated and disseminated to industry. Technology applications teams are assisting in developing cooperative programs with several other agencies such as the National Air Pollution Control Administration, Federal Water Pollution Control Administration, Law Enforcement Assistance Administration, Social Rehabilitation Service of HEW, Small Business Administration, and others. These joint efforts are designed to bring applicable aerospace technology to bear on technical problems in areas of major national concern such as environmental quality, law enforcement, and rehabilitation of the handicapped.

Program Evaluation

Research institute personnel evaluate technology transfer mechanisms and furnish recommendations for their improvement.

Mr. EVINS. The funding goes down in the Technology Utilization program from $5 million in 1970 to $4 million in 1971.

Are there any questions, gentlemen?

Thank you very much, Mr. Truszynski.

I suggest we suspend until 1:30.

AFTERNOON SESSION

CONSTRUCTION OF FACILITIES

Mr. EVINS. The committee will come to order. We will consider this afternon the construction budget for the National Aeronautics and Space Administration. Mr. Reporter, place in the record the budget schedules for "Construction of facilities" and the summary pages, pages SUM-1 through SUM-6.

(The information follow:)

Program and Financing (in thousands of dollars)

Identification code 27-00-0107-0-1-250	Budget plan (amounts for construction of facilities actions programed)			Costs and obligations		
	1969 actual	1970 estimate	1971 estimate	1969 actual	1970 estimate	1971 estimate
Program by activities:						
Direct program:						
1. Manned space flight	10,719	14,250	2,000	20,026	16,100	16,600
2. Scientific investigations in space	1,100	1,595	700	7,622	3,600	3,000
3. Space applications	.....	.....	5,350	.....	.....	900
4. Space technology	386	.....	6,275	12,494	10,100	7,300
5. Aviation technology	.....	4,767	.....	6,761	6,700	5,300
6. Supporting activities	19,875	32,621	20,275	5,389	23,500	30,900
Total direct program costs, funded	32,080	53,233	34,600	52,292	60,000	64,000
Reimbursable program:						
3. Space applications	.....	.....	.....	59	42	.....
Total program costs, funded	.....	.....	.....	52,351	60,042	64,000
Change in selected resources [1]	.....	.....	.....	2,451	19,893	−8,696
10 Total	32,080	53,233	34,600	54,802	79,935	55,304
Financing:						
21 Unobligated balance available, start of year: For completion of prior year budget plans	.....	.....	.....	−69,269	−47,406	−20,704
Reprograming to prior year budget plans	860	.....	.....	.....	.....	.....
24 Unobligated balance available, end of year: For completion of prior year budget plans	.....	.....	.....	47,406	20,704	.....
Budget authority	**32,940**	**53,233**	**34,600**	**32,940**	**53,233**	**34,600**
Budget authority:						
40 Appropriation	21,800	53,233	34,600	21,800	53,233	34,600
42 Transferred from other accounts	11,140	.....	.....	11,140	.....	.....
43 **Appropriation (adjusted)**	**32,940**	**53,233**	**34,600**	**32,940**	**53,233**	**34,600**
Relation of obligations to outlays:						
71 Obligations incurred, net				54,802	79,935	55,304
72 Obligated balance, start of year				83,464	72,998	92,933
74 Obligated balance, end of year				−72,998	−92,933	−76,237
90 Outlays				65,269	60,000	72,000

Note.—Reconciliation of budget plan to obligations:

	1969 actual	*1970 estimate*	*1971 estimate*
Total budget plan	32,080	53,233	34,600
Deduct portion of budget plan to be obligated in subsequent years	7,766	12,347	.....
Add obligations of prior year budget plans	30,488	39,049	20,704
Total obligations	54,802	79,935	55,304

[1] Selected resources as of June 30 are as follows:

	1968	*1969 adjustments*	*1969*	*1970*	*1971*
Unpaid undelivered orders	52,498	−30	54,889	74,782	66,086
Advances	.....	.....	30	30	30
Total selected resources	52,498	−30	54,919	74,812	66,116

Object Classification (in thousands of dollars)

Identification code 27-00-0107-0-1-250	1969 actual	1970 est.	1971 est.
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION			
Direct obligations:			
31.0 Equipment	7,145	12,000	10,100
32.0 Lands and structures	47,607	67,611	45,204
Total direct obligations	54,752	79,611	55,304
Reimbursable obligations:			
31.0 Equipment	8	20	----------
32.0 Lands and structures	1	5	----------
Total reimbursable obligations	9	25	----------
Total obligations, National Aeronautics and Space Administration	54,761	79,636	55,304
ALLOCATION TO DEPARTMENT OF TRANSPORTATION—FEDERAL HIGHWAY ADMINISTRATION			
25.0 Other services	17	17	----------
32.0 Lands and structures	24	282	----------
Total obligations, Department of Transportation—Federal Highway Administration	41	299	----------
99.0 Total obligations	54,802	79,935	55,304

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

GENERAL STATEMENT

This appropriation provides for contractual services for the design, major rehabilitation, and modification of facilities; the construction of new facilities; the purchase of related equipment and advance design activities related to facilities planned for future authorization. The principal projects in the 1971 program are described below:

MANNED SPACE FLIGHT: This activity includes funding for construction of support facilities at the John F. Kennedy Space Center, NASA, Kennedy Space Center, Fla.; a calibration laboratory at the Manned Spacecraft Center, Houston, Tex.; and a multi-spectral photographic laboratory at the Marshall Space Flight Center, Huntsville, Ala.

SCIENTIFIC INVESTIGATIONS IN SPACE: The estimates for this activity provide for modifications to a solar simulator at the Jet Propulsion Laboratory, Pasadena, Calif.

SPACE APPLICATIONS: Funds for this activity will provide for an earth resources technology laboratory at the Goddard Space Flight Center, Greenbelt, Md.; and alterations to a space launch complex at the Western Test Range, Vandenberg Air Force Base, Calif.

SPACE TECHNOLOGY: The estimate for this activity will provide for a polymer research laboratory at the Ames Research Center, Moffett Field, Calif.; an isotope thermoelectric systems applications laboratory at the Jet Propulsion Laboratory; and an engine/stage test stand at the Nuclear Rocket Development Station, Jackass Flats, Nev.

AVIATION TECHNOLOGY: No 1971 projects.

SUPPORTING ACTIVITIES: This activity includes funds for facility planning and design; for an addition to the powerplant at the Goldstone Complex, Fort Irwin, Calif.; for the relocation of a transportable tracking station; and for essential rehabilitation of and modifications to facilities at NASA installations and at plants operated by contractors for NASA.

The appropriation for FY 1970 was $53,233,000 and the authorization was $58,200,000. The request for 1971 is $34,600,000 a decrease of $18,633,000 from the 1970 appropriation. Total expenditures are estimated to be $72,000,000 in FY 1971, an increase of $12,000,000 from the $60,000,000 estimated for FY 1970.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1971 ESTIMATES

SUMMARY OF CONSTRUCTION OF FACILITIES BUDGET PLAN AS RECONCILED TO FINANCING SCHEDULE

	Fiscal Year 1969	Fiscal Year 1970	Fiscal Year 1971
Budget Activity			
1. Manned Space Flight.....	$10,719,000	$14,250,000	$2,000,000
2. Scientific Investigations in Space.....	1,100,000	1,595,000	700,000
3. Space Applications.....	---	---	5,350,000
4. Space Technology.....	386,000	---	6,275,000
5. Aviation Technology.....	---	4,767,000	---
6. Supporting Activities.....	19,875,000	32,621,000	20,275,000
Total Budget Plan.....	$32,080,000	$53,233,000	$34,600,000
Financing:			
Appropriation.....	$21,800,000	$53,233,000	$34,600,000
Transferred from other accounts.....	11,140,000	---	---
Appropriation (adjusted)	$32,940,000	$53,233,000	$34,600,000
Reprogramming to prior year budget plans.....	-860,000	---	---
Total financing of budget plan.....	$32,080,000	$53,233,000	$34,600,000

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1971 ESTIMATES

SUMMARY OF CONSTRUCTION OF FACILITIES BUDGET PLAN
BY BUDGET ACTIVITY SHOWING LOCATION TOTALS INCLUDED IN EACH ACTIVITY

	Fiscal Year 1969	Fiscal Year 1970	Fiscal Year 1971
1. MANNED SPACE FLIGHT	$10,719,000	$14,250,000	$2,000,000
John F. Kennedy Space Center, NASA	7,364,000	12,500,000	575,000
Manned Spacecraft Center	1,333,000	1,750,000	900,000
Marshall Space Flight Center	---	---	525,000
Michoud Assembly Facility	400,000	---	---
Various Locations	1,622,000	---	---
2. SCIENTIFIC INVESTIGATIONS IN SPACE	$1,100,000	$1,595,000	$700,000
Goddard Space Flight Center	---	670,000	---
John F. Kennedy Space Center, NASA	600,000	---	---
Jet Propulsion Laboratory	---	---	700,000
Wallops Station	500,000	500,000	---
Various Locations	---	425,000	---
3. SPACE APPLICATIONS	---	---	$5,350,000
Goddard Space Flight Center	---	---	2,050,000
Various Locations	---	---	3,300,000
4. SPACE TECHNOLOGY	$386,000	---	$6,275,000
Ames Research Center	386,000	---	1,525,000
Jet Propulsion Laboratory	---	---	1,250,000
Nuclear Rocket Development Station	---	---	3,500,000
5. AVIATION TECHNOLOGY	---	$4,767,000	---
Langley Research Center	---	4,767,000	---
6. SUPPORTING ACTIVITIES	$19,875,000	$32,621,000	$20,275,000
Various Locations	18,875,000	29,121,000	15,275,000
Facility Planning and Design	1,000,000	3,500,000	5,000,000
TOTAL PLAN	$32,080,000	$53,233,000	$34,600,000

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

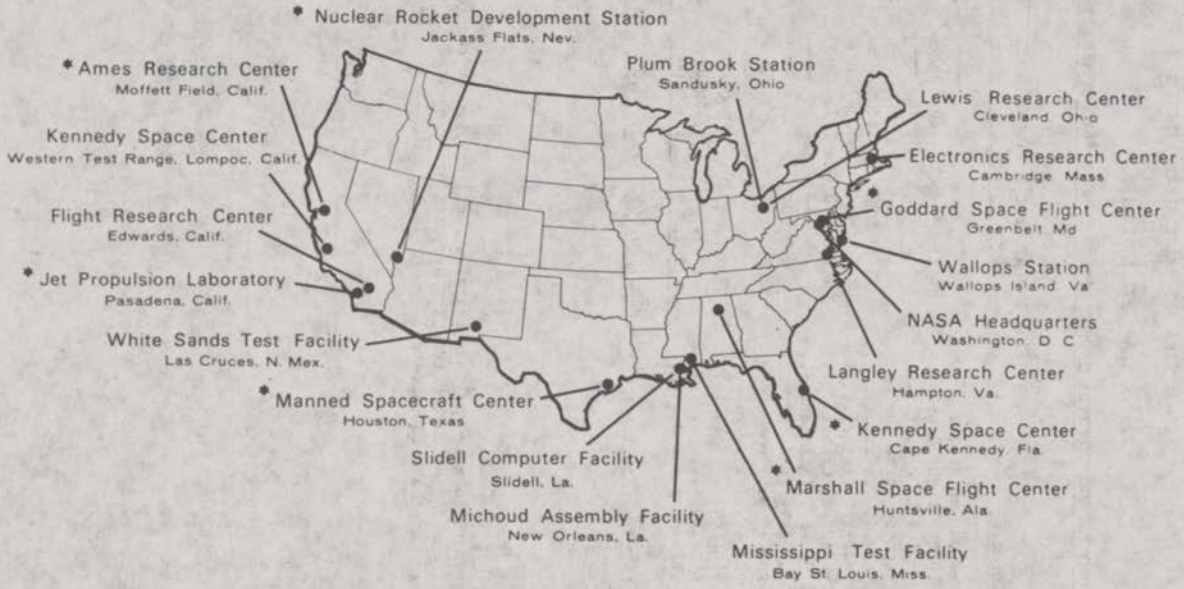
FISCAL YEAR 1971 ESTIMATES

SUMMARY OF CONSTRUCTION OF FACILITIES BUDGET PLAN BY LOCATION

Location	Fiscal Year 1969	Fiscal Year 1970	Fiscal Year 1971
Ames Research Center.....	$386,000	---	$1,525,000
Goddard Space Flight Center...	---	$670,000	2,050,000
Jet Propulsion Laboratory.....	---	---	1,950,000
John F. Kennedy Space Center, NASA.....	7,964,000	12,500,000	575,000
Langley Research Center.....	---	4,767,000	---
Manned Spacecraft Center.....	1,333,000	1,750,000	900,000
Marshall Space Flight Center..	---	---	525,000
Michoud Assembly Facility.....	400,000	---	---
Nuclear Rocket Development Station.....	---	---	3,500,000
Wallops Station.....	500,000	500,000	---
Various Locations.....	20,497,000	29,546,000	18,575,000
Facility Planning and Design..	1,000,000	3,500,000	5,000,000
Total Plan.....	$32,080,000	$53,233,000	$34,600,000

The geographic location of NASA installations is shown on the following page. Installations for which construction projects are requested in the fiscal year 1971 budget are identified.

NASA INSTALLATIONS



* Installations for which construction projects are requested in the FY 1971 budget estimates.

CAPITALIZED VALUE OF NASA'S FACILITIES
AS OF JUNE 30, 1969
(IN-HOUSE AND CONTRACTOR-HELD FACILITIES)
(DOLLARS IN THOUSANDS)

Date Prepared: September 19, 1969

Reporting Installation	Land	Buildings	Other Structures and Facilities	Leasehold Improvements	Equipment	Fixed Assets in Progress	Total
OFFICE OF MANNED SPACE FLIGHT							
Kennedy Space Center	$ 71,018	$ 281,739	$ 423,552	$ -	$ 81,348	$101,215	$ 958,872
Western Test Range Operation Div.	-	-	-	-	3,464	-	3,464
Various Locations (Contractor-Held)	-	-	-	-	84,957	-	84,957
Manned Spacecraft Center	5,459	131,558	28,712	-	177,748	15,852	359,329
White Sands Test Facility	-	8,976	17,754	-	4,035	1,205	31,970
Various Locations (Contractor-Held)	3,570	24,415	5,142	8	48,303	-	81,438
Marshall Space Flight Center	95	109,762	45,238	93	194,893	3,861	353,942
Michoud Assembly Facility	7,504	63,220	25,039	-	40,998	-	136,761
Mississippi Test Facility	19,729	64,716	166,900	-	23,677	1,181	276,203
Sidell Computer Facility	63	4,446	823	-	5,097	-	10,429
Various Locations (Contractor-Held)	3,491	27,046	38,739	23	83,038	14,010	166,347
Total	$110,929	$ 715,878	$ 751,899	$124	$ 747,558	$137,324	$2,463,712
OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY							
Ames Research Center	$ 2,372	$ 167,099	$ 2,987	$ -	$ 58,434	$ 4,510	$ 235,402
Various Locations (Contractor-Held)	-	47	-	1	2,377	-	2,425
Electronics Research Center	1,384	-	4	-	20,341	14,713	36,442
Various Locations (Contractor-Held)	-	-	-	-	272	-	272
Flight Research Center	-	7,658	2,135	-	36,650	595	47,038
Various Locations (Contractor-Held)	-	-	-	-	94	-	94
Langley Research Center	110	106,180	134,424	-	111,395	19,370	371,479
Various Locations (Contractor-Held)	6	15,217	25	-	3,180	-	18,428
Lewis Research Center	310	110,301	39,240	140	57,349	9,979	217,319
Plum Brook Station	1,287	74,746	17,728	-	10,252	7,069	111,082
Various Locations (Contractor-Held)	99	4,240	4,007	5	32,369	10,314	51,034
Space Nuclear Propulsion Office	-	18,957	6,917	-	3,987	17	29,878
Various Locations (Contractor-Held)	-	-	-	-	20,146	232	20,378
Total	$ 5,568	$ 504,445	$ 207,467	$146	$ 356,846	$ 66,799	$1,141,271
OFFICE OF SPACE SCIENCE AND APPLICATIONS							
Goddard Space Flight Center	$ 1,205	$ 68,626	$ 11,681	$297	$ 182,616	$ -	$ 264,425
*Tracking Stations	339	17,305	41,839	-	201,326	-	260,809
Various Locations (Contractor-Held)	-	88	45	4	37,960	-	38,097
Jet Propulsion Laboratory	1,067	44,012	6,563	414	79,515	-	131,571
Tracking Stations (Deep Space Net.)	-	9,160	21,403	-	31,291	-	61,854
Wallops Station	986	21,423	41,629	-	34,954	2,809	101,801
Various Locations (Contractor-Held)	-	2,544	270	-	3,906	-	6,720
NASA Pasadena Office	-	-	-	-	11	-	11
Total	$ 3,597	$ 163,158	$ 123,430	$715	$ 571,579	$ 2,809	$ 865,288
OTHER							
Headquarters	$ -	$ -	$ -	$ -	$ 6,627	$ -	$ 6,627
Various Locations (Contractor-Held)	-	-	-	-	8,240	-	8,240
Total	$ -	$ -	$ -	$ -	$ 14,867	$ -	$ 14,867
Grand Total	$120,094	$1,383,481	$1,082,796	$985	$1,690,850	$206,932	$4,485,138

* Includes capital type facilities of the MSF and STADA networks and other supporting activities including equipment aboard ships and aircraft.

Mr. EVINS. In 1969, you had $32 million in "Construction of facilities"; in 1970, you have $53.2 million; and in 1971 you are requesting $34.6 million. The $34,600,000 breaks down as follows: manned space flight, $2 million; scientific investigation, $700,000; space applications, $5,350,000; space technology, $6,275,000; and supporting activities, the largest amount is $20,275,000.

CONSTRUCTION AT AMES CENTER

We know generally the mission of each one of the facilities. For the Ames Research Center, Moffett Field, Calif., you are asking for $1,525,000. What is the purpose of this construction?

Dr. PAINE. Mr. Chairman, we have General Curtin, who is in charge of our facilities today and I will ask him to speak to that with your permission.

Mr. EVINS. Give us a statement on this one and the other facilities as we go along. What do you propose to do at the Ames Research Center?

General CURTIN. At Ames the $1,525,000 requested, Mr. Chairman, is to provide adequate housing for the chemical research activities located at that station in order to permit them to design and build polymers required to meet NASA mission needs.

Mr. EVINS. Is this housing for personnel?

General CURTIN. It is for personnel and equipment, Mr. Chairman. The present activity is located in eight dispersed locations at the center and involves a certain amount of inefficiency. Our effort here, however, is not merely to consolidate them, but also to provide a better operational environment in which this vital activity can be carried out.

We are proposing, therefore, to build a single-story laboratory in accordance with the drawings that have been furnished you. It will have certain special features, special ventilation and so on, things you might expect in a laboratory of this type, including special shielding.

This project has been looked at in considerable detail in terms of our present operation, as well as the possibility of modifying existing facilities. After an exhaustive study we concluded the best solution was to provide a new facility and thus hope to eliminate the inadequacies of the present operation.

Mr. EVINS. You want to provide a better operational environment, you couldn't modify the existing facilities and your decision was to build a new laboratory; it that correct?

General CURTIN. That is correct, Mr. Chairman, and this was looked into intensively.

CONSOLIDATION OF CHEMICAL PERSONNEL

Mr. EVINS. Are you going to be doing anything at Ames that you haven't been doing there?

General CURTIN. Actually, we will not be doing an additional function at Ames that we haven't been attempting to do, Mr. Chairman. As I indicated earlier, what we are proposing to do here is to bring the personnel and equipment now engaged in chemical research together in one location. There are actually 33 people involved, as I indicated earlier, and they are now located in eight dispersed locations.

Mr. EVINS. Have any facilities for this type work been phased out in the last year?

General CURTIN. No, sir; not to my knowledge.

Mr. EVINS. You intend to consolidate eight locations and put them in one building.

General CURTIN. Yes, sir; put them in one building at the north end of the installation and therefore we hope to also reduce the potential impact of the hazards associated with this research.

USE OF VACATED FACILITIES

Mr. EVINS. What will you do with the eight facilities you have there already?

General CURTIN. The eight detached locations we are now occupying will be used by activities that are immediately adjacent. In other words, everybody has been crowded up in order to accommodate these people and this will permit them to have just a little more elbow room than they now have.

Mr. EVINS. How much is the total investment at Ames?

General CURTIN. $235 million approximately, Mr. Chairman.

JUSTIFICATION MATERIAL—AMES RESEARCH CENTER

Mr. EVINS. Place in the record pages CF 1–2 through CF 1–6.

(The pages follow:)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

INSTALLATION SUMMARY

CONSTRUCTION OF FACILITIES

FISCAL YEAR 19 71 BUDGET ESTIMATES

(Dollars in thousands)

NASA INSTALLATION		COGNIZANT PROGRAM OFFICE FOR INSTALLATION
Ames Research Center		Office of Advanced Research and Technology
LOCATION OF INSTALLATION	COUNTY	NEAREST CITY
Moffett Field, California	Santa Clara	Mountain View, California

INSTALLATION MISSION

Laboratory research in aerodynamics, thermodynamics, materials, structures, guidance and control, space sciences, environmental biology, life detection, life synthesis, human factors, and fundamental physics and chemistry, project management of unmanned spaceflight projects (scientific probes and satellites); development of scientific-experiment payloads for spaceflight projects managed at Ames and elsewhere.

PROJECT LINE ITEM	COGNIZANT OFFICE	FY 1959 THRU CURRENT YR	FY 19 71 (Estimated)	FUTURE YEARS (Estimated)	TOTAL ALL YEARS (Estimated)
Polymer Research Laboratory	OART	70	1,525		1,595
TOTAL			1,525		

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CF 1-2

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1971 ESTIMATES

PROJECT TITLE: Polymer Research Laboratory

AUTHORIZATION LINE ITEM: Ames Research Center

COGNIZANT PROGRAM OFFICE: Office of Advanced Research and Technology

COGNIZANT INSTALLATION: Ames Research Center

LOCATION OF PROJECT: Moffett Field, Santa Clara County, California

TYPE OF PROJECT: New

FUNDING:

FY 1970 and Prior Years	$70,000
FY 1971 Estimate	1,525,000
Total Funding Through FY 1971	$1,595,000
Estimated Future Year CoF Funding	None

PROJECT PURPOSE AND SCOPE:

To provide an adequate research laboratory and support environment at Ames Research Center so that chemical research relating to polymers may be carried out efficiently and safely. Laboratory space for such activities as bio-polymers, photo-radiation chemical kinetics, snythetic and analytical chemistry, coatings, research, plastics and composites, and physical testing and process development will be provided. Functions such as materials compounding and evaluation as well as properties measurement require a special environment. The overall function takes or evolves fundamental knowledge to design and build polymers to solve NASA problems, many of which have other applications in the national interest such as the reduction of fire and aircraft crash hazards and the development of synthetic materials of importance to the aircraft industry.

PROJECT DESCRIPTION:

This project provides for the construction of a chemical research type laboratory having a total floor area of about 23,600 square feet. The research area will be divided into eight laboratories and each will contain exhaust hoods, chemical benches, sinks, and other associated equipment. Included is the related office, storage, mechanical/utility, and circulation

space. Special features include radiation and electrical shielding, special ventilation, and special filtration of inlet and exhaust from some laboratories. Certain areas will require very close control of temperature and humidity. Most of the needed instrumentation and equipment for this facility already exists. However, certain minor equipment relating to a cobalt radiation source is included with the project. All necessary site work, utilities, and paving are provided.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				$1,390,000
Site development	LS	---	$120,000	120,000
Building	Sq. Ft.	23,600	34.20	807,000
Special environmental control and shielding	LS	---	325,000	325,000
Utilities	LS	---	138,000	138,000
Equipment	LS	---	135,000	135,000
Fallout Shelter	---	---	---	---
	TOTAL			$1,525,000

PROJECT JUSTIFICATION:

The basic requirement is to provide a chemistry laboratory which will house all applied chemistry research at Ames Research Center with primary considerations for personnel safety, operational efficiency, and adaptability to changing research objectives. The Polymer Research Laboratory building is required to support the functions of chemical research which are generally unique. In addition to space and aeronautical research, these investigations do have a direct application to other national problems, such as reductions in fire and aircraft crash hazards.

Suitable space is not available at the Center to house this important activity. This research work is currently being carried on in makeshift quarters now scattered in eight locations throughout the Center. The Analytical Laboratory is located on the mezzanine floor of the Gas Dynamics Laboratory. This location is crowded and lacks adequate protection for the handling of hazardous and toxic chemicals and cannot be expanded in its present location. Another activity, the Chemical Synthesis Laboratory, is located on part of the upper floor of the Electrical Services Building which

is located in close proximity to the cafeteria. Processing the ingredient materials contained in new plastics involves handling and working with toxic and explosive mixtures. Because of the danger of toxic exhaust fume ingestion by the cafeteria air conditioning system, many necessary operations have been curtailed. Laboratory space is generally inadequate and was not designed for this kind of operation. Because of the second-story location of these laboratories, evacuation in the event of fire or explosion could be very difficult.

The Plastics and Coatings Development Laboratory is located in the Hypersonic Helium Tunnel Building. The Processing Development operation is carried out in part of a paint shop in yet another location. Tests of the fire quenching and fire protection properties of these new materials are conducted in temporary space in the Payload Test and Integration Facility. Research in membrane tests is presently being conducted in the penthouse of the Instrument Research Building, an area little suited to this type of research.

All of these operations involve a certain amount of material which is known to be toxic, and a number of new materials whose toxicity has yet to be determined. Therefore, the Center has exercised extreme care in their handling and use and, in many instances, has been forced to conduct its operations on weekends or at night when the number of people in the vicinity is minimal. This restriction greatly handicaps the Center's ability to efficiently carry out its day-to-day work on new chemistry problems of vital concern to NASA.

In connection with the overall agency-space utilization analysis, an in-depth study of the situation at Ames was made. This detailed study, supported by industrial expertise, reviewed the need for these laboratory facilities and the practicality of meeting this need with available space. The study conclusions fully support the urgent need for a new facility as proposed.

The polymer research effort at Ames is a problem-solving activity in the field of aeronautics, life sciences, and space technology, in which a new ingredient (polymer science) is being added to the methodology. The classical polymer chemistry approach has been to create new materials first and find applications later. At Ames, the problem is defined first and a new polymer is then tailored to solve the problem. Thus, the Chemical Research Projects Office concentrates its efforts on developing new polymers to meet specific requirements which have been identified by other research activities.

The research being conducted by this group is in the field of rapidly expanding techniques and, for the most part, the Center is utilizing people whose past experience is in allied fields of science. This situation requires a larger amount of effort devoted to day-to-day direction of the work than is normally required in older well-established scientific disciplines. Because the people are now scattered in different buildings, valuable research time is lost travelling from location to location. The consolidation of this effort under one roof will allow a more effective and efficient utilization of research manpower at the Ames Research Center. The prime element of justification is the need for space of the type and standard required so that this vital activity may be carried out efficiently and safely. There is no other satisfactory solution to the problem than to provide a new facility.

JUSTIFICATION FOR NEW FACILITY

Mr. EVINS. What is the priority to build a new facility at this time?

General CURTIN. There are two reasons. One is the press of space in the overall center, Mr. Chairman. More importantly, is our limited ability in the present configuration to carry out a really effective operation and to a lesser extent to reduce the toxic hazards to which I initially referred. We hope through this new location and facility to minimize these hazards.

Mr. LILLY. Also, Mr. Oran Nicks can speak to specific requirements of the work to be carried out.

Mr. EVINS. I notice you state in your justifications, "in similar work elsewhere," so there is work in this area being carried on elsewhere?

Mr. NICKS. Yes, Mr. Chairman. However, none of the things are focused on what we have at Ames. Work on fire retardant paints on insulation materials we could put on the inside of airframes which would keep them from burning in case of a fire or crash.

Mr. EVINS. Does this expansion at Ames involve any increase in personnel?

Mr. LILLY. No, sir.

GODDARD SPACE FLIGHT CENTER

Mr. EVINS. We will turn to the "Goddard Space Flight Center" and place in the record pages C2–3 through C2–5.

(The pages follow:)

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1971 ESTIMATES

PROJECT TITLE: Earth Resources Technology Laboratory

AUTHORIZATION LINE ITEM: Goddard Space Flight Center

COGNIZANT PROGRAM OFFICE: Office of Space Science and Applications

COGNIZANT INSTALLATION: Goddard Space Flight Center

LOCATION OF PROJECT: Greenbelt, Prince George's County, Maryland

TYPE OF PROJECT: Addition

FUNDING:

FY 1970 and Prior Years	$67,000
FY 1971 Estimate	2,050,000
Total Funding Through FY 1971	$2,117,000
Estimated Future Year CoF Funding	None

PROJECT PURPOSE AND SCOPE:

This project will provide office, laboratory, and special purpose space for the Earth Resources Technology Satellite (ERTS) control center and data processing facilities, and other related activities.

PROJECT DESCRIPTION:

This project proposes the construction of a three-story 45,000 square foot addition to the north end of the Data Interpretation Laboratory, Building 23, at the Goddard Space Flight Center. Construction will conform to existing standards with electrical, plumbing, heating, ventilating and air conditioning systems to support this special facility. Masonry-reinforced concrete and steel construction will be utilized. Fire protection and smoke detection systems will be included.

The development of the ERTS project requires the acquisition of certain specialized equipment which will be made available from the Research and Development appropriation. New equipment to be procured, totaling approximately $7 million, includes mission control center computer system and related displays and data handling systems.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				$2,050,000
Site development	LS	---	$35,000	35,000
Main building addition	Sq. Ft.	45,000	25.00	1,125,000
Plumbing, heating, and air-conditioning systems	Sq. Ft.	45,000	10.00	450,000
Electrical installations	Sq. Ft.	45,000	5.00	225,000
Raised floor	Sq. Ft.	30,000	5.00	150,000
Fire protection system	LS	---	65,000	65,000
Equipment	---	---	---	---
Fallout Shelter (Not Feasible)	---	---	---	None
		TOTAL		$2,050,000

PROJECT JUSTIFICATION:

The Earth Resources Technology Satellite (ERTS) is an earth sensing system which provides a continuous imagery coverage of the U. S. continent land mass and adjacent coastal and oceanic areas under a defined set of conditions. The satellite will be equipped with two multichannel electronic sensors which will continuously relay information to three ground receiving stations. The data received from the ground stations must be processed and provided to scientists while the mission is in progress as a major aspect of determining the optimum application of space technology to resources surveys of water and land mass areas. The effective acquisition and utilization of the large amount of data which will become available from the ERTS project requires the availability of a control center, data processing equipment and facilities for principal investigators, all tied together into an integrated system.

This project will provide the office, laboratory, and special purpose space for the ERTS control center, data processing capability, and house the ERTS project team. Due to the urgency of the need for a control center to support the ERTS-A mission, the Control Center and other related facilities will be housed within the existing third floor of the Goddard Data Interpretation Laboratory, Building 23. This project, through an addition to this same building, will provide the facilities required to permit a proper examination of data as it is received, and to use this

information for operational control of the satellite. In addition, space must be provided for user agency principal investigators who will require real time access to the data while the ERTS satellites are in orbit and to relocate certain data reduction functions displaced by the rearrangement of the third floor, Building 23. ERTS ground equipment will be procured and installed specifically for these missions since it has been established that time sharing of equipment is not feasible with this operational mode.

All facilities at GSFC have been examined and alternate solutions explored. The construction of an addition to Building 23 for the purpose outlined was determined to be the most prudent solution. The proposed solution utilizes 26,000 square feet on the third floor of Building 23 and provides for the addition of 45,000 square feet. This total of 71,000 square feet is the minimum now estimated to be required for these important ERTS project activities.

ADDITION TO BUILING 23

Mr. EVINS. You are asking for $2,050,000 in 1971. What do you propose to do at Goddard?

General CURTAIN. This is an addition to the existing Building 23 to adequately house the earth resources technology satellite ground operations. The functions to be carried out would be the examination of all data after it is received from the satellites, the use of this data in the control of the satellites and the provision to user agencies and principal investigators on a real-time basis, access to the data. We are proposing here an addition of about 45,000 square feet at an estimated cost of $2,050,000. This will have certain special features, a certain amount of raised flooring for the electronic gear and a small laboratory area. The major feature, however, is a control center for control of the entire operation.

Mr. EVINS. Do you have enough laboratories at Goddard?

General CURTAIN. No, sir, Mr. Chairman. This again has been examined very critically. As you are aware, we have some of the Goddard people offsite at the moment in leased facilities and the situation out there is very tight from both a laboratory as well as an office space point of view.

Mr. EVINS. Everybody needs more space. How much is invested in Goddard?

Mr. LILLY. $264 million.

JET PROPULSION LABORATORY

Mr. EVINS. Let's turn to the "Jet propulsion laboratory" section and place pages C 3–2 through C 3–9 in the record.

(The pages follow:)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

INSTALLATION SUMMARY

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1971 BUDGET ESTIMATES

(Dollars in thousands)

NASA INSTALLATION		COGNIZANT PROGRAM OFFICE FOR INSTALLATION
Jet Propulsion Laboratory		Office of Space Science and Applications
LOCATION OF INSTALLATION	COUNTY	NEAREST CITY
Pasadena, California	Los Angeles	Pasadena

INSTALLATION MISSION

The Jet Propulsion Laboratory (JPL) is a government-owned research and development facility, operated by the California Institute of Technology under a contract with the National Aeronautics and Space Administration. The laboratory carries out research programs and unmanned lunar and planetary space projects for NASA, and conceives and executes advanced development and experimental engineering investigations to further the technology required for the nation's space program.

PROJECT LINE ITEM	COGNIZANT OFFICE	FY 1959 THRU CURRENT YR	FY 1971 (Estimated)	FUTURE YEARS (Estimated)	TOTAL ALL YEARS (Estimated)
Solar Simulator Modifications	OSSA	1,721	700		2,421
Isotope Thermoelectric Systems Application Laboratory	OART	60	1,250		1,310
TOTAL			1,950		

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1971 ESTIMATES

PROJECT TITLE: Solar Simulator Modifications

AUTHORIZATION LINE ITEM: Jet Propulsion Laboratory

COGNIZANT PROGRAM OFFICE: Office of Space Science and Applications

COGNIZANT INSTALLATION: Jet Propulsion Laboratory

LOCATION OF PROJECT: Pasadena, Los Angeles County, California

TYPE OF PROJECT: Modification

FUNDING:

FY 1970 and Prior Years	$1,721,480
FY 1971 Estimate	700,000
Total Funding Through FY 1971	$2,421,480
Estimated Future Year CoF Funding	None

PROJECT PURPOSE AND SCOPE:

To provide the capability for simulating solar radiation energy in an existing 10-foot simulator, at intensity levels to be encountered by a spacecraft at a distance from the sun equivalent to the planet Mercury, and to retain the capability for testing at lower intensity levels.

PROJECT DESCRIPTION:

This project provides for replacement of the existing 8-foot diameter, one solar constant beam, with a modified and improved system designed to produce a high quality, well-collimated 6 1/2-foot diameter beam of radiant energy at a maximum intensity of 780 watts per square foot. This maximum intensity level was selected because current mission studies propose an encounter with the planet Mercury at a solar distance of 0.42 astronomical units or greater. Lower intensity will continue to be available at 6 1/2- and 8-foot diameters with existing equipment.

The proposed system will replace the 25 existing 5 Kw arc lamp/reflector/ power supply units with 19 new 20 Kw lamp packages, including the necessary starters, console controls, monitoring instrumentation and power wiring. A new optical mixer unit, with its associated cooling system will be installed.

The 10-foot diameter collimating mirror will be provided with an improved temperature control capability. Ultimate performance should be better than ±5% in uniformity with ±2 1/2° collimation.

There are no other concurrent major alterations anticipated to the vessel, shroud or cryogenic control systems, vessel penetration or building structure itself.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction	---	---	---	---
Equipment	---	---	---	$700,000
20 Kw lamps	LS	---	$55,000	55,000
Gimbaled collector assemblies (19)	LS	---	235,000	235,000
Mixer optics	LS	---	40,000	40,000
Mixer structure and installation	LS	---	40,000	40,000
Mirror cooling	LS	---	45,000	45,000
Array truss assembly	LS	---	25,000	25,000
Water cooling systems	LS	---	50,000	50,000
Power supplies and starters	LS	---	150,000	150,000
Power and control wiring	LS	---	60,000	60,000
Fallout Shelter	---	---	---	---
	TOTAL			$700,000

PROJECT JUSTIFICATION:

The thermal control of spacecraft for a Venus/Mercury mission is an extremely difficult and demanding problem. Not only must the spacecraft survive the high solar intensity at Mercury, but it must also adjust to the very large intensity changes from earth orbit (factor of six). The development and verification testing of spacecraft performance and reliability under these simulated solar flux conditions is essential for maximum confidence in overall mission success. Thermal control techniques do not at present permit reliable extrapolation of existing

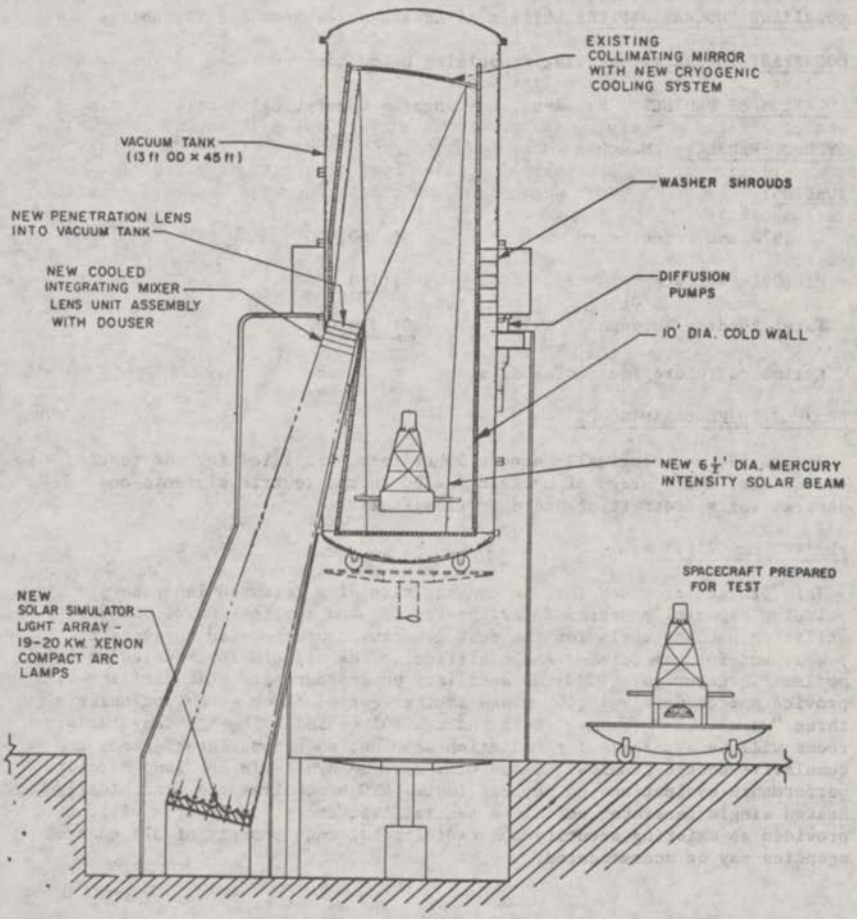
experience to 780 watts per square foot of solar energy. We believe that the only reasonable solution is to minimize the reliability risks by adequate testing under simulated flux equivalent to that expected to be encountered in space.

The value of simulator testing was fully established during a previous Venus mission where space simulator tests carried out at intensities somewhat greater than one solar constant indicated the need for changes in the thermal control system. However, any attempt to extrapolate from this level of thermal control data to the high levels existing at Mercury radically increases the probability of a serious or catastrophic failure. The proposed modifications will provide the testing capability which will minimize the possibility of failure at a relatively modest cost.

The capability of testing spacecraft at Mercury solar intensity levels does not currently exist in the United States. Because of the technical characteristics of the presently installed optical system, the modifications proposed represent the most economical and timely approach to achieve most of this capability.

Because of the lead time associated with the required optical element procurements and the relatively long fabrication times, this project must be funded in FY 1971 so that it will support a 1973 mission.

JET PROPULSION LABORATORY
FISCAL YEAR 1971 ESTIMATE
MODIFICATIONS TO THE 10 FOOT SOLAR SIMULATOR
(MERCURY INTENSITY CAPACITY)



CONSTRUCTION OF FACILITIES

FISCAL YEAR 1971 ESTIMATES

PROJECT TITLE: Isotope Thermoelectric Systems Application Laboratory

AUTHORIZATION LINE ITEM: Jet Propulsion Laboratory

COGNIZANT PROGRAM OFFICE: Office of Advanced Research and Technology

COGNIZANT INSTALLATION: Jet Propulsion Laboratory

LOCATION OF PROJECT: Pasadena, Los Angeles County, California

TYPE OF PROJECT: New

FUNDING:

FY 1970 and Prior Years	$60,000
FY 1971 Estimate	1,250,000
Total Funding Through FY 1971	$1,310,000
Estimated Future Year CoF Funding	None

PROJECT PURPOSE AND SCOPE:

To provide radiologically secure laboratory facilities for the testing, evaluation, and storage of nuclear fueled thermoelectric elements and devices for spacecraft on-board power systems.

PROJECT DESCRIPITON:

This project provides for the construction of a research laboratory building especially designed for the testing and application of devices utilizing nuclear fuels for the next generation of on-board spacecraft power, and for the testing and qualification of radioisotope fueled thermoelectric generators (RTG) as auxiliary power sources. This facility will provide approximately 17,600 gross square feet of floor space including three "warm cells" (one 40' cell and two 20' cells). The high bay isolation rooms will be available for radiation mapping, spectrum, interference and cumulative dosage studies. Space will also be available for long duration performance evaluations of nuclear fueled RTG assemblies and electrically heated single generator units. A central laboratory stores area will be provided so existing security and radiological requirements of all control agencies may be accommodated.

A minimum amount of space will be made available for necessary administrative, safety, operations, data processing and office functions to create an efficient and functional laboratory complex. Existing equipment is available to meet the initial needs of this new facility.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				$1,250,000
Site development	LS	---	$55,000	55,000
Utilities	LS	---	60,000	60,000
Building	Sq. Ft.	17,600	64.50	1,135,000
Equipment	---	---	---	---
Fallout Shelter	---	---	---	---
		TOTAL		$1,250,000

PROJECT JUSTIFICATION:

Future space missions will be of such long duration and will travel so far from the sun that electric power systems depending on the sun's energy cannot produce sufficient dependable power with a long enough lifetime to operate the spacecraft experiments, electronics and communications. Therefore, future space missions need a unique power supply independent of the sun. The currently available power systems are not able to support long duration missions such as the "grand tour", the outer planet explorers, and the "out of the ecliptic missions" which are now under definition. To solve some of the problems to be faced in these long duration missions; NASA has established a research project titled Thermoelectric Outer Planet Spacecraft (TOPS) to develop and design the critical components and constituents of the spacecrafts which will fly these long duration missions. Part of the TOPS project includes the design and development of radioisotope fueled thermo-electric generators (RTG). These multi-hundred watt RTG units are being developed by the AEC. The RTG units are scheduled for delivery to JPL early in calendar year 1972. The laboratory facility provided by this project is needed to receive, store, test, and work with the RTG units. Without this laboratory facility at JPL, NASA cannot proceed with the Spacecraft/RTG system integration work. Extensive ground tests and evaluation must be carried out in this facility in order to develop an 8 to 12 year life isotope power supply which does not create harmful effects on the spacecraft, its equipment or experiments.

The problem of utilizing RTG power sources in the presence of sensitive scientific instrumentation is also complicated by the fact that the fuel capsules contain minute quantities of impurities in the fuel compounds that cannot be removed. These impurities contribute significantly to the total radiation pattern of the unit, both as to the type of elementary particle and the energy level. In order to develop scientific instrument packages which give reliable, accurate data, it is required that they be thoroughly tested and calibrated in conjunction with the actual fueled capsules which will power the flight spacecraft.

From the work to be carried out in this facility, NASA will be able to resolve technological problems involving reliable prediction of performance and useful life, the handling and control of radiation, and the successful integration of the spacecraft equipment, power supply and experiments.

The proposed laboratory facility will create a new and indispensable capability needed to develop and evaluate secondary power systems and to provide state-of-the-art data regarding spacecraft systems and integration problems for all classes of advanced spacecraft.

Mr. EVINS. Would you tell us what the $1,950,000 in 1971 is for?

General CURTIN. There are two projects involved, $1,250,000 is for the isotope thermoelectric systems applications laboratory, and then there is a $700,000 amount involved for a solar simulator modification.

Mr. EVINS. Justify each one.

General CURTIN. The isotope thermoelectric systems application laboratory is required to meet the downstream needs of scientific satellites that would be exploring the outer planets. These satellites are no longer able to use solar cells, for example, for electric power because the distance from the sun will be too great. Instead, they will be required to use radioisotope thermoelectric generators referred to as "RTGs." This laboratory is required to receive, store, test and work with these units. Here the units will actually be integrated with the spacecraft and the associated scientific instrumentation. As I indicated, the goal is to develop these power supplies for long lifetime and also in such a manner they will not create harmful effects on the spacecraft and its experiments and thus degrade their effectiveness.

SOLAR SIMULATOR MODIFICATIONS

Mr. EVINS. General Curtin, we appropriated $1,721,000 last year for the solar simulator. Why do you need the additional $700,000?

Wasn't the project completed with that amount?

General CURTIN. This $700,000, Mr. Chariman, refers to the actual amount that we are requesting for the solar simulator modifications at the jet propulsion laboratory. In the fiscal year 1971 estimates, the $1,721,000 was the cost associated with the initial acquisition of this simulator and the $700,000 will provide updating modifications to it. The total investment after the $700,000 expended will be of the order of $2.4 million.

JPL INVESTMENT

Mr. EVINS. What is the total investment in the JPL facility?

Mr. LILLY. $131 million, sir.

Mr. EVINS. What is the annual cost of maintenance of a $131 million facility?

General CURTIN. I will have to furnish that for the record.

(The information follows:)

The total amount for all facilities services in fiscal year 1970 for JPL is $6,572,000 and the fiscal year 1971 estimate is $6,556,000. The fiscal year 1970 amount required to maintain, repair, accomplish facilities operation, and provide utility services to the NASA physical plant at JPL is $4,500,000. In fiscal year 1971 this estimate will increase slightly to about $4,700,000 as we now see it.

Mr. EVINS. You have a contractor out there, don't you? Maintenance is included in the contract. What is the maintenance contract for operating JPL?

Mr. LILLY. As you know, JPL is funded under the research and development appropriation, which covers the same kind of funding that is in our research and program management appropriation for the NASA centers. That amount for JPL is $88,855,000 estimated for 1971. That breaks down into $71 million for personnel. Travel is $2.4 million——

Mr. EVINS. How much is your contract for maintaining the facility?

Mr. LILLY. The facilities services costs at JPL are $6.5 million, sir.

Mr. EVINS. When you add another multimillion dollar facility every year to it, does the contractor come in and increase his contract? You have more to maintain. What has been the maintenance contract for the last 3 or 4 years? Do you have your figures on what it was the year before and the year before that?

Mr. LILLY. For facilities services in 1969 it was $5,995,000. For 1970 it was $6,572,000. For 1971 they are down to $6,556,000.

Mr. EVINS. In your justifications you state that because of the lead-time associated with the required optical element procurements and the relatively long fabrication times, this project must be funded in 1971 to support a 1973 mission.

General CURTIN. That is correct, Mr. Chairman.

Mr. EVINS. Is this the Venus-Mercury flight?

Dr. PAINE. Yes, sir.

DECENTRALIZING FACILITIES

Mr. EVINS. Did you ever consider decentralizing some of these facilities, spreading the business a little bit, or are you going to keep on adding cream to the already overcrowded cake?

I suppose you weed out some of the requests for extensions and additions and keep what you consider to be the most essential.

General CURTIN. That is correct, Mr. Chairman. The development of this year's program, basically all of the facilities before you, these 11 definitive items, have a timeframe in terms of the NASA programs and missions and the lead time in acquiring them is such that they have to be in this particular program. The total request from our centers, Mr. Chairman, was of the order of $350 million.

Mr. EVINS. That is what I was already driving at; $350 million. You did pretty good screening. You brought it down.

RADIOISOTOPE LABORATORY

What is the purpose of the radioisotope laboratory in a congested area?

General CURTIN. This is the laboratory associated with the development of the radioisotope thermoelectric generator. In this laboratory we will carry out the integration of these generators with the spacecraft and its instrumentation. Actually there is no facility capable of doing this at the present time and the purpose of this really is to insure that we not only have a generator that will work but also that it will not create harmful effects on the spacecraft and the experimentation. There is no other facility that will serve this purpose.

Mr. EVINS. You have unit cost of $64.50 per sq. ft. Why is that so high?

General CURTIN. It is the very nature of the facility, Mr. Chairman. It involves a considerable amount of radioactive shielding which can only be provided mainly by very large massive wall construction. This cost has been examined very carefully and we feel that the nature of the facility fully justifies it.

KENNEDY SPACE CENTER

Mr. EVINS. Let's turn to the Kennedy Space Center section and place in the record pages C4–3 through C4–7.

(The pages follow:)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

INSTALLATION SUMMARY

CONSTRUCTION OF FACILITIES

FISCAL YEAR 19 71 BUDGET ESTIMATES

(Dollars in thousands)

NASA INSTALLATION		COGNIZANT PROGRAM OFFICE FOR INSTALLATION
John F. Kennedy Space Center, NASA		Manned Space Flight
LOCATION OF INSTALLATION	COUNTY	NEAREST CITY
Cape Kennedy and Merritt Island	Brevard	Cocoa Beach, Florida

INSTALLATION MISSION

The Center conducts overall planning and supervision of the integration, test, checkout and launch of NASA space vehicle systems at the Air Force Eastern and Western Test Ranges, and Merritt Island, and provides support services for all NASA elements located in the area.

PROJECT LINE ITEM	COGNIZANT OFFICE	FY 1959 THRU CURRENT YR	FY 19 71 (Estimated)	FUTURE YEARS (Estimated)	TOTAL ALL YEARS (Estimated)
Launch Support Facilities	MSF	33	575		608
TOTAL			575		

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CF 4-3

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1971 ESTIMATES

PROJECT TITLE: Launch Support Facilities

AUTHORIZATION LINE ITEM: John F. Kennedy Space Center, NASA

COGNIZANT PROGRAM OFFICE: Office of Manned Space Flight

COGNIZANT INSTALLATION: John F. Kennedy Space Center, NASA

LOCATION OF PROJECT: Merritt Island, Brevard County, Florida

TYPE OF PROJECT: New Construction, Alterations, and Addition

FUNDING:

FY 1970 and Prior Years	$33,000
FY 1971 Estimate	575,000
Total Funding Through FY 1971	$608,000
Estimated Future Year CoF Funding	None

PROJECT PURPOSE AND SCOPE:

To provide: (1) a 3,700 square foot facility to house the electrical utilities maintenance and operations personnel, (2) alteration of 2,870 square feet of existing space to house personnel managing the modifications and repair of launch equipment and, (3) a 5,500 square foot addition to the Communications Distribution and Switching Center to adequately house personnel directly supporting Center communications and instrumentation systems operations, and to modify the existing structure to enhance utilization and personnel safety. All of these are in support of launch operations.

PROJECT DESCRIPTION:

Electrical Utilities Maintenance Building - This sub-project is for the construction of a single story office-type building containing approximately 3,700 square feet. The building will be heated and air conditioned. Necessary sitework and utilities are included. The facility will be located at Saturn Causeway and Contractor Road in the general vicinity of the Vehicle Assembly Building.

Launch Equipment Shop Office Area - This sub-project provides for the conversion of 2,870 square feet of mezzanine space in the Launch Equipment Shop from an open and unfinished condition into fully useable support space.

The work will include the installation of floor surfacing, insulated suspended ceiling, and painted gypsum board walls, suitable lighting and air conditioning, and will include the replacement of an access stairway.

Communications Distribution and Switching Center - This sub-project provides for the construction of a single story 5,500 square foot addition to the Communications Distribution and Switching Center. The addition will be a reinforced concrete frame structure with masonry block walls. All necessary site preparation, paving and utilities are included in this project.

Included also are modifications to the air conditioning systems of the existing building. Existing systems consist of one chilled water system and four direct expansion units. The direct expansion units will be replaced with a chilled water unit which will be connected to the existing chilled water system. This will provide a single more effective and economical air conditioning system for the entire building. Modifications to the interior of the existing structure in the form of partition and equipment rearrangement will also be necessary to provide safe access between work areas.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				$575,000
Electrical utilities maintenance building:				170,000
Building construction	Sq. Ft.	3,700	$31.00	(114,700)
Site preparation	LS	---	19,000	(19,000)
Water	LS	---	3,300	(3,300)
Sewer	LS	---	2,500	(2,500)
Exterior electrical	LS	---	24,000	(24,000)
Parking	Sq. Yd.	1,000	6.50	(6,500)
Launch equipment shop office area:				52,000
Modification work	Sq. Ft.	2,870	18.12	(52,000)

	Unit of Measure	Quantity	Unit Cost	Total Cost
Communications distribution and switching center:				$353,000
Addition	Sq. Ft.	5,500	$32.55	179,000
Arch/structural	Sq. Ft.	5,500	(18.73)	(103,000)
Mechanical	Sq. Ft.	5,500	(4.91)	(27,000)
Electrical	Sq. Ft.	5,500	(7.46)	(41,000)
Fire protection	Sq. Ft.	5,500	(1.45)	(8,000)
Modifications to existing building	LS	---	63,000	63,000
Site preparation	LS	---	13,000	13,000
Exterior electrical	LS	---	72,000	72,000
Parking and drainage	LS	---	26,000	26,000
Equipment	---	---	---	---
Fallout Shelter	---	---	---	---
	TOTAL			$575,000

PROJECT JUSTIFICATION:

This project is required to provide suitable and adequate space to house some 125 personnel accomplishing permanent and essential operations at these specific locations. These personnel are currently situated in 15 deteriorating trailers and 1,330 square feet of other substandard space at these three locations and require permanent adequate housing in these areas.

Electrical Utilities Maintenance Building - This building will provide space for approximately 30 engineering, supervisory and other personnel who support the operation and maintenance of the Launch Complex 39 electrical distribution system.

These personnel perform a continuing, permanent, and vital function, but are presently housed in two trailers and a substandard building located at Launch Complex 39. The substandard facility is a construction "shack" built in 1963 for use by an early construction contractor. It is substandard since it does not provide adequate environmental control, lighting, sanitary facilities or proper office space to house this important function.

Launch Equipment Shop Office Area - This alteration work will provide adequate permanent office space to house some 45 personnel now occupying 6 trailers located adjacent to the Launch Equipment Shop. These personnel support the modification and repair of launch support equipment, including such items as tail service masts and hold down arms. This function is essential to launch operations and must be accommodated in adequate and nearby space.

Communications Distribution and Switching Center - This addition and alteration work is necessary to adequately house some fifty personnel now accommodated in seven trailers located immediately adjacent to and east of the existing Communications Distribution and Switching Center. In addition, alterations to the existing facility are required to provide adequate and safe personnel circulation areas, and an efficient and economical air conditioning system.

General - All three sub-projects above involve the replacement of trailers with more appropriate facilities. This not only reflects the fact that these are permanent continuing functions but in addition they are functions which must be carried out in the given areas involved.

With regard to trailers, experience has shown that the operating and maintenance costs for trailers are significantly higher than for permanent office space. In addition, productivity of personnel is greatly reduced because of the need to conduct business between scattered trailers serving the same function. The problem is compounded during inclement weather, since sanitary facilities are not available in trailers, and employees must travel outdoors to the nearest permanent facility.

Kennedy Space Center has a large number of trailers in use. Many of these will be eight years old or older by the end of Fiscal Year 1971. Since the normal useful life of a trailer in this area is eight years, replacement will be essential in the very near future. Since launch support activities are a continuing and important function, the trailers must be replaced by permanent facilities for effective and more economical operation.

ADDITIONAL SPACE

Mr. EVINS. You are asking for $575,000 at the John F. Kennedy Space Center. You have been asking for housing at the Kennedy Space Center for years. Where are these people now housed?

General CURTIN. This is a peculiar requirement, Mr. Chairman, at Kennedy. Actually these people are presently housed in about 15 very old trailers and in about 1,300 square feet of very substandard space, really in the attic of an old building.

Mr. EVINS. Didn't we provide money for housing last year and the year before?

General CURTIN. We were provided $200,000 last year to meet the initial phase of this program, Mr. Chairman. This is actually a program that is addressed to operational people at Kennedy who have to be in specific locations. In other words, the fact that there is general office space available will not meet their requirement. We have, therefore, made up a comprehensive 4-year program and this is the second element of that program. These are mission-required people who have to be at a specific location. They are now inadequately housed in trailers which are not only expensive as initial investments, but expensive to maintain. They have very limited sanitary facilities and all in all it is a very poor situation. Our program here is an effort to reduce this crowding and these poor conditions.

DISPOSITION OF TRAILERS

Mr. EVINS. Who owns the trailers and what will happen to the trailer after the people move out?

General CURTIN. NASA owns the trailers, Mr. Chairman. We will analyze these and probably dispose of most of them. We have had in the agency for 2 years a program of not buying additional trailers, but to reassign available assets to meet needs of this kind.

Mr. JONAS. General, when I was down there last summer for the launch, I was told that the housing vacancy rate in that area was the highest in the whole United States and I saw sign after sign "For Rent." Yet you tell us there is no rental space available for housing your people?

General CURTIN. No, sir, Mr. Jonas. I agree with you that the occupancy rate in the family houses in the area is extremely high. Whether it is the highest in the Nation or not I couldn't comment. This is office space for operational people who are required to be in the area of launch complex 39 in order to carry out their physical mission. It can't be another location.

Mr. EVINS. This is not the housing for families?

General CURTIN. No, sir, this is office space for the management personnel involved.

Mr. JONAS. The same thing that applies to housing applies to business space. Everybody that I have talked to who live nearby—and that includes Members of Congress and others—were really crying because of unused space that was available. We have been reducing personnel there substantially.

General CURTIN. That is correct, and that is why I want to establish, Mr. Jonas, the fact that these are not just general management or overhead people. These are specific people associated with the management of activities that are carried out in the launch complex area and in order to do their job effectively, they have to be physically located in that area. This has been examined very closely in terms of not only the actual but projected strengths at Kennedy and I would agree with your general observation that as far as general office space is concerned there is no requirement at the present time. These are specific and peculiar requirements for just these small groups of people who have to be in specific locations.

Mr. EVINS. It is not too small a group, 125 personnel. They have been doing a pretty good job, have been pretty efficient, and you have accomplished your missions.

NUMBER OF BUILDINGS

Are you going to consolidate these into one area or are you going to build more than one building?

General CURTIN. There are three separate buildings involved. The trailers they are now occupying are in the 7 or 8-year vintage as I recall and shortly would have to be replaced anyway in some fashion. This is another factor that brings us to the crossroads of making a judgment decision.

Mr. EVINS. With the slower schedule of Apollo flights, could this construction be deferred for another years?

General CURTIN. No, sir, it is not sensitive to the schedule change.

Mr. EVINS. What is the investment at the Kennedy Space Center?

Mr. LILLY. $958 million, sir.

MANNED SPACECRAFT CENTER

Mr. EVINS. We will proceed to the "Manned Spacecraft Center" and place in the record pages CF 5–2 through CF 5–5.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

INSTALLATION SUMMARY

CONSTRUCTION OF FACILITIES

FISCAL YEAR 19 71 BUDGET ESTIMATES

(Dollars in thousands)

NASA INSTALLATION		COGNIZANT PROGRAM OFFICE FOR INSTALLATION
Manned Spacecraft Center		Manned Space Flight
LOCATION OF INSTALLATION	COUNTY	NEAREST CITY
Houston, Texas	Harris	Houston

INSTALLATION MISSION

The Manned Spacecraft Center has as its primary mission the development of spacecraft for Manned Space Flight programs. The Center is also responsible for Manned Space Flight operations, conduct of astronaut training, and earth resources aircraft project.

PROJECT LINE ITEM	COGNIZANT OFFICE	FY 1959 THRU CURRENT YR	FY 19 71 (Estimated)	FUTURE YEARS (Estimated)	TOTAL ALL YEARS (Estimated)
Calibration Laboratory	MSF	60	900		960
TOTAL			900		

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CF 5-2

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1971 ESTIMATES

PROJECT TITLE: Calibration Laboratory

AUTHORIZATION LINE ITEM: Manned Spacecraft Center

COGNIZANT PROGRAM OFFICE: Office of Manned Space Flight

COGNIZANT INSTALLATION: Manned Spacecraft Center

LOCATION OF PROJECT: Houston, Harris County, Texas

TYPE OF PROJECT: New

FUNDING:

FY 1970 and Prior Years	$60,000
FY 1971 Estimate	900,000
Total Funding Through FY 1971	$960,000
Estimated Future Year CoF Funding	None

PROJECT PURPOSE AND SCOPE:

To provide environmentally-controlled facility to adequately house some 100 personnel and associated equipment involved in the standardization and calibration of measuring instruments used by the development and test laboratories, shops, biological and medical activities and quality assurance activities at the Manned Spacecraft Center.

PROJECT DESCRIPTION:

This project provides for the construction of a 22,000 square foot environmentally-controlled Calibration Laboratory Facility. The building will be a steel frame structure with metal siding matching other laboratory buildings in the general area. Existing equipment will be relocated to the new facility. Major laboratories to be included in this facility are:

Electrical-Electronic Reference Standards for maintaining secondary electrical-electronic standards and working instrumentation in a dust free, vibration controlled and electrically shielded room with close environmental control tolerance of 73°F ± 1°F and relative humidity of 40% ± 10%.

Physical Science Reference Standards for maintaining primary standards for calibration of secondary standards in a closely controlled environment of 68°F ± 1/2°F temperature, and relative humidity of 40% ± 10%. This laboratory will also be dust free and vibration isolated.

Electrical-Electronic Calibration Laboratory to calibrate instruments used in measuring current, voltage, power, resistance, capacitance, inductance, frequency, and phase.

Physical Sciences Equipment Calibration Laboratory to calibrate instrumentation used in measuring dimensions, mass, temperature, force, torque, pressure, vibration, angles, liquid and gaseous flow, vacuum, humidity, acoustics, illumination, radiation and others.

Analytical Laboratory for quantitative and qualitative analysis of materials from the lightest gases through the heaviest metals, for purity and contamination content, and determination of partial contaminants.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				$900,000
Building	Sq. Ft.	22,000	$38.00	836,000
Site preparation	LS	---	32,500	32,500
Utilities	LS	---	31,500	31,500
Equipment	---	---	---	---
Fallout Shelter	---	---	---	---
		TOTAL		$900,000

PROJECT JUSTIFICATION:

The Calibration Laboratory is required to house locally needed reference standards originating with the National Bureau of Standards. This is necessary in order to standardize all measuring instruments and devices used at the Center. The proposed facility will also house calibration

laboratories necessary to insure the reliability and accuracy of measurements for electrical, electronic, physical, mechanical, biological and medical activities.

Calibration activities are currently carried out in sixteen scattered areas in the high bay and mezzanine area of the Instrumentation and Electronic Systems Laboratory Building and two other buildings, one of which is located at Ellington Air Force Base. These facilities are either substandard, overcrowded or lack the proper temperature and humidity controls and generally do not provide adequately stable platforms and other essential features needed for the work to be performed. The high bay area is also used as an Environment Test Area. Several of the calibration activities are located adjacent to "shake tables", located in the Environmental Test Area. When this equipment is in use vibrations are sufficiently severe to require all calibration efforts to cease at frequent and unpredictable intervals. In addition to vibrations from the "shake tables", which interrupt all calibration efforts, the opening of the high bay door results in sudden temperature changes and creates air turbulence throughout the laboratory area which can result in calibration errors. Calibration activities are also interrupted during the operation of an open cage makeshift elevator to the mezzanine and an overhead 10 ton crane. Under normal working conditions, the vibration of the building can be observed through oscillation of mercury or other liquids contained in beakers or equipment gauges located throughout the laboratories.

The Instrumentation and Electronic Systems Laboratory Building was designed and is used principally for the development and testing of spacecraft electrical systems and subsystems. Approximately 300 persons including those involved with calibration activities, are occupying the approximately 46,000 square feet of space in this building which was designed for 175 persons. The situation is such that calibration of instruments must be conducted in hallways, aisles and other totally unsuitable areas. Items to be calibrated cannot be properly cleaned because there is no adjacent area available for cleaning equipment and solvents.

In view of the significance and importance of instrument calibration to space programs, a facility which is designed and constructed to specifically accommodate the unique needs of this function is essential to the Center. Without such a facility, calibration of equipment and instrumentation will continue to lack the high degree of reliability and quality assurance necessary for the calibration activities and in addition require more effort and time to accomplish. The Calibration Laboratory is required in support of current and future space programs, such as the Apollo Applications, Lunar Exploration and Earth Resources Survey, Space Station and Space Shuttle. As mission and payloads grow in complexity, calibration work increases and assumes even greater significance in terms of quality and reliability. The present need for and trend toward instrument miniaturization adds to the critical need for increased accuracy and quality assurance.

Mr. EVINS. What is the investment in the Houston Center?
Mr. LILLY. $359 million, sir. You want the calibration laboratory?

CALIBRATION LABORATORY

General CURTIN. That is right, Mr. Chairman. At the Manned Spacecraft Center we are requesting $900,000 for a calibration laboratory.
Mr. EVINS. Total cost, $960,000?
General CURTIN. $900,000 this year. The $60,000 in planning effort is from prior years.
Mr. EVINS. The total cost will be $960,000?
General CURTIN. That is right. This is to house the activities related to the standardization and calibration of measuring instruments at the Center. They use these experiments in the test laboratories and the quality assurance and comparable activities at the Center. At the present time these activities are housed in 15 or 16 different noncontiguous areas in three different buildings. About 95 people are presently involved in a very crowded area. The limitations in the existing facilities are what make this project necessary in our view, Mr. Chairman, and these are basically that we have marginal humidity and temperature control.

TOTAL EMPLOYMENT

Mr. BOLAND. What is the total employment at Houston?
Mr. LILLY. In fiscal year 1970, 4,250.
Mr. BOLAND. What would it be in 1971?
Mr. LILLY. In 1971, we drop down to 4,200.
Mr. BOLAND. Will this reduction of personnel make space available for the calibration laboratory?
General CURTIN. No, it will not. This is a very peculiar requirement. I am not sure how it got into its present posture, but with the future programs coming down the road, the need for increased accuracy and sensitivity, something really has to be done to provide a facility in which they can carry out their activities without the present limitations.
Mr. LILLY. It is a long-term objective, Mr. Boland, to move as many people housed over in the Ellington Air Force Base up into the center as quickly as we can.
Mr. EVINS. When you consolidate into one building, what are you going to do with the vacated space?
General CURTIN. The space is about 12,000 feet they are now occupying, Mr. Chairman, and it again will be used by expansion into these areas of the adjacent activities that are now crowded up.
Dr. LOW. A lot of it is now being done in hallways and the space really does not exist now.
Mr. MYERS. You have calibration machines where you have to turn off a machine next to it so you can run it.

NUCLEAR ROCKET DEVELOPMENT STATION

Mr. EVINS. Let's turn to the "Nuclear Rocket Development Station" section and place in the record pages CF F-2 through CF 7-5.
(The pages follow:)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

INSTALLATION SUMMARY

CONSTRUCTION OF FACILITIES

FISCAL YEAR 19 71 BUDGET ESTIMATES

(Dollars in thousands)

NASA INSTALLATION		COGNIZANT PROGRAM OFFICE FOR INSTALLATION
Nuclear Rocket Development Station		Office of Advanced Research and Technology
LOCATION OF INSTALLATION	COUNTY	NEAREST CITY
Jackass Flats, Nevada	Nye	Las Vegas

INSTALLATION MISSION

The mission of the Nuclear Rocket Development Station is to provide a site for ground static testing of the reactors, engines, and stages associated with nuclear rocket development.

PROJECT LINE ITEM	COGNIZANT OFFICE	FY 1959 THRU CURRENT YR	FY 19 71 (Estimated)	FUTURE YEARS (Estimated)	TOTAL ALL YEARS (Estimated)
Engine/Stage Test Stand No. 2	OART		3,500	45,000	48,500
TOTAL			3,500		

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CF 7-2

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1971 ESTIMATES

PROJECT TITLE: Engine/Stage Test Stand No. 2

AUTHORIZATION LINE ITEM: Nuclear Rocket Development Station

COGNIZANT PROGRAM OFFICE: Office of Advanced Research and Technology

COGNIZANT INSTALLATION: Space Nuclear Propulsion Office

LOCATION OF PROJECT: Jackass Flats, Nye County, Nevada

TYPE OF PROJECT: New

FUNDING:

FY 1970 and Prior Years	---*
FY 1971 Estimate	$3,500,000
Total Funding Through FY 1971	$3,500,000
Estimated Future Year Funding	$45,000,000

PROJECT PURPOSE:

The nuclear rocket stage development program will require early system development tests, within the nuclear and space environment, to serve as a basis for flight systems design verification. This project will provide the necessary test facility capability to demonstrate the operational performance of the nuclear stage with the NERVA engine from very low power to full power conditions, including qualification of the NERVA engine stage and establishment of reliability and flight confidence factors for various flight profiles.

PROJECT DESCRIPTION:

The primary objective of the nuclear rocket stage development program is to confirm the validity of flight-systems design and to qualify the systems for flight. To achieve these goals, a ground test module will be used as a test bed. Construction of a new test facility at the Nuclear Rocket

*Excludes cost of ETS-1.

Development Station, Nevada, is required to accommodate this nuclear ground test module. The new facility will be designated as Engine/Stage Test Stand 2 (E/STS-2) and will subsequently be constructed near the existing Engine Test Stand-1 (ETS-1) complex in order to utilize appropriate existing capabilities. The major elements of the proposed facility are: (1) Cryogenic systems; (2) High-pressure gas systems; (3) Process water systems; (4) Exhaust duct and steam generation system; (5) Contaminated waste disposal system; (6) Instrumentation and control systems; (7) Test stand superstructure and substructure; (8) Facility shields; (9) Control center; (10) Utilities and (11) Site work.

The requested funding in FY 1971 is for the first increment of this facility. It involves the provision of steam generating capacity which will be necessary for E/STS-2 and will also beneficially augment the existing capacity for ETS-1 operations. This $3,500,000 is required to procure equipment including storage vessels, heat exchangers, and associated pumps, piping, valves, instrumentation and controls. This will provide about 20 minutes additional full steam flow rated capacity for the steam generation and delivery system (SGDS) of the common complex (ETS-1/E/STS-2). This, being in addition to 20 minutes of steam currently provided at ETS-1, will give the needed total of 40 minutes full steam flow rated capacity for the common complex.

PROJECT COST ESTIMATE:

	Unit of Measure	E/STS-2 Total Cost	FY 1971 Cost
Land Acquisition	---	---	---
Construction		$12,810,000	---
Test stand	LS	7,410,000	---
Buildings	LS	2,320,000	---
Utilities	LS	2,080,000	---
Site work	LS	1,000,000	---
Equipment		35,690,000	$3,500,000
Test support system	LS	16,840,000	---
NERVA altitude simulation system	LS	11,500,000	3,500,000
Instrumentation and control	LS	7,350,000	---
Fallout Shelter	---	---	---
	TOTAL	$48,500,000*	$3,500,000

*Excluding $3,500,000 of design to be programmed as Facility Planning and Design (FP&D).

PROJECT JUSTIFICATION:

A ground test facility is required to develop and qualify the nuclear rocket stage for flight. The total capability provided by this project is considered the minimum necessary to proceed with the development of a nuclear propulsion module with a minimum of funding commensurate with NASA schedules and safety and reliability standards.

An existing test facility, ETS-1, is being modified and up-graded separately from this project in order to accommodate the development test of the NERVA nuclear engine. However, ETS-1 is not capable of accommodating the nuclear stage. Accordingly, Engine/Stage Test Stand-2 (E/STS-2) will be required to provide this test capability.

The initial increment of funding requested in 1971 is to provide a steam generation system for altitude simulation. The steam capacity to be provided by this project is basic and essential to the future E/STS-2 and is being added at this time to take advantage of the increased capability it can also provide for testing the NERVA engine on ETS-1.

Mr. Evins. At the Nuclear Rocket Development Station you are requesting $3.5 million. What is this request for?

General Curtin. At the Nuclear Rocket Development Station we are requesting $3.5 million. This project is the first increment actually of a stage test facility. It relates to the steam generation capacity needed for altitude simulation. This project will also, in addition to being the first increment of a follow-on stage test facility, permit us to increase the running time at the existing engine test stand No. 1, thus enabling us to develop a longer duration capability to provide more economical testing for the NERVA engines.

Another advantage of this timing is the fact that the construction that we are proposing here funded in the 1971 timeframe, would permit us to undertake this work while other modifications on the existing stand are being accomplished and thus eliminate, we hope, to a large extent, future interferences.

TOTAL COST

Mr. Evins. General, you want $3.5 million for 1971 and you say the total estimated cost is $48.5 million?

General Curtin. That is correct. Additional cost would run on the order of $45 million based upon our present preliminary engineering reports and the current evaluation of what this future stage test stand might be.

Mr. Evins. Where have these tests been conducted up to now?

General Curtin. These tests have not been conducted, Mr. Chairman. These are follow-on tests from engine development and would involve ultimately the testing of the engine and the stage combination.

Mr. Nicks might like to speak to that in more detail.

Mr. Evins. You have had all kinds of tests out there. What kind of tests are you going to be doing that you haven't been doing?

Mr. Nicks. This will be combined tests of the engines, the reactor that goes with it and the stage which would be the tanks and the rest of the structures that would become the full space vehicle stage the present facility cannot accomodate such tests.

We are testing the engine by itself to prove that it can work all right with the reactor, but we have had boilerplate tanks and boilerplate plumbing and things of that sort which this new test would accommodate. In addition, we have had short tests and this will provide for exhaust system duration tests of 40 minutes or so, up to an hour eventually, which we need to prove this engine out economically.

CONSTRUCTION TIME

Mr. Evins. How many years would it take to construct this facility?

General Curtin. The total time would depend entirely on the increments that are funded, Mr. Chairman. We presently envision something like three to three and a half years for construction and a total of about 5 years from now to have the facility fully checked out.

Mr. Evins. Is this a backup for your other stand?

General Curtin. No, sir. This particular increment, however, would give the other stand this additional capability in run time that I previously mentioned but it is not a backup in the true sense.

Mr. EVINS. This is the first funding of a $48.5 million facility, is that correct?

General CURTIN. That is correct, Mr. Chairman.

Mr. EVINS. I am sure you will say it is your collective judgment that this should go forward now and not be deferred.

General CURTIN. In our judgment, yes, sir.

Mr. EVINS. What would be the impact if it were deferred?

General CURTIN. If it is deferred, it would mean our capability of the existing stand would be limited in terms of run time to something of the order of half the run time that this augmentation would permit us to have. Furthermore, this facility is the pacing item in the development of the stage to be powered by NERVA.

Mr. EVINS. There has been a stretch-out of the NERVA program anyway.

Mr. LILLY. This funding is consistent with that stretch-out. If it had not been, if one were still planning to bring in a nuclear stage in the 1977–78 time period, it would have required much more funding. This was reduced when we stretched out the target dates for the nuclear stage.

MARSHALL SPACE FLIGHT CENTER

Mr. EVINS. We will now turn to the "Marshall Space Flight Center" section. Mr. Reporter, place pages CF 6–2 through CF 6–4 in the record.

(The pages follow:)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

INSTALLATION SUMMARY

CONSTRUCTION OF FACILITIES

FISCAL YEAR 19 71 BUDGET ESTIMATES

(Dollars in thousands)

NASA INSTALLATION		COGNIZANT PROGRAM OFFICE FOR INSTALLATION
Marshall Space Flight Center		Manned Space Flight
LOCATION OF INSTALLATION	COUNTY	NEAREST CITY
Huntsville, Alabama	Madison	Huntsville, Alabama

INSTALLATION MISSION

The mission of the Marshall Space Flight Center is the development of launch vehicles, engines and vehicle systems for Manned Space Flight programs. The Center also performs advanced studies and research in the general field of astronautics.

PROJECT LINE ITEM	COGNIZANT OFFICE	FY 1959 THRU CURRENT YR	FY 19 71 (Estimated)	FUTURE YEARS (Estimated)	TOTAL ALL YEARS (Estimated)
Multi-Spectral Photographic Laboratory	MSF	36	525		561
TOTAL			525		

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CF 6-2

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1971 ESTIMATES

PROJECT TITLE: Multi-Spectral Photographic Laboratory

AUTHORIZATION LINE ITEM: Marshall Space Flight Center

COGNIZANT PROGRAM OFFICE: Office of Manned Space Flight

COGNIZANT INSTALLATION: Marshall Space Flight Center

LOCATION OF PROJECT: Huntsville, Madison County, Alabama

TYPE OF PROJECT: New

FUNDING:

FY 1970 and Prior Years	$36,000
FY 1971 Estimate	525,000
Total Funding Through FY 1971	$561,000
Estimated Future Year CoF Funding	None

PROJECT PURPOSE AND SCOPE:

To replace an existing but extremely substandard structure, now utilized on an interim basis by Marshall Space Flight Center as a photographic laboratory, with a new facility designed to support the Center in multi-spectral photographic analysis and related photographic work.

PROJECT DESCRIPTION:

This project provides for the construction of a single story building of approximately 14,000 square feet. The building will be a laboratory-type structure equipped with temperature, humidity and dust control systems. The facility will provide for the processing and printing of still and motion picture film, as well as the special types of films documenting research and development tests and projects. Laboratory facilities for the fabrication, assembly and checkout of photographic systems and instrumentation in support of specific projects will be provided. Support space, including secure film holding and storage facilities, special lighting, and utilities, including a water filtration system, and access drives will be included. Existing equipment will be relocated to the new facility.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				$525,000
Building	Sq. Ft.	14,000	33.50	469,000
Site development	LS	---	20,000	20,000
Utilities	LS	---	36,000	36,000
Equipment	---	---	---	---
Fallout Shelter	---	---	---	---
		TOTAL		$525,000

PROJECT JUSTIFICATION:

The building now used as a photographic laboratory by Marshall Space Flight Center was erected in 1943 as a chemical manufacturing and processing plant. In 1961, the pressing needs of the space program led to the interim conversion of this high bay, mill-type structure to serve photographic laboratory needs. While it has served in this capacity ever since, the age and deteriorating condition of the structure, as well as its fundamentally poor construction constitute a severe limitation on the quality of effort required by this laboratory.

Approximately twenty-five percent of the total photographic workload is devoted to programs and tests which are totally dependent upon film documentation for data collection. An additional fifty percent of the workload is in direct support of research, development, tests, and evaluation of programs conducted at the Center, while the balance is required for general Center support. An important function of the Photographic Division is to promote the use of new techniques and to keep abreast of advanced technology. To meet this challenge, suitable and adequate facilities are required.

To attain the stringent requirements dictated by advancement in the photographic sciences and to optimize the quality of product, a controlled environment and reliable processing facilities are basic prerequisites. The present laboratory, even if modified cannot meet these requirements due to location, type of construction and existing environmental systems. The present interim facility is located within 20 feet of a road so that heavy vehicular traffic and the operation of nearby test facilities give rise to severe vibration in this light frame structure.

Mr. EVINS. What is the $525,000 for your Marshall Space Flight Centers for?

General CURTIN. This $525,000 is to provide a replacement facility in order to adequately house the essential multispectral analysis and photographic support activities at Marshall. This activity is presently housed in a 1,200-square-foot building built in 1943 as a chemical manufacturing plant. It was modified in 1961 for interim use as a photo lab and has been used as such since that time. It has severe restrictions on its use, including very marginal fume hoods and ventilation. It is extremely crowded. Reference was made earlier in connection with the calibration lab to people doing work in the corridors and this applies here also. It lacks adequate sanitary facilities and involves at the present time something on the order of about $1.5 million of equipment which should be adequately housed.

Mr. EVINS. Will this be the wrap-up cost?

Mr. LILLY. Yes, sir, Mr. Chairman.

Mr. EVINS. You didn't need it during the Apollo flight; why do you need it now? How urgent is the building now?

General CURTIN. It is extremely urgent. We are in the position, Mr. Chairman, that unless a new building of this order of magnitude is provided we will probably have to spend something on the order of 50 or 60 percent of this cost merely to hold on to the facility and make it reasonably acceptable for operation. With that order of magnitude of cost facing us, we feel it is good business to do the thing properly.

VARIOUS LOCATIONS

Mr. EVINS. Let's look at your various facilities. Place in the record pages CF 8–1 through CF 8–8, CF 8–11, CF 8–12, CF 8–15, and CF8–16.

(The pages follow:)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

INSTALLATION SUMMARY

CONSTRUCTION OF FACILITIES

FISCAL YEAR 19 71 BUDGET ESTIMATES

(Dollars in thousands)

NASA INSTALLATION		COGNIZANT PROGRAM OFFICE FOR INSTALLATION
Various Locations		Various
LOCATION OF INSTALLATION	COUNTY	NEAREST CITY
Not Applicable	Not Applicable	Not Applicable

INSTALLATION MISSION

PROJECT LINE ITEM	COGNIZANT OFFICE	FY 1959 THRU CURRENT YR	FY 1971 (Estimated)	FUTURE YEARS (Estimated)	TOTAL ALL YEARS (Estimated)
Rehabilitation and Modification of Facilities	O&M	10,360	14,000		24,360
Alterations to Launch Complex 2	OSSA	4,641	3,300		7,941
Power Plant Addition, 210' Antenna Facility	OTDA	35	750		785
Relocation of a Transportable Facility	OTDA	25	525		550
TOTAL			18,575		

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NASA-HQ
CF 8-1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1971 ESTIMATES

VARIOUS LOCATIONS

REHABILITATION AND MODIFICATION OF FACILITIES

PROJECT PURPOSE:

To provide for major rehabilitation and modification of facilities at NASA field installations and Government-owned industrial plants engaged in NASA activities. The purpose of this program is to protect, preserve, and improve the general capabilities or usefulness of these facilities, and to insure the continued safe, economical, and efficient use of NASA's physical plant.

PROJECT DESCRIPTION:

Projects proposed to be accomplished within this program are outlined under "Project Cost Estimate" and total $14.0 million. These projects represent items considered to be of the highest priority at this time, and have been carefully selected from a list totalling $36 million on the basis of relative urgency and expected return on the investment involved. It is recognized, however, that during the course of the year some rearrangement of priorities may be necessary and possibly a change in some of the items to be accomplished within allocated funds may be required.

PROJECT COST ESTIMATE:

I. OFFICE OF MANNED SPACE FLIGHT	$6,610,000
A. Kennedy Space Center	2,605,000
(1) Rehabilitate Pad A, Launch Complex 39	380,000
(2) Rehabilitate Power Systems	275,000
(3) Rehabilitate Air Conditioning Systems	250,000
(4) Building Fire Protection	552,000
(5) Rehabilitate Instrumentation and Communication Systems	574,000
(6) Rehabilitate Roofs and Building Exteriors	304,000
(7) Rehabilitate Electric Power Industrial Area, Western Test Range	165,000
(8) Rehabilitate Spacecraft Area, Building 836, Western Test Range	105,000

B.	Manned Spacecraft Center	680,000
	(1) Rehabilitate Air Conditioning Systems	225,000
	(2) Rehabilitate Cooling Tower, Building 24	200,000
	(3) Structural and Roof Repairs, Ellington Air Force Base	255,000
C.	Marshall Space Flight Center	2,200,000
	(1) Refurbish Surface Treatment Facility, Building 4760	500,000
	(2) Install Fire Extinguisher Systems	1,700,000
D.	Michoud Assembly Facility	250,000
	(1) Rehabilitate Utilities Systems	250,000
E.	Mississippi Test Facility	375,000
	(1) Rehabilitate High Pressure Gas Facility	375,000
F.	Various Locations	500,000
	(1) Rehabilitation and Modification of Industrial Plants	500,000
II.	OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY	$3,230,000
A.	Ames Research Center	535,000
	(1) Modification of Electrical Utilities	280,000
	(2) Building Fire Protection Systems	255,000
B.	Flight Research Center	315,000
	(1) Rehabilitate Utilities Systems	315,000
C.	Langley Research Center	1,152,000
	(1) Replacement Boiler for Heating Plant	700,000
	(2) Rehabilitate Fire Alarm and Monitoring Systems	452,000

D.	Lewis Research Center	894,000
	(1) Rehabilitate Research and Control Building.....	327,000
	(2) Replacement of Boiler No. 5.....	115,000
	(3) Rehabilitate Dryer and Heat Exchangers at the Engine Research Building and the Propulsion Systems Laboratory.....	452,000
E.	Plum Brook Station	334,000
	(1) Rehabilitate Utilities Systems.....	334,000
III.	OFFICE OF SPACE SCIENCE AND APPLICATIONS	$2,790,000
A.	Goddard Space Flight Center	1,090,000
	(1) Fire Protection and Safety Modifications.....	485,000
	(2) Central Refrigeration System.....	605,000
B.	Jet Propulsion Laboratory	870,000
	(1) Erosion Control and Storm Drainage.....	140,000
	(2) Fire Protection and Prevention.....	260,000
	(3) Rehabilitate Road Networks and Parking Areas.....	330,000
	(4) Rehabilitate Buildings 233 and 238.....	140,000
C.	Wallops Station	830,000
	(1) Rehabilitate Hangar Building D-1.....	355,000
	(2) Rehabilitate Buildings E-106 and E-107.....	290,000
	(3) Rehabilitate Building X-15.....	185,000
IV.	OFFICE OF TRACKING AND DATA ACQUISITION	$1,370,000
A.	Fire Protection and Safety Improvements.....	1,370,000
	(1) Fire Alarm and Detection Systems.....	200,000
	(2) Water Supply and Distribution Systems.....	700,000

(3) Hose Stations and Hydrants	100,000
(4) Water Sprinkler Systems	370,000
TOTAL	$14,000,000

PROJECT JUSTIFICATION:

The NASA physical plant at initial cost totals about $4.5 billion. Its current replacement value is about $7.5 billion. It is composed of two major segments. The first and oldest consists of the research centers and industrial plants which are now, in many cases, over 25 years old. The second segment is composed of the more recent facilities acquired to support the Manned Space Flight program. Both segments of the plant have been exposed to hard and continued usage and particularly the older segment has experienced a long history of changing utilization and adaptation. Rehabilitation and modification of these facilities is required as a continuing program. This is necessary to: (1) protect the capital investment represented by these facilities; (2) insure their continued and reliable operation; (3) improve their capabilities and usefulness to NASA mission accomplishment; (4) provide a safer environment for personnel, (5) and to overcome the cumulative effects of wear, deterioration, and obsolescence.

Only major rehabilitation and modification of facilities type work is included, and are of the magnitude that they cannot be accomplished by day-to-day maintenance or by minor repair efforts. Routine maintenance, major additions, new construction, and projects which qualify as special or specific program requirements are excluded.

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1971 ESTIMATES

PROJECT TITLE: Alterations to Launch Complex 2

AUTHORIZATION LINE ITEM: Various Locations

COGNIZANT PROGRAM OFFICE: Office of Space Science and Applications

COGNIZANT INSTALLATION: John F. Kennedy Space Center

LOCATION OF PROJECT: Western Test Range, Vandenberg Air Force Base, California

TYPE OF PROJECT: Modification

FUNDING:

FY 1970 and Prior Years	$4,640,798
FY 1971 Estimate	3,300,000
Total Funding Through FY 1971	$7,940,798
Estimated Future Year CoF Funding	Will be dependent on future flight programs requiring polar orbit launching.

PROJECT PURPOSE AND SCOPE:

The purpose of this project is to improve the safety and operational efficiency of the Complex and to keep pace with launch vehicle requirements.

PROJECT DESCRIPTION:

This project provides for the following alterations and additions to Space Launch Complex 2W:

Mobile Service Structure

Alterations will be made to the mobile service structure to provide adequate work space and access to the vehicle including: relocation, modification and addition of new platform levels; elevator modifications; installation of new weather and environmental enclosures for the elevated work area; and modification and upgrading of the electrical, compressed air, GN_2 purge ventilation, lighting and lightning protection systems; modification of the rail system, provision of new guy cables and hoists, and repaving of the service structure area.

CF 8-6

Umbilical Tower

A new umbilical tower will be constructed similar in design to the Delta umbilical towers located at Kennedy Space Center. This includes all electrical, mechanical and communications equipment, blast wall modifications, and replacement of defective wiring and fixtures on the service structure. Modifications will be made to the launch deck areas as required by the vehicle including new blast deflectors, modifications to the electrical, mechanical and gas systems, installation of a new concrete deck, and resurfacing of the surrounding paved area.

Cryogenic Systems

Launch and support cryogenic and related systems supplying gaseous and liquid helium and nitrogen will be removed from trailers and permanently installed. They will be modified and upgraded as necessary to insure reliable performance.

Control Center

Blockhouse control and monitoring console will be rearranged, updated, and augmented to accommodate current and modified launch vehicle configurations. Modifications will be made of the associated interconnecting mechanical, propulsion, and electrical systems between and in the blockhouse and launch deck.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				$2,096,000
Mobile service structure modification	LS	---	$880,000	880,000
Umbilical tower	LS	---	685,000	685,000
Launch mount support	LS	---	81,000	81,000
Fuel and LOX transfer piping and pneumatic systems modification	LS	---	450,000	450,000

PROJECT COST ESTIMATE (Cont'd)

	Unit of Measure	Quantity	Unit Cost	Total Cost
Equipment				$1,204,000
Modifications to first stage propellant loading system	LS	---	$500,000	500,000
Modifications to launch control and monitoring console	LS	---	550,000	550,000
Solid motor alignment system	LS	---	154,000	154,000
Fallout Shelter (Not feasible)	---	---	---	None
		TOTAL		$3,300,000

PROJECT JUSTIFICATION:

Space Launch Complex 2 is used for all direct polar orbital launches for NASA and ESSA scientific, earth resources technology, and operational weather satellite missions. Present programmed missions require new launch vehicle configurations with solid strap-on motors. This project provides for necessary modifications to Space Launch Complex 2 to meet the programmed launch requirements. In addition, the service structure and umbilical tower electrical power systems will be upgraded to conform to approved launch area safety standards. Upgrading of the blockhouse and launch pad support equipment will improve operational efficiency and flexibility.

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1971 ESTIMATES

PROJECT TITLE: Power Plant Addition, 210 Foot Antenna Facility

AUTHORIZATION LINE ITEM: Various Locations

COGNIZANT PROGRAM OFFICE: Office of Tracking and Data Acquisition

COGNIZANT INSTALLATION: Jet Propulsion Laboratory Pasadena, California

LOCATION OF PROJECT: Goldstone Complex, Fort Irwin, California

TYPE OF PROJECT: Addition

FUNDING:

FY 1970 and Prior Years	$35,000
FY 1971 Estimate	750,000
Total Funding Through FY 1971	$785,000
Estimated Future Year CoF Funding	None

PROJECT PURPOSE AND SCOPE:

To provide an additional 3000 Kilowatt (KW) generating power capability required for the operation of a high powered transmitter.

PROJECT DESCRIPTION:

This project provides for the construction of a 5060 square foot power plant addition, together with the procurement and installation of four 750 KW engine generating sets and associated equipment and switch-gear. The project will also provide for an extension of existing underground power and electrical distribution systems and all necessary supporting features.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction	---	---	---	$270,000
Building addition	Sq. Ft.	5060	$35.00	177,000
Generator foundations	Each	4	12,000	48,000
Electrical distribution system	LS	---	45,000	45,000
Equipment				$480,000
Engine Generator Sets (4 each of 750 KW Capacity)	KW	3000	160.00	480,000
Fallout Shelter	---	---	---	---
		TOTAL		$750,000

PROJECT JUSTIFICATION:

This project is required to provide additional operational electrical power associated with the high-powered transmitter on the Goldstone 210-foot antenna. High powered up-link support will begin with the Pioneer F (1972 launch). The present power system at Goldstone consists of (1) a commercial power service and (2) a on-station 2000 KW (4 each 500 KW) diesel-generating power plant. In order to ensure reliability and quality of power, the on-station generated power service is required during all mission support periods. Commercial power at the Goldstone complex is used at all other times.

The above existing power generating plant at the Mars 210' antenna now provides the electrical power to run the antenna system and all electronics and utilities associated with the station, including a 20 KW transmitter. It is now necessary to provide sufficient on-station power to serve the high power transmitter required for critical mission support to the approved planetary flight programs. This high power transmitter is driven by a 3500 HP motor generator set, which brings the total operational power load requirement for the station to approximately 3000 KW including minimum back-up.

Lead times for construction and activation of this additional capacity require funding in FY 1971.

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1971 ESTIMATES

PROJECT TITLE: Relocation of Transportable Facility

AUTHORIZATION LINE ITEM: Various Locations

COGNIZANT PROGRAM OFFICE: Office of Tracking and Data Acquisition

COGNIZANT INSTALLATION: Goddard Space Flight Center, Greenbelt, Maryland

LOCATION OF PROJECT: Santiago, Chile

TYPE OF PROJECT: New

FUNDING:

FY 1970 and Prior Years	$25,000
FY 1971 Estimate	525,000
Total Funding Through FY 1971	$550,000
Estimated Future Year CoF Funding	None

PROJECT PURPOSE AND SCOPE:

This project proposes construction necessary for the relocation of the transportable Unified S-Band facility at Grand Bahama Island which will be relocated to an existing Tracking and Data Acquisition station at Santiago, Chile, to provide support for the Apollo Applications Program (AAP).

PROJECT DESCRIPTION:

This project will provide for the construction of antenna foundations, trailer pads, supporting features, and necessary utilities and site development at Santiago, Chile.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction	---	---	---	$525,000
Concrete pads for vans	Each	12	$1,000	12,000
Antenna foundations	Each	2	11,000	22,000
Antenna erection	Each	2	28,000	56,000
Communications	LS	---	130,000	130,000
Roads and paving	LS	---	95,000	95,000
Site development	LS	---	65,000	65,000
Electrical distribution	LS	---	65,000	65,000
Utilities	LS	---	80,000	80,000
Equipment	---	---	---	---
Fallout Shelter	---	---	---	---
		TOTAL		$525,000

PROJECT JUSTIFICATION:

The existing configuration of the Manned Space Flight Network does not permit adequate support to long duration missions of the Apollo Applications Program in the South America area. Consequently, the transportable station presently located on Grand Bahama Island will be relocated to and co-located with the STADAN station at Santiago, Chile. The AAP workshop will be launched in late 1972.

Initial equipment is available and will be relocated.

Mr. EVINS. For rehabilitation and modification of facilities you are requesting $14 million. For alterations to Launch Complex 2, $3.3 million. Powerplant addition, 210-foot antenna facility, $750,000. Relocation of a transportable facility, $525,000. This adds up to a total cost of $18,575,000.

General CURTIN. Yes, sir. The largest part of this request relates to the $14 million that we are requesting for rehabilitation and modification work.

Mr. EVINS. Where is this work to be done?

General CURTIN. At the locations and for the projects that are shown on pages 8–2, 8–3, 8–4 and 8–5, Mr. Chairman.

Mr. EVINS. At the Kennedy Space Center you want to rehabilitate pad A for $380,000. Rehabilitate power systems, $275,000. Rehabilitate air-conditioning systems, $250,000. Building fire protection, $552,000. Rehabilitate instrumentation and communications systems, $574,000. Rehabilitate roofs and building exteriors, $304,000. You have to maintain your property.

General CURTIN. That is correct.

Mr. EVINS. Rehabilitate electric power industrial area Western Test Range, $165,000. Rehabilitate spacecraft area, building 836, Western Test Range, $105,000.

Then you list the Manned Spacecraft Center, the Marshall Space Flight Center, Michoud assembly facility, the Mississippi test facility, and various locations. You have various locations under various locations. Where are these located?

General CURTIN. The "various locations" is a line item, Mr. Chairman. It is a line item to take care of what we know will be firm requirements in connection with modification and rehabilitation work that will have to be done on our industrial plant as it phases down. These would be plants such as at Downing and Seal Beach in California, Mr. Chairman.

Mr. EVINS. You have more here for the Ames Research Center, We just covered Ames a while ago.

General CURTIN. That is correct. These are smaller projects.

Mr. EVINS. $535,000 more at Ames?

General CURTIN. That is correct.

TOTAL INVESTMENT

Mr. EVINS. What is the total investment in your facilities?

General CURTIN. We are carrying our physical plant on our books at initial acquisition cost for about $4.5 billion. However, we estimate, on a conservative basis, if we were to replace it at today's prices, it would be something on the order of $7.5 billion. This is a continuation of the program we began last year for the preservation and enhancement of our existing plant. As you will recall, last year we started this program out at a $9 million level and this request for $14 million is the second increment of this program. It broadly breaks out into the rehabilitation of our utility systems, a continuation of our program to improve fire protection and detection, the rehabilitation of certain special facilities, general-purpose build-

ings, roads and roofs and some line items for the replacement of old boilers in our heating plants and steam generation systems at our older laboratories.

CAPITALIZED VALUE OF FACILITIES

Mr. EVINS. You have a table in volume 1 showing the capitalized value of your facilities. Place page SA 3 in the record at this point.

(The page follows:)

CAPITALIZED VALUE OF NASA'S FACILITIES
AS OF JUNE 30, 1969
(IN-HOUSE AND CONTRACTOR-HELD FACILITIES)
(DOLLARS IN THOUSANDS)

Reporting Installation	Land	Buildings	Other Structures and Facilities	Leasehold Improvements	Equipment	Fixed Assets in Progress	Total
OFFICE OF MANNED SPACE FLIGHT							
Kennedy Space Center	$ 71,018	$ 281,739	$ 423,552	$ -	$ 81,348	$101,215	$ 958,872
Western Test Range Operation Div.	-	-	-	-	3,464	-	3,464
Various Locations (Contractor-Held)	-	-	-	-	84,957	-	84,957
Manned Spacecraft Center	5,459	131,558	28,712	-	177,748	15,852	359,329
White Sands Test Facility	-	8,976	17,754	-	4,035	1,205	31,970
Various Locations (Contractor-Held)	3,570	24,415	5,142	8	48,303	-	81,438
Marshall Space Flight Center	95	109,762	45,238	93	194,893	3,861	353,942
Michoud Assembly Facility	7,504	63,220	25,039	-	40,998	-	136,761
Mississippi Test Facility	19,729	64,716	166,900	-	23,677	1,181	276,203
Sidell Computer Facility	63	4,446	823	-	5,097	-	10,429
Various Locations (Contractor-Held)	3,491	27,046	38,739	23	83,038	14,010	166,347
Total	$110,929	$ 715,878	$ 751,899	$124	$ 747,558	$137,324	$2,463,712
OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY							
Ames Research Center	$ 2,372	$ 167,099	$ 2,987	$ -	$ 58,434	$ 4,510	$ 235,402
Various Locations (Contractor-Held)	-	47	-	1	2,377	-	2,425
Electronics Research Center	1,384	-	4	-	20,341	14,713	36,442
Various Locations (Contractor-Held)	-	-	-	-	272	-	272
Flight Research Center	-	7,658	2,135	-	36,650	595	47,038
Various Locations (Contractor-Held)	-	-	-	-	94	-	94
Langley Research Center	110	106,180	134,424	-	111,395	19,370	371,479
Various Locations (Contractor-Held)	6	15,217	25	-	3,180	-	18,428
Lewis Research Center	310	110,301	39,240	140	57,349	9,979	217,319
Plum Brook Station	1,287	74,746	17,728	-	10,252	7,069	111,082
Various Locations (Contractor-Held)	99	4,240	4,007	5	32,369	10,314	51,034
Space Nuclear Propulsion Office	-	18,957	6,917	-	3,987	17	29,878
Various Locations (Contractor-Held)	-	-	-	-	20,146	232	20,378
Total	$ 5,568	$ 504,445	$ 207,467	$146	$ 356,846	$ 66,799	$1,141,271
OFFICE OF SPACE SCIENCE AND APPLICATIONS							
Goddard Space Flight Center	$ 1,205	$ 68,626	$ 11,681	$297	$ 182,616	$ -	$ 264,425
*Tracking Stations	339	17,305	41,839	-	201,326	-	260,809
Various Locations (Contractor-Held)	-	88	45	4	37,960	-	38,097
Jet Propulsion Laboratory	1,067	44,012	6,563	414	79,515	-	131,571
Tracking Stations (Deep Space Net.)	-	9,160	21,403	-	31,291	-	61,854
Wallops Station	986	21,423	41,629	-	34,954	2,809	101,801
Various Locations (Contractor-Held)	-	2,544	270	-	3,906	-	6,720
NASA Pasadena Office	-	-	-	-	11	-	11
Total	$ 3,597	$ 163,158	$ 123,430	$715	$ 571,579	$ 2,809	$ 865,288
OTHER							
Headquarters	$ -	$ -	$ -	$ -	$ 6,627	$ -	$ 6,627
Various Locations (Contractor-Held)	-	-	-	-	8,240	-	8,240
Total	$ -	$ -	$ -	$ -	$ 14,867	$ -	$ 14,867
Grand Total	$120,094	$1,383,481	$1,082,796	$985	$1,690,850	$206,932	$4,485,138

* Includes capital type facilities of the MSF and STADA networks and other supporting activities including equipment aboard ships and aircraft.

Mr. EVINS. How much, percentagewise, is this $34.6 million of the $4.5 billion total investment? How much is rehabilitation when compared with the total investment?

General CURTIN. Something less than half of 1 percent is a calculated figure.

Dr. LOW. $14 million for rehabilitation is less than one-quarter of 1 percent of the total capital investment.

DEFERRING REHABILITATION

Mr. EVINS. The Michoud Facility, which you are phasing out, can be deferred and the Mississippi Test Facility can be deferred; $250,000 and $375,000 respectively.

General CURTIN. No, sir; Mr. Chairman. I would like to speak to those if I may.

At Mississippi Test we have a high pressure gas system that services the test areas there. This high pressure gas system represents an investment of something on the order of $30 million and this work should be done in order to preserve that system for any potential followon use of the test area.

What I am really suggesting is that if we have confidence that the test area will be used in the future, it makes good business sense to do this work at this time.

Our estimate is if the work is not done and the system has to be reactivated, even in such a short period as 2 to 4 years, it would cost us something on the order of $3 million to $4 million to reactivate it.

Mr. EVINS. What about this $8 million expenditure at the Kennedy Space Center, Western Test Range?

You have spent $4.6 million through last year and you want $3.3 million in 1971.

General CURTIN. That is right. Those are alterations to the complex The $4.6 million relates to several prior years' expenditures, Mr. Chairman, going back into the 1965–66–67 time frame, and to the work that has been done at the space launch complex No. 2 at the Western Test Range. This year we are asking $3.3 million for the improvement of the launch complex 2 west, the west complex, to improve safety and operational efficiency as well as certain requirements related to launch vehicle needs.

FUTURE FUNDING

Mr. EVINS. What is the projected funding after 1971?

General CURTIN. This will depend to a large extent as to what the launch schedules will firm up as. As you realize, we have an east stand as well as this west stand. The east stand is in extremely poor condition. It may be that in subsequent years the launch schedules will require the activation and use of both stands. In this eventuality, we would either have to do extensive modifications on the east stand or replace it completely, depending on what the engineering analysis at that time shows.

FACILITY IN SANTIAGO

Mr. EVINS. You are requesting $525,000 for relocation of a transportable facility in Santiago, Chile.

General CURTIN. This is $525,000, Mr. Chairman, to relocate a unified S-Band transportable facility. It is now in the Grand Bahama Islands and it is to go to Santiago, Chile, to support the Skylab project in the late 1972 time frame. Existing equipment at Grand Bahamas will be relocated under this project. This relocation is required to meet the operational needs of the program.

Santiago has at the present time an existing station there and it was also chosen because it is the southernmost station in South America that provides us the sort of coverage needed.

FACILITY PLANNING AND DESIGN

Mr. EVINS. We will turn to "Facility planning and design" and place pages CF 9–1 through CF 9–3 in the record.

(The pages follow:)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

INSTALLATION SUMMARY

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1971 BUDGET ESTIMATES

(Dollars in thousands)

NASA INSTALLATION		COGNIZANT PROGRAM OFFICE FOR INSTALLATION
A11		Office of Organization and Management
LOCATION OF INSTALLATION	COUNTY	NEAREST CITY
---	---	---

INSTALLATION MISSION

PROJECT LINE ITEM	COGNIZANT OFFICE	FY 1959 THRU CURRENT YR	FY 1971 (Estimated)	FUTURE YEARS (Estimated)	TOTAL ALL YEARS (Estimated)
Facility Planning and Design	O&M	59,131	5,000		Not Applicable
TOTAL			5,000		

NASA FORM 1029 JUN 68 PREVIOUS EDITIONS ARE OBSOLETE.

CF 9-1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1971 ESTIMATES

Facility Planning And Design

The funds requested are to provide for the following advance planning and design activities related to facilities projects:

a. Preparation of preliminary engineering reports, cost estimates, and design and construction schedules.

b. Preparation of preliminary plans and specifications as well as final construction contract plans, specifications and associated cost estimates and schedules.

c. Necessary development and master planning for field installations.

d. Special facilities siting and other investigations, facilities methodology and other studies, and facilities reports.

The $5 million request for facility planning and design for FY 1971 is made up of two major segments:

a. Regular requirements - $3,500,000

b. Special requirements - $1,500,000

Regular requirements encompass the basic purposes outlined above while special requirements cover special needs which are related to large, complex future potential projects on which significant planning work should be accomplished prior to its inclusion in a budget request and for which planning lead time is exceptionally long.

Regular Requirements

a. Necessary updating of the development and master plans for field installations and special facilities studies investigations and reports is required. Charter plans are revised on an average of once every three years for each installation, with about one-third of the installations being involved in any one fiscal year. $200,000

b. Preparation of preliminary engineering reports, investigations and studies related to proposed facilities projects to be included in the subsequent FY 1973 Construction of Facilities program are provided for by this amount. These reports are required to permit the early and timely development of the best project required to meet the stated functional need and to provide the related basic data, cost estimates and schedules related to any such future budgetary proposals.	$700,000
c. The amount requested will provide for the preparation of design, plans, drawings and specifications necessary for the accomplishment of the subsequent FY 1972 Construction of facilities program.	2,600,000
Subtotal, Regular Requirements:	$3,500,000

Special Requirements

These special facilities planning and design requirements are generated by potential future projects, large in size and of a complex nature. These may be associated with future engine or space vehicles or such testing needs at the NERVA Engine/Stage Test Stand #2 proposed for the Nuclear Rocket Development Station, Nevada. These and like project needs require a long planning cycle. Early and progressive design work is essential to insure the ultimate best design, cost estimates and schedules. These projects then require added planning effort and associated design lead time well beyond that normally associated with preliminary engineering reports and general type facilities projects. For this reason, these requirements must be provided for over and above the regular facility planning and design needs.

Subtotal, Special Requirements:	$1,500,000
Total, Facility Planning and Design	$5,000,000

REGULAR VS. SPECIAL REQUIREMENTS

Mr. EVINS. You break this down into regular requirements and special requirements. That does not tell us much.

General CURTIN. Our regular requirements in this area——as you know, facility planning is a long lead time endeavor. The regular requirements associate themselves with, you might say, our normal needs. The $3.5 million figure is the level that was appropriated last year and we feel it is adequate for the coming year.

The special needs, however, relate to large, unique facilities on which some preliminary work must be done.

Let's go back to the test stand in Nevada we were talking about, the $48 million project. At the moment now we only have a very preliminary engineering analysis on this and it is just good business sense to proceed now and make additional studies and start preliminary design on this particular item so that we can properly analyze the cost tradeoffs and other factors involved. Otherwise, when we prepare budget estimates, we have only a very preliminary feeling of what the cost may be. It is our opinion—and I am sure you share it—that we should have fairly substantial documentation of these cost estimates before putting them in a program.

QUESTION OF PRIORITY

Mr. EVINS. General Curtin, if you were sitting on this side of the table and you had to set a priority, how would you do it? Which one of these is the most important?

General CURTIN. I would say the importance of these projects, the planning and design, is right up at the top of the list, Mr. Chairman. It is an extremely valuable activity and in my judgment——

Mr. EVINS. I am talking about overall. Planning and design is important, but of the $34.6 million how much can be deferred?

General CURTIN. In there, not a nickel, Mr. Chairman, and I say that sincerely. As I indicated, to you before, we started out with $350 million worth of projects and they have been boiled down. All of the 11 projects we have are time sensitive. The modification-rehabilitation program is just keeping our head above water and preserving and protecting our plant. The facilities planning and design is a very modest amount compared to the requirements in terms of space shuttle, in terms of the NRDS facilities and other large facilities that the agency will be facing up to.

Mr. EVINS. General, you are a good advocate.

RESEARCH AND PROGRAM MANAGEMENT

We will turn to volume IV, "Research and program management."

Mr. Reporter, place in the record the budget schedules and pages SUM–1 through SUM–10.

(The material follows:)

Program and Financing (in thousands of dollars)

Identification code 27-00-0103-0-1-250	Budget plan			Costs and obligations		
	1969 actual	1970 estimate	1971 estimate	1969 actual	1970 estimate	1971 estimate
Program by activities:						
Direct program:						
1. Manned space flight	320,000	328,900	334,100	320,600	331,200	334,700
2. Scientific investigations in space	77,700	87,700	85,700	78,300	87,400	85,800
3. Space applications	21,000	23,700	27,200	21,100	23,600	27,000
4. Space technology	121,200	124,400	122,000	119,100	125,400	122,700
5. Aviation technology	73,400	85,100	83,500	78,500	84,800	82,700
6. Supporting activities	34,664	38,601	39,800	34,722	38,400	39,400
Total direct program costs, funded	647,964	688,401	692,300	652,322	690,800	692,300
Reimbursable program:						
1. Manned space flight	1,342	1,898	1,775	1,250	1,898	1,775
3. Space applications	977	1,733	1,356	894	1,733	1,356
4. Space technology	481	569	569	460	569	569
Total reimbursable program costs	2,800	4,200	3,700	2,604	4,200	3,700
Total program costs, funded	650,764	692,601	696,000	654,926	695,000	696,000
Change in selected resources [1]				−4,162	−2,399	
10 Total	650,764	692,601	696,000	650,764	692,601	696,000
Financing:						
Receipts and reimbursements from:						
11 Federal funds				−2,544	−3,744	−3,360
14 Non-Federal sources [2]				−256	−456	−340
17 Recovery of prior year obligations				−1,235		
23 Unobligated balance transferred to other accounts				1,235		
25 Unobligated balance lapsing				147		
Budget authority				648,111	688,401	692,300
Budget authority:						
40 Appropriation				603,173	637,400	692,300
41 Transferred to other accounts				−280	−474	
42 Transferred from other accounts				45,218	9,708	
43 **Appropriation (adjusted)**				648,111	646,634	692,300
44.20 **Proposed supplemental for civilian pay act increase**					41,767	
Relation of obligations to outlays:						
71 Obligations incurred, net				646,729	688,401	692,300
72 Obligated balance, start of year				86,373	75,407	84,408
74 Obligated balance, end of year				−75,407	−84,408	−83,708
77 Adjustments in expired accounts				−1,475		
90 Outlays, excluding pay increase supplemental				656,220	640,000	690,633
91.20 Outlays from civilian pay act supplemental					39,400	2,367

[1] Selected resources as of June 30 are as follows:

	1968	1969 adjusted	1969	1970	1971
Unpaid undelivered orders	35,806	−2,546	29,259	26,860	26,860
Advances	342		181	181	181
Total selected resources	36,148	−2,546	29,440	27,041	27,041

[2] Reimbursements from non-Federal sources are receipts for services performed on Communications Satellite Corporation projects (42 U.S.C. 2473) and for personal property sold for replacement purposes (40 U.S.C. 481).

Object Classification (in thousands of dollars)

Identification code 27-00-0103-0-1-250		1969 actual	1970 est.	1971 est.
	Direct obligations:			
	Personnel compensation:			
11.1	Permanent positions	411,766	458,952	455,140
11.3	Positions other than permanent	5,097	5,531	5,163
11.5	Other personnel compensation	7,504	7,365	7,066
11.8	Special personal service payments	3,531	3,961	3,907
	Total personnel compensation	427,898	475,809	471,276
12.1	Personnel benefits: Civilian employees	32,564	37,185	39,311
13.0	Benefits for former personnel	286	24	1,460
21.0	Travel and transportation of persons	15,633	18,408	19,874
22.0	Transportation of things	3,706	3,953	3,668
23.0	Rent, communications, and utilities	45,025	44,704	44,308
24.0	Printing and reproduction	6,649	6,120	5,939
25.0	Other services	93,575	84,972	89,568
26.0	Supplies and materials	15,624	13,520	13,223
31.0	Equipment	5,328	2,370	2,239
32.0	Lands and structures	1,554	1,250	1,350
41.0	Grants, subsidies, and contributions	44	54	54
42.0	Insurance claims and indemnities	78	32	30
	Total direct obligations	647,964	688,401	692,300
	Reimbursable obligations:			
11.1	Personnel compensation: Permanent positions	572	882	581
12.1	Personnel benefits: Civilian employees	31	44	28
21.0	Travel and transportation of persons	80	166	115
22.0	Transportation of things	21	17	17
23.0	Rent, communications, and utilities	892	1,033	1,027
25.0	Other services	791	1,125	1,112
26.0	Supplies and materials	350	800	799
31.0	Equipment	7	21	21
32.0	Lands and structures	56	112	----------
	Total reimbursable obligations	2,800	4,200	3,700
99.0	Total obligations	650,764	692,601	696,000

Personnel Summary

Total number of permanent positions	31,745	31,350	30,550
Full-time equivalent of other positions	934	928	874
Average number of all employees	32,967	32,429	31,441
Average GS grade	10.9	11.0	11.1
Average GS salary	$13,473	$15,078	$15,293
Average salary, grades established by the Administrator, NASA	$8,811	$9,856	$10,212
Average salary of ungraded positions	$27,405	$30,364	$30,371

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

RESEARCH AND PROGRAM MANAGEMENT

GENERAL STATEMENT

The Research and Program Management appropriation includes funding for research in Government laboratories, management of programs and other activities of the National Aeronautics and Space Administration. Principally, these are to:

Provide the civil service staff necessary for in-house research, and to plan, manage, and support the Research and Development programs.

Provide other elements of operational capability to the laboratories and facilities such as general purpose computer capability, logistics support including travel and transportation, maintenance and operation of facilities, and technical and administrative support.

The following table summarizes the distribution of the Research and Program Management appropriation by installation:

SUMMARY OF OBLIGATIONS BY INSTALLATION

	Fiscal Year 1969	Fiscal Year 1970	Fiscal Year 1971
MANNED SPACE FLIGHT.....	$310,968,000	$323,688,000	$330,583,000
John F. Kennedy Space Center, NASA.....	95,794,000	97,445,000	98,150,000
Manned Spacecraft Center.....	98,840,000	104,546,000	107,758,000
Marshall Space Flight Center....	116,334,000	121,697,000	124,675,000
SPACE SCIENCE AND APPLICATIONS....	$82,329,000	$94,317,000	$97,461,000
Goddard Space Flight Center.....	73,227,000	84,772,000	87,670,000
Wallops Station.....	9,102,000	9,545,000	9,791,000

	Fiscal Year 1969	Fiscal Year 1970	Fiscal Year 1971
ADVANCED RESEARCH AND TECHNOLOGY..	$193,890,000	$208,578,000	$201,521,000
Ames Research Center.....	34,032,000	36,359,000	38,248,000
Electronics Research Center.....	17,237,000	19,483,000	4,470,000
Flight Research Center.....	9,697,000	10,131,000	10,549,000
Langley Research Center.....	62,945,000	67,973,000	70,734,000
Lewis Research Center.....	67,844,000	72,398,000	75,218,000
Space Nuclear Propulsion Office.	2,135,000	2,234,000	2,302,000
SUPPORTING OPERATIONS			
NASA Headquarters.....	$60,777,000	$61,818,000	$62,735,000
TOTAL.....	$647,964,000	$688,401,000	$692,300,000

The Research and Program Management appropriation request is subdivided into six functional categories, as follows:

1. Personnel Related Costs are comprised of salaries and benefits for civil service personnel, over 70% of whom are technical, and for personnel of other government agencies detailed to NASA. Costs in this category also include supporting personnel costs, i.e., the cost of moving expenses, as provided by law, the cost of recruiting and personnel investigation services provided by the Civil Service Commission, and personnel training.

2. Travel includes the cost of transportation, per diem and related expenses of travel required for direction, coordination, and management of research and development and construction of facilities program activities, for contract management and flight mission support; overseas travel to launch and tracking sites; and travel to meetings and technical seminars.

3. Automatic Data Processing includes the cost of the lease, purchase, and maintenance of equipment, and the cost of providing contract services for programming and operations for general purpose computer capability.

4. Facilities Services includes the cost of leasing research laboratories and facilities, minor construction, maintenance and related services, custodial services, facility operations, and range operations at the John F. Kennedy Space Center, NASA.

5. Technical Services includes the cost of certain engineering services, the dissemination of scientific and technical information derived from the technology utilization program, and the operation of educational and program activities.

6. Administrative Support includes the cost of communications, administrative printing, administrative supplies, materials and equipment, transportation support, and other support services.

The following summary table indicates the distribution of the total appropriation requirements by functional category:

Function	1969	1970	1971
Personnel related costs.....	$463,675,000	$516,175,000	$515,108,000
Travel.....	14,003,000	16,712,000	18,200,000
Automatic data processing...	23,808,000	21,548,000	22,710,000
Facilities services.....	85,841,000	80,872,000	84,083,000
Technical services.....	18,026,000	15,272,000	14,327,000
Administrative support.....	42,611,000	37,822,000	37,872,000
Total.....	$647,964,000	$688,401,000	$692,300,000

Installations are under the management direction of the Associate Administrator having primary responsibility for the research and development programs conducted at the installation. The Associate Administrator for Manned Space Flight is responsible for the Kennedy Space Center, Manned Spacecraft Center, and Marshall Space Flight Center; the Associate Administrator for Space Science and Applications is responsible for the Goddard Space Flight Center and Wallops Station; and the Associate Administrator for Advanced Research and Technology is responsible for the Ames Research Center, Flight Research Center, Langley Research Center, Lewis Research Center, and the Space Nuclear Propulsion Office. The Electronics Research Center will be closed in 1971. The Associate Administrator for Organization and Management is the institutional director for NASA Headquarters.

1970 OPERATING BUDGET

The budget request for 1970 for Research and Program Management was $650,900,000. Final Congressional action reduced both the authorization and appropriation to $637,400,000. After careful consideration of the effects of several alternatives on the NASA program of operating at this level, it was NASA's judgment that the level of R&PM must be increased to $643,750,000 through a reprogramming action.

In addition to the reprogramming of $6,350,000 to meet the minimum operating requirements of the agency, $3,020,000 is required to provide cost increases as a result of legislative actions increasing (a) the government's contribution for civil service retirement and (b) the level of per diem paid Federal employees while on travel status. A final

reprogramming of $338,000 will result from a decision to transfer to NASA 50 civilian employees of the Air Force, whose cost is now reimbursed from NASA R&D funds and who perform inspection and reliability functions for NASA at Seal Beach and Downey, California. These increases to the R&PM appropriation have been partially offset by an appropriation transfer of $474,000 to the General Services Administration for the rental of buildings for the Goddard Institute of Space Studies in New York.

To provide for the costs of the final increment of the Federal Employees Pay Act of 1967, which was effective in July 1969, NASA is to be included in a government-wide supplemental appropriation for a total of $41,767,000. With the reprogramming, and supplemental appropriation, as partially offset by the transfer to GSA, the NASA 1970 operating plan for R&PM is $688,401,000. The following table summarizes the development of the 1970 operating budget:

Appropriation	$637,400,000
Increase to minimum operating level	+6,350,000
Subtotal	$643,750,000
Reprogramming for the increase in the government's contribution for civil service retirement	+1,154,000
Reprogramming for the increase in per diem rates	+1,866,000
Reprogramming for the transfer of 50 Air Force civil service employees to NASA	+338,000
Proposed supplemental for civilian pay act increase	+41,767,000
Subtotal	$688,875,000
Transfer to GSA	-474,000
Planned FY 1970 program level	$688,401,000

Concerning civil service manpower NASA planned, in the 1970 budget as submitted to Congress, an end year 1970 employment level of 31,600. This level represented a gross reduction of 452 positions from the planned end year 1969 level, partially offset by planned increases of 56 at the Electronics Research Center and 251 at the Goddard Space Flight Center for the final increment for the conversion of certain functions formerly carried on through support service contracts to civil service operation. The net reduction planned in 1970 was 145.

During 1970, NASA was directed as part of the government-wide reduction in personnel to reduce its end year 1970 employment level by an additional 300. This reduction was partially offset by the transfer to NASA of 50 civil service employees from the Air Force. These employees have been performing inspection and reliability functions for NASA at Seal Beach and Downey, California, industrial plants for several years. The net result of these actions is to reduce the planned end year 1970 employment level to 31,350.

During the 1971 budget process the decision was made to discontinue operations at the Electronics Research Center. The 600 positions shown in the budget for 1970 are required to close the center, dispose of property, and plan and assist in the transfer of continuing research and technology effort. These positions will be vacated shortly after June 30, 1970. Some R&PM costs are carried for ERC in 1971 as required for the closing of the center and the program transfer.

1971 BUDGET ESTIMATE

The 1971 budget estimate is based on a continuation of the basic operating level established in 1970. The reduction in costs associated with the phasing out of ERC is offset by the full year costs of legislation passed during 1970 (increases in the rate for civil service retirement contributions and per diem allowances), the full year costs of the final increment of the conversion of certain functions carried on through support services contracts to civil service performance at Goddard Space Flight Center, the full year costs of certain increases in personnel costs for the remainder of NASA, the provision for twelve months funding of support services contracts currently in effect, and the provision for increased man year cost rates for such contracts.

For civil service manpower, NASA plans an end year complement of 30,550 in 1971, a decrease of 800 from the planned end year 1970 level. The reductions will be as follows:

Final close out of the Electronics Research Center...	-600
Reductions at Other Installations:	
Headquarters.....	-50
Kennedy Space Center.....	-31
Manned Spacecraft Center.....	-50
Marshall Space Flight Center.....	-69
Total reductions.....	-800

The following table distributes civil service positions by installation:

NUMBER OF PERSONNEL POSITIONS

	Fiscal Year 1969	Fiscal Year 1970	Fiscal Year 1971
MANNED SPACE FLIGHT.....	13,410	13,033	12,883
John F. Kennedy Space Center, NASA.....	2,877	2,779	2,748
Manned Spacecraft Center.....	4,384	4,250	4,200
Marshall Space Flight Center....	6,149	6,004	5,935
SPACE SCIENCE AND APPLICATIONS....	4,625	4,900	4,900
Goddard Space Flight Center.....	4,141	4,412	4,412
Wallops Station.....	484	488	488
ADVANCED RESEARCH AND TECHNOLOGY..	11,617	11,294	10,694
Ames Research Center.....	1,992	1,972	1,972
Electronics Research Center.....	802	600	---
Flight Research Center.....	539	535	535
Langley Research Center.....	3,912	3,872	3,872
Lewis Research Center.....	4,268	4,215	4,215
Space Nuclear Propulsion Office.	104	100	100
SUPPORTING OPERATIONS			
NASA Headquarters.....	2,093	2,123	2,073
TOTAL PERMANENT POSITIONS.....	31,745	31,350	30,550
POSITIONS OTHER THAN PERMANENT.....	2,196	2,300	2,300
TOTAL POSITIONS.....	33,941	33,650	32,850

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1971 ESTIMATES

RESEARCH AND PROGRAM MANAGEMENT

DISTRIBUTION OF OBLIGATIONS BY FUNCTION
BY INSTALLATION
(Thousands of dollars)

FUNCTION	Total NASA	Subtotal OMSF	J. F. Kennedy Space Center, NASA	Manned Spacecraft Center	Marshall Space Flight Center	Subtotal OSSA	Goddard Space Flight Center	Wallops Station	Subtotal OART	Ames Research Center	Electronics Research Center	Flight Research Center	Langley Research Center	Lewis Research Center	Space Nuclear Propulsion Office	Headquarters
Personnel																
1969	$463,675	$204,076	$43,325	$69,285	$91,466	$61,853	$56,252	$5,601	$159,744	$28,477	$11,979	$7,522	$51,899	$57,987	$1,880	$38,002
1970	516,175	222,000	46,630	76,307	99,063	74,994	68,728	6,266	177,252	31,059	13,847	8,221	57,744	64,351	2,030	41,929
1971	515,108	222,019	46,161	77,173	98,685	77,409	70,929	6,480	173,027	32,385	3,670	8,503	59,269	67,111	2,089	42,653
Travel																
1969	14,003	6,247	566	3,562	2,119	1,782	1,665	117	3,435	696	321	200	1,134	898	188	2,539
1970	16,712	7,395	811	4,177	2,407	2,422	2,265	157	3,760	736	351	219	1,237	1,013	204	3,135
1971	18,200	7,854	874	4,463	2,517	2,759	2,584	175	4,325	921	200	234	1,669	1,088	213	3,262
Automatic Data Processing																
1969	23,808	12,453	1,044	5,501	5,908	6,066	5,987	79	2,953	324	1,206	58	933	432	---	2,336
1970	21,548	13,884	943	5,741	7,198	5,104	5,042	62	1,001	115	590	9	240	47	---	1,559
1971	22,710	14,915	943	5,930	8,042	5,788	5,723	65	433	115	---	9	256	53	---	1,574
Facilities Services																
1969	85,841	58,304	39,649	10,278	8,377	7,097	4,825	2,272	20,013	3,659	1,822	1,257	6,394	6,881	---	427
1970	80,872	54,551	38,559	8,825	7,167	6,684	4,472	2,212	19,311	3,696	2,317	1,072	6,116	6,110	---	326
1971	84,083	59,469	39,933	10,195	9,341	6,253	4,048	2,205	18,035	4,073	100	1,118	6,749	5,995	---	326
Technical Services																
1969	18,026	3,583	---	1,956	1,627	1,018	967	51	1,831	41	866	47	73	737	67	11,594
1970	15,272	3,694	---	2,317	1,377	860	801	59	1,172	9	981	73	73	36	---	9,546
1971	14,327	3,734	---	2,275	1,459	854	796	58	249	9	---	77	73	90	---	9,490
Administrative Support																
1969	42,611	26,305	11,210	8,258	6,837	4,513	3,531	982	5,914	837	1,043	613	2,512	909	---	5,879
1970	37,822	22,164	10,502	7,177	4,485	4,253	3,464	789	6,082	744	1,397	537	2,563	841	---	5,323
1971	37,872	22,592	10,239	7,722	4,631	4,398	3,590	808	5,452	745	500	608	2,718	881	---	5,430
Total																
1969	647,964	310,968	95,794	98,840	116,334	82,329	73,227	9,102	193,890	34,032	17,237	9,697	62,945	67,844	2,135	60,777
1970	688,401	323,688	97,445	104,546	121,697	94,317	84,772	9,545	208,578	36,359	19,483	10,131	67,973	72,398	2,234	61,818
1971	692,300	330,583	98,150	107,758	124,675	97,461	87,670	9,791	201,521	38,248	4,470	10,549	70,734	75,218	2,302	62,735

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1971 ESTIMATES

RESEARCH AND PROGRAM MANAGEMENT

DISTRIBUTION OF OBLIGATIONS BY OBJECT CLASSIFICATION BY FUNCTION

(Thousands of Dollars)

Object Classification	Total NASA	Personnel	Travel	Automatic Data Processing	Facilities Services	Technical Services	Administrative Support
Fiscal Year 1969							
Personnel compensation	$427,898	$427,898	---	---	---	---	---
Personnel benefits	32,564	32,564	---	---	---	---	---
Benefits for former personnel	286	286	---	---	---	---	---
Travel & transp. of persons	15,633	150	$14,003	---	---	---	$1,480
Transportation of things	3,706	387	---	---	---	$156	3,163
Rents, communications, and utilities	45,025	---	---	$12,599	$18,823	---	13,603
Printing and reproduction	6,649	---	---	---	1	534	6,114
Other services	93,575	2,385	---	9,043	55,964	16,324	9,859
Supplies and materials	15,624	---	---	---	7,885	503	7,236
Equipment	5,328	5	---	2,157	1,616	509	1,043
Lands and structures	1,534	---	---	---	1,534	---	---
Grants, subsidies and contributions	44	---	---	9	---	---	35
Insurance claims and indemnities	78	---	---	---	---	---	78
Totals	$647,964	$463,675	$14,003	$23,808	$85,841	$18,026	$42,611
Fiscal Year 1970							
Personnel compensation	$475,809	$475,809	---	---	---	---	---
Personnel benefits	37,185	37,185	---	---	---	---	---
Benefits for former personnel	24	24	---	---	---	---	---
Travel & transp. of persons	18,408	220	$16,712	---	---	---	$1,476
Transportation of things	3,953	424	---	---	---	$95	3,434
Rents, communications, and utilities	44,704	---	---	$12,338	$19,237	2	13,127
Printing and reproduction	6,120	---	---	---	3	539	5,578
Other services	84,972	2,513	---	9,189	52,229	13,840	7,221
Supplies and materials	13,520	---	---	---	6,959	447	6,114
Equipment	2,370	---	---	35	1,194	349	792
Lands and structures	1,250	---	---	---	1,250	---	---
Grants, subsidies and contributions	54	---	---	---	---	---	54
Insurance claims and indemnities	32	---	---	6	---	---	26
Totals	$688,401	$516,175	$16,712	$21,568	$80,872	$15,272	$37,822
Fiscal Year 1971							
Personnel compensation	$471,276	$471,276	---	---	---	---	---
Personnel benefits	39,311	39,311	---	---	---	---	---
Benefits for former personnel	1,460	1,460	---	---	---	---	---
Travel & transp. of persons	19,874	208	$18,200	---	---	---	$1,466
Transportation of things	3,668	416	---	---	---	$95	3,157
Rents, communications, and utilities	44,308	---	---	$13,017	$18,248	---	13,043
Printing and reproduction	5,939	---	---	---	---	475	5,464
Other services	89,568	2,437	---	9,693	56,286	13,293	7,859
Supplies and materials	13,223	---	---	---	7,035	199	5,989
Equipment	2,239	---	---	---	1,164	265	810
Lands and structures	1,350	---	---	---	1,350	---	---
Grants, subsidies and contributions	54	---	---	---	---	---	54
Insurance claims and indemnities	30	---	---	---	---	---	30
Totals	$692,300	$515,188	$18,200	$22,710	$84,083	$14,327	$37,872

SUM 8

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
FISCAL YEAR 1971 ESTIMATES
RESEARCH AND PROGRAM MANAGEMENT
DISTRIBUTION OF PERSONNEL BY OBJECT CLASSIFICATION
(Thousands of dollars)

Object Classification	Total R&RM	Subtotal ORDP	J. F. Kennedy Space Center, NASA	Manned Spacecraft Center	Marshall Space Flight Center	Subtotal OSSA	Goddard Space Flight Center	Wallops Station	Subtotal OAST	Ames Research Center	Electronics Research Center	Flight Research Center	Langley Research Center	Lewis Research Center	Space Nuclear Propulsion Office	OSSWA
FISCAL YEAR 1969																
Personnel compensation	427,868	188,717	48,581	44,179	84,384	57,074	51,941	5,133	143,770	26,446	11,011	6,957	47,837	53,743	1,494	34,335
Personnel benefits	32,344	14,032	3,913	4,730	4,387	4,307	3,911	396	11,263	1,995	820	521	3,684	4,244	179	2,963
Benefits to former personnel	286	155	---	---	155	---	---	---	25	---	---	---	---	23	---	108
Travel & transportation of persons	15,653	7,709	1,730	3,769	2,210	1,901	1,710	191	3,441	713	221	201	1,134	894	189	2,562
Transportation of things	3,706	1,933	1,693	356	84	1,111	990	121	287	21	54	34	193	181	4	275
Rents, communications, and utilities	45,025	21,991	7,903	8,005	6,183	8,372	7,935	437	11,958	3,063	2,118	206	3,818	3,779	---	2,706
Printing and reproduction	6,849	4,811	3,226	885	300	183	123	59	413	4	68	7	262	70	---	1,443
Other services	93,575	60,767	32,725	14,111	13,931	1,625	1,327	1,298	12,964	1,289	2,363	1,408	4,236	3,699	69	14,230
Supplies and materials	15,434	8,869	4,412	2,275	2,182	2,055	1,064	991	4,157	433	580	217	2,134	953	---	963
Equipment	5,338	1,293	861	191	241	1,374	933	353	1,231	40	196	94	423	474	---	1,536
Lands and structures	1,154	875	475	358	42	423	301	121	254	1	---	72	183	---	---	---
Grants, subsidies & contributions	44	---	---	---	---	---	---	---	9	9	---	---	---	---	---	35
Insurance claims and indemnities	78	14	13	---	1	1	1	---	18	---	---	---	1	17	---	45
Totals	647,984	310,968	95,796	88,860	114,336	82,529	71,227	9,302	193,990	34,032	17,157	9,697	62,965	67,966	2,135	60,773
FISCAL YEAR 1970																
Personnel compensation	475,909	201,018	42,993	70,631	91,392	48,034	43,332	3,362	183,786	28,835	12,695	7,409	53,187	59,611	1,867	37,931
Personnel benefits	37,185	15,907	3,343	5,363	7,101	3,363	4,930	433	13,719	2,170	986	567	4,213	4,811	180	3,436
Benefits for former personnel	34	---	---	---	---	---	---	---	34	---	---	---	---	---	---	---
Travel and transportation of persons	18,608	8,892	1,998	4,416	2,477	2,339	2,108	231	3,799	743	362	234	1,237	1,014	207	3,158
Transportation of things	3,913	1,917	1,481	356	80	1,108	981	127	997	32	360	15	210	100	---	331
Rents, communications, and utilities	44,704	22,300	7,325	8,190	6,675	7,865	7,438	427	12,471	3,105	1,998	176	3,695	3,500	---	3,060
Printing and reproduction	8,120	4,473	3,173	800	500	175	120	55	368	4	92	10	200	60	---	1,158
Other services	86,972	56,177	31,995	12,843	11,342	3,494	2,228	1,266	11,359	792	2,498	1,085	3,785	3,050	---	12,080
Supplies and materials	13,520	7,754	4,075	1,839	1,806	1,584	1,075	509	3,390	443	334	223	1,100	369	---	432
Equipment	2,370	723	364	200	179	412	200	212	918	207	137	84	278	200	---	317
Lands and structures	1,250	869	399	100	150	265	140	125	136	---	---	73	63	---	---	---
Grants, subsidies & contributions	54	---	---	---	---	---	---	---	7	6	---	1	---	---	---	47
Insurance claims and indemnities	32	18	18	1	1	---	---	---	4	---	---	---	3	1	---	8
Totals	688,401	323,688	97,643	104,564	121,687	96,217	86,772	9,345	258,578	36,339	19,681	10,131	67,971	72,398	2,254	61,858
FISCAL YEAR 1971																
Personnel compensation	471,376	206,321	42,496	71,390	90,735	71,333	65,409	5,924	157,281	29,751	3,000	7,853	54,218	61,614	1,881	38,361
Personnel benefits	39,311	16,128	3,562	5,681	7,305	5,310	5,025	485	13,753	2,604	210	673	4,709	5,252	592	3,930
Benefits for former personnel	1,660	---	---	---	---	---	---	---	1,660	---	1,660	---	---	---	---	---
Travel & transportation of persons	19,876	9,329	2,036	4,691	2,602	2,906	2,656	250	4,352	828	200	249	1,669	1,096	314	3,387
Transportation of things	3,668	1,895	1,660	356	99	1,327	1,100	127	359	33	---	14	210	100	---	187
Rents, communications, and utilities	44,308	22,395	7,480	8,260	6,675	8,718	8,290	428	10,033	3,384	100	184	3,845	3,990	---	3,162
Printing and reproduction	5,939	4,343	3,063	800	500	172	120	52	364	4	---	10	270	60	---	1,050
Other services	89,568	62,781	33,693	14,840	14,429	4,962	3,630	1,332	9,438	864	500	1,343	4,101	3,050	---	12,186
Supplies and materials	13,223	7,679	4,060	1,739	1,900	2,056	1,100	956	3,110	482	---	252	2,127	369	---	380
Equipment	3,239	723	364	200	179	239	100	139	818	210	---	127	281	200	---	359
Lands and structures	1,350	750	400	100	250	240	140	100	360	---	---	79	281	---	---	---
Grants, subsidies & contributions	54	---	---	---	---	---	---	---	7	6	---	1	---	---	---	47
Insurance claims and indemnities	30	18	16	1	1	---	---	---	4	---	---	---	3	1	---	8
Totals	692,300	330,583	98,150	107,758	126,673	97,661	87,670	9,791	201,331	38,168	4,670	10,369	70,734	75,218	2,302	62,735

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1971 ESTIMATES

RESEARCH AND PROGRAM MANAGEMENT

ANALYSIS OF REQUIREMENTS FOR GOVERNMENT-OWNED PASSENGER-CARRYING MOTOR VEHICLES

The appropriation language provides for the acquisition of thirty-nine passenger motor vehicles, for replacement purposes only. All vehicles for replacement will meet the criteria established by the General Services Administration for replacement of vehicles due to age or mileage, or both of these factors.

A summary analysis of inventory transactions by type of vehicle in FY 1971 is as follows:

	Total	Medium Sedans	Other Sedans	Station Wagons	Ambulances	Buses
Planned fleet, July 1, 1970	183	-	50	101	13	19
Number to be purchased in FY 1971.....	39	-	13	26	-	-
Number of disposals planned:	-39	-	-5*	34	-	-
To be replaced by identical vehicle type.....	(31)	(-)	(5)	(26)	(-)	(-)
To be replaced by another vehicle type.....	(8)	(-)	(-)	(8)*	(-)	(-)
Planned fleet, June 30, 1971.....	183	-	58	93	13	19

* Eight station wagon disposals will be replaced with "Other Sedans."

The "Research and program management" appropriation includes funding for research in Government laboratories, management of programs and other activities of the National Aeronautics and Space Administration.

These are to provide for civil service staff necessary for in-house research, and to plan, manage and support the research and development programs.

IN-HOUSE RESEARCH VERSUS CONTRACT

Is it cheaper or more expensive to conduct in-house research or do it by contracts?

Dr. PAINE. I think the best system that we have evolved here, Mr. Chairman, is one in which about 10 percent or so of the NASA work is done in-house in the Government laboratories. We keep up our skills and ability to manage the rest of the 90 percent of the program most effectively.

Mr. EVINS. Ninety percent of your research is done by contract outside, 10 percent in-house. Is this about the picture?

Dr. PAINE. That is about it. Maybe 15 percent. I would have to look at the number for this year.

OBLIGATIONS BY INSTALLATION

Mr. EVINS. We have your summary of obligations by installations. Manned space flight was $310,968,000 in 1969, you have $323,688,000 in 1970, and you are requesting $330,583,000 in 1971.

Dr. PAINE. In general, Mr. Chairman, the numbers we are looking at here represent about 75 percent, the direct salaries and benefits of the personnel; 25 percent the other.

Mr. EVINS. Space science and applications was $82,329,000 in 1969; $94,317,000 in 1970 and $97,461.000 in 1971.

Advance research and technology goes up from $193,890,000 in 1969 to $201,521,000 in 1971.

The Electronics Research Center is estimated to be $4,470,000, down from $19,483,000 in 1970. In view of the transfer, will this $4,470,000 be needed?

Mr. LILLY. Yes, sir. To the best we can tell, our calculations on the $4,470,000, Mr. Evins, was to take care of that limited number of people required in closing up the installation, shipping out the equipment and things of this nature. The largest part of this money would go into personnel related costs, it would provide for severance pay in the amount of $1,460,000, and for compensation for that number of people we would have for about 3 months to wrap up the——

POSITIONS AT ERC

Mr. EVINS. How many positions did you have at the Electronics Research Center at the peak?

Mr. LILLY. The number of people on board at the peak I believe was right between 840 and 850.

Mr. EVINS. How many do you have at the present time?

Mr. LILLY. I believe we had 718 on board a couple of days ago.

Mr. EVINS. You haven't reduced the personnel much.

How many positions are being transferred?

Mr. LILLY. We are not transferring any positions, Mr. Evins. Some of the employees will be offered jobs at other NASA centers within existing ceilings.

Mr. EVINS. $4,470,000 is quite a sum of money to terminate them.

Mr. LILLY. It takes a number of people to close up and ship out the equipment, the moving, boxing, crating, and taking care of the records. It will take that amount of money, in our judgment, to close out the NASA interests in the facility.

Dr. PAINE. Our total investment there is about $50 million as you will recall, Mr. Chairman.

Mr. EVINS. We just got this fine, modern, high-rise building completed. We saw it develop from the ground up and now that we have it complete, we phase it out. This is wasteful, uneconomic Government operations.

Dr. PAINE. We are very pleased that the Department of Transportation has a need for it, Mr. Chairman. I had the unpleasant task of, when the paint was still wet on the auditorium walls, calling the staff together and telling them that NASA was phasing it out. But, as you recognize, with these very greatly reduced budgets, NASA's base had to be contracted.

Mr. BOLAND. Where would you get an installation as fine as this? This one is really built for research.

Dr. PAINE. It is the most modern in all of the NASA centers and really the best facility.

Mr. EVINS. You are apparently going to do a lot of research at Ames and at Langley.

Dr. PAINE. These are all prewar.

FUTURE OF RESEARCH IN ELECTRONICS

Mr. EVINS. Are you going to do some of the research that is now being done at ERC at the existing research centers?

Dr. PAINE. Not a great deal. By and large the closing down of the ERC also represents a contracting of the amount of electronic research we will be doing of a more basic type. These other centers will be doing work specifically aimed at their missions.

Mr. BOLAND. What type of research will the Department of Transportation be doing for NASA?

Dr. PAINE. Primarily they will be using this facility as a general purpose research facility. I understand they intend to add social scientists and other people who can understand the Nation's research needs in the field of transportation and will be reconverting people there now working in the field of electronics to those fields of electronics directly in support of this transportation.

Mr. EVINS. Have there been any facilities in NASA phased out, other than ERC?

Mr. LILLY. There are no facilities, sir, that we have phased out completely. We have been in a general phase down of a number of our facilities such as the Mississippi test facility and Michoud. Many of our centers have been phasing down considerably but none completely closed.

CHANGING LAUNCH SITES

Mr. EVINS. We notice in the press, considerable concern about the possibility of the long-range future of changing your launch centers from Kennedy to some other place where your space shuttles can land.

Do you want to tell us anything about your future planning, about any phasing out that might be in the picture?

Dr. PAINE. I could make a very brief statement on that. I believe these news reports are occasioned by the fact that in the era of the space shuttle it is not so important to us to fly across an ocean in which we can drop off the expendable stations as it has been in the past decade. We are taking a good hard look at where the obvious best places for launch and recovery of the space shuttle system will be.

This study, which is underway I think, caused these reports in the press that we are considering relocating. But with the tremendous investment we have at Kennedy, you can be very sure that we would certainly expect to continue operations there. This study I think is causing a good deal more press comment than is warranted.

FUTURE OF OTHER FACILITIES

Mr. LILLY. We have announced, however, that two of our test facilities, one at Mississippi test facility and one at Michoud, will start phasing out and be put into mothball condition——

Dr. PAINE. Not mothball, but standby.

Mr. LILLY. Standby, until or unless some other agency has use for it. NASA is working hard to try to help identify those who could use these facilities. The White Sands facility is in the same sort of status but would be phasing down about 6 months later unless new work is identified.

BREAKDOWN OF COSTS

Mr. EVINS. Research and Program Management is subdivided into six functions, personnel costs, travel, automatic data processing, facilities services, technical services and administrative support. Personnel related costs are about the same, but travel goes up from $14 million to $16.7 million to $18.2 million. Automatic data processing stays at about the same level and facilities services goes from $85.8 million in 1969, to $80.9 million in 1970, and up to $84 million in 1971.

Technical services was $18 million in 1969, $15.2 million in 1970, and $14.3 million in 1971. Administrative support goes from $42.6 million in 1969, to $37.8 million in 1970, and increases $50,000 more in 1971.

PAY ACT SUPPLEMENTAL

Mr. EVINS. We note that you are sending a supplemental appropriation request for Pay Act costs, $41,767,000; is that correct?

Mr. LILLY. Yes.

Mr. EVINS. The 1970 operating plan for Research and Program Management is $668,401,000.

PERSONNEL REDUCTIONS

Your personnel reductions in the 1971 budget are: 600 from the Electronic Research Center, 50 at headquarters, 31 at the Kennedy Space Center, 50 at the Manned Spacecraft Center and 69 at the Marshall Space Flight Center for a total reduction of 800 personnel.

Dr. PAINE. Mr. Chairman, as you perhaps would recall, in 1967 we had some 34,126 employees at NASA, at its peak. This will bring us down to some 30,550. With the civil service positions, as you know, we converted 965 positions over, this actually represents a total reduction of some 4,594 NASA employees since the 1967 period.

Mr. EVINS. How much money was spent on the Electronics Research center in land and construction of facilities, not including personnel?

Mr. LILLY. Total in this, Mr. Evins, in land and buildings——

Mr. EVINS. And equipment.

Mr. LILLY. And equipment. Our current book value is between $49 million and $50 million, pretty close to $50 million. As of June 30 last year, it was approximately $36 million.

Dr. PAINE. Of that, about $24 million is equipment, Mr. Chairman.

Mr. EVINS. Mr. Jonas?

REDUCTIONS IN CONTACTOR PERSONNEL

Mr. JONAS. When you are talking about personnel, Dr. Paine, on NASA's payroll, you ought to put a statement in showing reduction of contractors' personnel, so we can get it all at one place.

Dr. PAINE. We will present that to you for the record. I can give it to you in round numbers.

Mr. JONAS. That is sufficient.

Dr. PAINE. At the peak of our program we had in excess of 420,000 Americans total within NASA, and outside NASA working on the space program. At the present time we have gone from that 420,000 people to just below 190,000. So we have more than cut the program in half.

The result of the 1971 budget that we are laying before you will be a decrease of some 45,000 additional people across the country working on the space program.

Mr. JONAS. So we will have about 145,000?

Dr. PAINE. We will have 145,000 Americans total.

Mr. EVINS. With the overall employment for the space program dropping from 420,000 at the peak to about 145,000 in 1971, with this sharply declining effort, why not a greater reduction in cost at the centers?

NASA CADRE REMAINS

Dr. PAINE. Mr. Chairman, at the time that we built up to the 420,000 from the lower numbers of the previous NACA era, we did not proportionately increase the people in the NASA centers. We deliberately had the policy of having this increase be taken by prime contractor people and university people.

Had we built up the NASA people proportionately, we would have had more than 90,000 employees in NASA. Now that we are going down the other way, we again are not taking out the NASA people

proportionately, we are taking out people building Saturn and Apollo hardware, people of this nature.

The result is that we are going to have just about the same proportion of people in NASA to outside contracts as we had many years ago at the time that we were in this buildup.

NASA PERSONNEL BY ELEMENTS

Mr. EVINS. The chart on page sum 6 shows NASA's own personnel, not including contract personnel.

At the Manned Space Flight Center, it goes down from 13,410 in 1969, to 13,033 in 1970, and to an estimated 12,883 in 1971.

Space science and applications remains the same in 1971 as in 1970, 4,900.

Advanced research and technology declines from 11,617 in 1969, to 11,294 in 1970, and to 10,694 in 1971.

NASA Headquarters also shows a slight decrease from 2,123 in 1970 to 2,073 in 1971.

The total positions in NASA declines from 33,941 in 1969, to 33,650 in 1970, and to an estimated 32,850 for 1971. That gives us a good picture.

Dr. PAINE. I might amplify that slightly, Mr. Chairman, to say that as we look at the separation rate we have been able to keep together our skilled staff of scientists and engineers.

Only 3 percent of the agency separation rate for 1970 has been in scientists-engineers, 5 percent have been in administrative professionals, and 13.7 percent has been in clerical employees. So that primarily we have been removing the clerical and administrative people rather than our science and engineering people.

PERSONNEL COSTS

Mr. EVINS. We will now turn to the "Personnel" section. Mr. Reporter, place in the record pages RPM 1–1 through RPM 1–12.

(The pages follow:)

RESEARCH AND PROGRAM MANAGEMENT

FISCAL YEAR 1971 ESTIMATES

PERSONNEL

	1969	1970	1971	Change in 1971
Personnel	$463,675,000	$516,175,000	$515,108,000	$-1,067,000

DESCRIPTION:

The estimate for personnel and related costs includes the regular pay, overtime, holiday, Sunday and nightwork differential pay of NASA personnel in permanent, temporary, part-time and intermittent positions, and the cost of military personnel and personnel of other agencies detailed to NASA. It also includes the Government's contribution to the Civil Service Retirement Fund for permanent employees, the contribution to social security for other than permanent employees, the Government's share of the cost of employees' life insurance and health benefits, incentive awards and the cost of severance pay. The estimate provides for the cost of travel to initial duty station, and travel and shipment of household goods for transferred employees. Reimbursement to the Civil Service Commission for security investigations and payments to other agencies and nongovernment institutions for personnel training are also included in this activity.

DISTRIBUTION OF FUND REQUIREMENTS BY INSTALLATION:

	1969	1970	1971
Kennedy Space Center	$43,325,000	$46,630,000	$46,161,000
Manned Spacecraft Center	69,285,000	76,307,000	77,173,000
Marshall Space Flight Center	91,466,000	99,063,000	98,685,000
Goddard Space Flight Center	56,252,000	68,728,000	70,929,000
Wallops Station	5,601,000	6,266,000	6,480,000
Ames Research Center	28,477,000	31,059,000	32,385,000
Electronics Research Center	11,979,000	13,847,000	3,670,000
Flight Research Center	7,522,000	8,221,000	8,503,000
Langley Research Center	51,899,000	57,744,000	59,269,000
Lewis Research Center	57,987,000	64,351,000	67,111,000
Space Nuclear Propulsion Office	1,880,000	2,030,000	2,089,000
NASA Headquarters	38,002,000	41,929,000	42,653,000
Total	$463,675,000	$516,175,000	$515,108,000

BASIS OF FUND REQUIREMENTS:

The planned end of year employment for NASA civil service personnel includes 31,350 permanent employees in 1970 and 30,550 permanent employees in 1971, a reduction of 800. The plan for nonpermanent employees is 2,300 in both 1970 and 1971. The total complement, therefore, is 33,650 positions in 1970 and 32,850 positions in 1971. The distribution of the permanent positions by installation is as follows:

DISTRIBUTION OF POSITIONS BY INSTALLATION

	1969	1970	1971	Change in 1971
Permanent Positions				
Kennedy Space Center	2,877	2,779	2,748	-31
Manned Spacecraft Center	4,384	4,250	4,200	-50
Marshall Space Flight Center	6,149	6,004	5,935	-69
Goddard Space Flight Center	4,141	4,412	4,412	---
Wallops Station	484	488	488	---
Ames Research Center	1,992	1,972	1,972	---
Electronics Research Center	802	600	---	-600
Flight Research Center	539	535	535	---
Langley Research Center	3,912	3,872	3,872	---
Lewis Research Center	4,268	4,215	4,215	---
Space Nuclear Propulsion Office	104	100	100	---
Headquarters	2,093	2,123	2,073	-50
Subtotal	31,745	31,350	30,550	-800
Nonpermanent Positions	2,196	2,300	2,300	---
Total	33,941	33,650	32,850	-800

The number of permanent positions requested in the 1970 budget was 31,600. During the development of the 1970 operating plan, that level was reduced by a net of 250 as a part of the overall retrenchment in the government-wide level of civil service manpower. The cut of 300 positions was partially offset by an increase in authorized ceiling to accommodate the transfer to NASA of 50 Air Force civil service reliability and inspection employees. Included in the reductions is the phase out of operations at the Electronics Research Center. The 1970 operating plan thus derived for personnel provides an end year employment level of 31,350.

The following table summarizes the changes for 1970 permanent position allocations from the 1970 budget to the current plan.

CHANGES IN THE 1970 PERMANENT POSITION PLAN

Institutional Director	Plan in 1970 Budget	Government-wide Reduction	Air Force NASA Transfer	1970 Plan in 1971 Budget
Manned Space Flight	13,035	-52	+50	13,033
Space Science and Applications	4,900	---	---	4,900
Advanced Research and Technology	11,533	-239	---	11,294
NASA Headquarters	2,132	-9	---	2,123
Total	31,600	-300	+50	31,350

NASA is planning 30,550 permanent positions in 1971, a reduction of 800 positions from 1970. Of the reduction, 600 will result from the completion of the close out of operations at the Electronics Research Center, 150 from manned space flight centers and the remainder, 50 from Headquarters. The following table summarizes the changes in 1971:

CHANGES FROM 1970 TO THE 1971 PERMANENT POSITION PLAN

Institutional Director	1970 Plan	Changes in 1971	1971 Plan
Manned Space Flight	13,033	-150	12,883
Space Science and Applications	4,900	---	4,900
Advanced Research and Technology	11,294	-600	10,694
NASA Headquarters	2,123	-50	2,073
Total	31,350	-800	30,550

Nonpermanent Positions

The 1970 and 1971 plans for nonpermanent positions are 2,300. These positions are required for a variety of programs, the largest of which is the NASA summer employment program. NASA hires college students and high school and college faculty members during the summer to provide these people exposure to the NASA programs and government operations. The benefits to the participants are numerous, as are the benefits to NASA from the employment of these highly skilled individuals, and the education and training they receive is a considerable national asset.

A portion of the nonpermanent positions is used to provide for NASA's participation in the President's Youth Opportunity Campaign. This program provides underprivileged youths the opportunity to work at summer jobs at the various NASA installations, when unskilled personnel can be effectively used. Some of these positions are used during the remainder of the year to provide for the agency's participation in the President's Youth Opportunity Back to School Drive. This program continues during the school year, and

the underprivileged youths are employed at a variety of unskilled tasks during a limited workweek of not more than 16 hours.

As in the past, the agency continues to provide significant training opportunities for technically oriented college students participating in the cooperative training program throughout the year. The student employed under a cooperative training agreement works for a term at a NASA installation and then spends a term in regular study at his college or university. This work-study program combines practical experience with theory and has been a significant recruitment source for NASA.

Experts and consultants are also included under nonpermanent positions. They are usually employed for a few days at a time when their expertise is required.

The following table summarizes the planned utilization of personnel:

DISTRIBUTION OF PERMANENT POSITIONS BY PROGRAM

Direct Positions	1969	1970	1971
Manned Space Flight	10,010	9,699	9,478
Apollo	7,965	6,664	4,904
Space flight operations	1,825	2,789	4,322
Advanced missions	220	246	252
Space Science and Applications	3,441	3,606	3,519
Physics and astronomy	1,501	1,608	1,495
Lunar and planetary exploration	454	511	485
Bioscience	212	208	199
Space applications	681	702	783
Launch vehicle procurement	593	577	557
University Affairs			
Sustaining university program	12	12	9
Advanced Research and Technology	7,801	7,725	7,483
Basic research	1,172	1,129	1,058
Space vehicle systems	1,488	1,434	1,495
Electronics systems	952	863	649
Human factor systems	338	329	307
Space power and electric propulsion systems	999	987	976
Nuclear rockets	159	150	159
Chemical propulsion	277	246	246
Aeronautical vehicles	2,416	2,587	2,593

Direct Positions (Continued)	1969	1970	1971
Tracking and Data Acquisition	1,073	1,130	1,133
Technology Utilization	47	49	49
Subtotal, direct positions	22,384	22,221	21,671
Indirect Positions			
Director and staff	844	833	793
Administrative support	4,552	4,440	4,305
Research and development support	3,965	3,856	3,781
Subtotal, indirect positions	9,361	9,129	8,879
Total, permanent positions	31,745	31,350	30,550
Other than permanent positions	2,196	2,300	2,300
Total	33,941	33,650	32,850

The NASA work force may be summarized by broad occupational groupings as follows:

COMPOSITION OF PERMANENT STAFF BY OCCUPATIONAL GROUP

	1969		1970		1971	
Occupational Group	Number	Percent	Number	Percent	Number	Percent
Professional scientists and engineers	13,861	43.7	13,749	43.9	13,408	44.0
Technicians	5,123	16.1	5,873	18.7	5,818	19.0
Wage board	3,666	11.5	3,005	9.6	2,935	9.6
Professional administrative	4,367	13.8	4,341	13.8	4,194	13.7
Clerical	4,728	14.9	4,382	14.0	4,195	13.7
Total	31,745	100.0	31,350	100.0	30,550	100.0

As reflected above, professional scientists and engineers comprise forty-four percent of the NASA work force. Technicians and technically oriented wage board employees, who work in direct support of the professional technical staff, make up another twenty-nine percent of the complement. The types of positions included in each category are described below:

Professional scientists and engineers include all professional technical employees engaged in aerospace research, development, operations, and related work, including the development and operation of specialized facilities and supporting equipment.

Technician positions include scientific and engineering aids, shop superintendents, quality assurance specialists, production planners and inspectors, technicians in drafting, photography, and related positions.

Wage board positions include trade, craft and general labor positions (both supervisory and nonsupervisory) which are compensated on the basis of prevailing local wage rates.

Professional administrative positions include professional management positions in the fields of general management, financial management, procurement, contracting, personnel, security, library and editorial work, and related fields for which a university degree or the equivalent, and specialized training and experience are basic qualifications.

Clerical positions include secretarial, specialized and general clerical, administrative assistant, and related positions, the qualification requirements for which are clerical training and experience or specialized nonprofessional experience in the areas of supply, fiscal, logistics, statistics, or related activities.

SUMMARY OF PERSONNEL COSTS:

	1969	1970	1971
A. COMPENSATION AND BENEFITS			
1. COMPENSATION			
a. Permanent positions....	$411,766,000	$458,952,000	$455,140,000
b. Nonpermanent positions.	5,097,000	5,531,000	5,163,000
c. Reimbursable details...	3,531,000	3,961,000	3,907,000
d. Overtime and other compensation.....	7,504,000	7,365,000	7,066,000
Subtotal.....	$427,898,000	$475,809,000	$471,276,000
2. BENEFITS.....	32,557,000	36,932,000	40,341,000
Subtotal.....	$460,455,000	$512,741,000	$511,617,000
B. SUPPORTING COSTS			
1. Transfer of personnel.....	$814,000	$886,000	$972,000
2. Civil Service Commission services.....	95,000	110,000	120,000
3. Personnel training.....	2,311,000	2,438,000	2,399,000
Subtotal.....	$3,220,000	$3,434,000	$3,491,000
Total, Personnel.....	$463,675,000	$516,175,000	$515,108,000

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	1969	1970	1971
1. COMPENSATION	$427,898,000	$475,809,000	$471,276,000
a. Permanent Positions	411,766,000	458,952,000	455,140,000

The largest segment of personnel related costs, compensation of personnel in permanent positions, amounts to $455,140,000 in 1971, a decrease of $3,812,000 from 1970. This decrease results from netting of decreases from abolished positions in 1970 and 1971, and the closing of ERC, partially offset by increases related to the full year's cost of new positions in 1970 at Goddard for conversion of contractor operations to civil service, the 1969 general pay raise and career development in 1970, and to the partial year's cost of within grade advances and career development in 1971.

The estimate for permanent compensation is based upon the position structure at the start of the year, as modified by the addition of new positions and abolishment of existing positions, within grade advances, career development, etc. After these modifications, the year-end position structure is established and the cost effect for the year is calculated based on the estimated period that these modifications are in effect. The derivation of the cost for personnel in permanent positions is detailed below:

	1969	1970	1971
Cost of position structure - beginning of the year	$388,146,000	$416,865,000	$463,333,000
Cost of additions to the structure:			
New positions	5,179,000	5,246,000	---
Salary legislation and pay raises	23,831,000	39,778,000	---
Within grade advances	7,249,000	7,125,000	6,737,000
Career development	5,330,000	5,284,000	4,780,000
Structural changes	176,000	426,000	---
Abolished positions	-12,126,000	-9,733,000	-11,954,000
Effect of separation replacement policy	-920,000	-1,658,000	-4,747,000
Cost of position structure - end of year	$416,865,000	$463,333,000	$458,149,000
Offsets:			
Lapse of new positions	$-4,206,000	$-2,032,000	---
Delay in filling vacancies	-1,362,000	-2,689,000	$-3,765,000
Lapse on salary legislation and pay raises	-1,520,000	-1,891,000	---
Lapse on within grade advances	-3,708,000	-3,492,000	-3,408,000
Lapse on career development increases	-3,038,000	-2,904,000	-2,368,000
Partial year funding of separations	+442,000	+1,011,000	+1,520,000

	1969	1970	1971
Offsets (Continued):			
Partial year funding of abolished positions.....	$+6,767,000	$+5,781,000	$+1,846,000
Terminal leave payments.....	+826,000	+945,000	+1,795,000
Work days in excess of 52 weeks..	+1,272,000	+1,772,000	+1,952,000
Reimbursement received from other government agencies.....	-572,000	-882,000	-581,000
Net cost of permanent positions....	$411,766,000	$458,952,000	$455,140,000

Development of Salary Structure and Cost Estimate

The cost of new positions represents the salary requirements for additional positions in 1969 and 1970. There will be no new positions in 1971.

The increased costs due to salary legislation and pay raises are the result of Congressional action, the revision of special pay provisions by the Civil Service Commission and the periodic wage surveys for Wage Board employees. The increase shown for 1969 represents the second increment of the Federal Salary Act of 1967, effective in July 1968, and the periodic wage surveys conducted in 1969. The cost in 1970 represents the final scale adjustment provided for in the Federal Salary Act of 1967 and the cost of wage surveys conducted in 1970. The cost of pending salary legislation is not included in this budget request.

The calculations for within grade advances, career development, and the effect of the separation replacement policy savings are derived through modification of the beginning inventory of grade levels and skill groups, after determining the number of separations that can be expected, based on current experience, the number who meet the time and performance criteria NASA has established for promotions, estimating within grade salary increases for employees who meet the statutory time and quality requirements and planning the replacement of vacated positions at a generally lower level than those held by the former employees.

The changing character of work patterns results in shifts in the position structure between Wage Board and General Schedule positions. These changes in structure differ from installation to installation to meet the needs of each.

The offset item, abolished positions, is the annual salary cost of the actual position reductions in 1969 and 1970, and those planned for 1971, which are the 600 at ERC, 50 at Headquarters, and 150 at the manned space flight centers. The other offset item, effect of separation replacement policy, is the savings in annual salaries resulting from the agency policy of replacing two-thirds of the separations in professional positions at the entrance level rather than at the grade of the separated employee.

The cost of the position structure at the end of the year and the net cost, that is compensation actually paid, differ because the end-year structure carries all salaries on an annual salary basis. The differences between the salary structure and compensation are generally characterized as lapse items, and may be either deductive or additive in the schedule, depending upon the type of actions.

The lapse on new positions represents the savings for the additional positions which become available to the agency during the fiscal year for the period of time required to place the new employees on the rolls.

Delays in filling vacancies represent the savings in annual salaries for the interval between the time an employee leaves the agency and the time a replacement is placed on the rolls. For 1971, this time interval is estimated at about five weeks. The estimate of savings in 1971 is higher than that for 1970 because of the higher number of positions being refilled rather than abolished after being vacated in 1971 at other installations.

The savings from lapse on salary legislation and pay raises result because they are effective for only part of the year in which they occur. Wage Board employees' increases are established at various times during the year, and vary by geographical location, and the savings amount reflects these variances.

Lapses on within grade advances and career development increases represent the savings for the period that employees were paid at salaries lower than those held at the end of the year. Partial year funding of abolished positions represents the cost of these positions before they were abolished. Partial year funding of separations is the cost of positions at the higher rate, which subsequently are filled at a lower grade because of the separation replacement policy.

Terminal leave payments are for accrued annual leave due separating employees and are an offset against the salary savings realized by the separation. The 1971 estimate reflects a large one-time cost associated with the close out of ERC.

Reimbursement received from other government agencies reflects the expected payments, chiefly from the Environmental Sciences Services Administration, for work performed by NASA. The decrease in 1971 reflects completion of certain phases of work for which NASA has been receiving reimbursements.

	1969	1970	1971
b. Nonpermanent positions.....	$5,097,000	$5,531,000	$5,163,000

The cost of nonpermanent positions is for the varied temporary employment programs carried on by NASA, such as the cooperative student training program, the summer student and faculty employment programs, participation in the President's Youth Opportunity Campaign, and other similiar programs. The reduction in cost reflects a lower average number of such positions to be filled during 1971.

	1969	1970	1971
c. Reimbursable details	$3,531,000	$3,961,000	$3,907,000

The services of a small group of military officers and civilian detailees from other government agencies are utilized in the conduct of NASA's programs where such use is appropriate. In accordance with existing agreements, NASA reimburses the parent organization for the salaries and related costs of the detailees. The reduction in 1971 results from a planned smaller number of detailees than in 1970, largely because of the close out of ERC.

	1969	1970	1971
d. Overtime and other compensation	$7,504,000	$7,365,000	$7,066,000

The reduction of $299,000 for overtime and other compensation planned for in 1971 results from the close out of ERC, reduced requirements related to the Apollo program and a continued emphasis within NASA to reduce costs in this category to the lowest level consistent with mission and legal requirements.

	1969	1970	1971
2. BENEFITS	$32,557,000	$36,932,000	$40,341,000

In addition to compensation, NASA makes an employer's contribution to personnel benefits as authorized and required by law. The following table indicates the costs of personnel benefits by the major categories:

Category of Cost	1969	1970	1971
Contribution to the Civil Service Retirement Fund	$26,787,000	$30,921,000	$32,511,000
Contribution for employee life insurance	1,625,000	1,745,000	1,759,000
Contribution for employee health insurance	2,727,000	2,859,000	2,948,000
Contribution to FICA	161,000	210,000	233,000
Incentive awards	378,000	441,000	441,000
Other personnel benefits	593,000	732,000	989,000
Severance pay	286,000	24,000	1,460,000
Total	$32,557,000	$36,932,000	$40,341,000

The largest part of personnel benefits is the Agency's contribution to the Civil Service Retirement fund. Until January 1970, the Agency's contribution equalled six and one-half percent of each permanent employees' salary. In January 1970, the rate of contribution was raised to seven percent as a result of P.L. 91-93. The increased cost in 1971 results from the full year's funding of that increase.

The agency contribution toward the cost of employee life and health insurance is based upon employee participation. FICA or social security contributions are for nonpermanent employees who are not covered by the Civil Service Retirement Act.

The incentive awards program provides for cash awards for outstanding contributions to NASA, employees superior performance and for improvement of the agency's operations. The cost of the program remains relatively stable. Other personnel benefits provide for reimbursement to the Department of Labor for workmen's compensation cost and such items as uniform allowances and a special commuting allowance for personnel at the Nuclear Rocket Development Station in Nevada. The increase requested in 1971 is to pay for the increased workmen's compensation billing provided by the Labor Department.

The severance pay estimate is related to the legal requirement to pay severance pay to employees who are separated from the rolls through no fault of their own. Such is the case for employees separated because of the close out of operations at the Electronics Research Center. The amount shown for 1971 is the estimated liability for severance payments at ERC.

	1969	1970	1971
B. SUPPORTING COSTS.....	$3,220,000	$3,434,000	$3,491,000

Supporting personnel costs provide for the expenses of moving employees to their initial duty station or reassignment; for security investigations and other recruitment costs; and for maintaining and expanding the skills of our employees. These costs are summarized as follows:

	1969	1970	1971
1. Transfer of personnel.....	$814,000	$886,000	$972,000

The legislation approved in 1966 provided that the government would pay for certain relocation costs, such as the expenses of selling and buying a home, the cost of one trip to the new duty station for the purpose of securing new housing, and the cost of family relocation allowances. The estimate is based on previous experience. The increase in these costs results because of the larger number of vacated positions being refilled in 1971 rather than being abolished.

	1969	1970	1971
2. Civil Service Commission services.....	$95,000	$110,000	$120,000

The Civil Service Commission conducts security investigations for NASA. The cost of security investigations is a function of two variables, the number of investigations to be conducted and the unit-charge made by the Civil Service Commission. Compilation of installation estimates of the

number to be conducted and the projected unit-charge for each year is the basis for the cost estimate.

	1969	1970	1971
3. Personnel training.....	$2,311,000	$2,438,000	$2,399,000

The maintenance and expansion of the skills of personnel is essential to an organization such as NASA which is charged with the responsibility for complex technical programs. Such training is provided within the framework of the Government Employees Training Act of 1958. Part of the training is provided by other government agencies. When employees participate in training courses of other agencies, NASA is able to benefit from existing programs. The remainder of the training is provided through nongovernmental sources; the cost is for tuition, fees and related costs for training at colleges, universities, technical institutes and related institutions; and for the cost of seminars and workshops in which groups of employees receive training in courses of agency-wide interest. Such training is used to maintain and to expand employee skills. The estimate is based on a continuation of current training programs and the growing requirements to reorient skills of employees into channels compatible with the direction of the space program in the 1970's.

Mr. EVINS. Your personnel costs are estimated to be $515,108,000 in 1971. These costs include salaries, overtime pay, the Government's share of the cost of employees' life insurance and health benefits, incentive awards, and cost of severance pay.

Mr. LILLY. Yes.

Mr. EVINS. The cost is down approximately $1 million from last year, not a very significant reduction with the 800 reductions in personnel.

Mr. LILLY. I might put in a word here.

The reductions that we are taking in people is off-set, to a large degree, by the one additional pay period for the full pay increase that we had this year. Also, the more stable work force, lower attrition, and normal increase for ingrade promotions that must take place, combine to raise the base of NASA by about $5 million a year just keeping the same people.

These are the kinds of things offset by these reductions in personnel that we have been taking.

TRAVEL COSTS

Mr. EVINS. Let's look at the "Travel" section.

Mr. Reporter, place in the record pages RPM 1–13 through RPM 1–16.

(The pages follow:)

RESEARCH AND PROGRAM MANAGEMENT

FISCAL YEAR 1971 ESTIMATES

TRAVEL

	1969	1970	1971	Change in 1971
Travel.....	$14,003,000	$16,712,000	$18,200,000	$+1,488,000

DESCRIPTION:

The estimates include the cost of transportation, per diem, and incidental costs required for employee travel for the purpose of direction and coordination of Research and Development and Construction of Facilities program activities; travel for contract management and flight mission support; travel to launching sites and tracking stations, and for administrative travel. It also includes the cost of travel to NASA-sponsored meetings and conferences, as well as meetings sponsored outside NASA, when such travel is in the interest of the agency; of travel by non-NASA employees (31 USC 22a); and of travel by unpaid members of research advisory committees. Charter, contract, or lease of passenger aircraft and the cost of local transportation by taxi, bus, or private automobile for which the employee is reimbursed are included in the estimate. Costs for travel to initial duty station and for permanent change of station are excluded from these estimates and are included under Personnel Related Costs. The major share of the increase in travel costs for 1971, $1,344,000, is related to the full year funding of the increase in per diem rates approved in November, 1969, in PL 91-114.

DISTRIBUTION OF FUND REQUIREMENTS BY INSTALLATION:

	1969	1970	1971
Kennedy Space Center.....	$566,000	$811,000	$874,000
Manned Spacecraft Center.....	3,562,000	4,177,000	4,463,000
Marshall Space Flight Center.....	2,119,000	2,407,000	2,517,000
Goddard Space Flight Center.....	1,665,000	2,265,000	2,584,000
Wallops Station.....	117,000	157,000	175,000
Ames Research Center.....	694,000	736,000	921,000
Electronics Research Center.....	321,000	351,000	200,000
Flight Research Center.....	200,000	219,000	234,000
Langley Research Center.....	1,134,000	1,237,000	1,669,000
Lewis Research Center.....	898,000	1,013,000	1,088,000
Space Nuclear Propulsion Office..	188,000	204,000	213,000
NASA Headquarters.....	2,539,000	3,135,000	3,262,000
Total.....	$14,003,000	$16,712,000	$18,200,000

BASIS OF FUND REQUIREMENTS:

SUMMARY OF TRAVEL BY MAJOR CATEGORY

	1969	1970	1971	Change in 1971
Program Related Travel				
Direction, coordination, and management of Research and Development and Construction of Facilities program activities	$8,441,000	$10,035,000	$11,210,000	$+1,175,000
Flight mission support.	1,214,000	1,428,000	1,485,000	+57,000
Overseas travel to launch and tracking sites	437,000	544,000	596,000	+52,000
Subtotal	$10,092,000	$12,007,000	$13,291,000	$+1,284,000
Meetings and Technical Seminars				
Government-sponsored meetings	$1,146,000	$1,279,000	$1,364,000	$+85,000
Other than government-sponsored meetings and technical seminars	937,000	993,000	1,018,000	+25,000
Subtotal	$2,083,000	$2,272,000	$2,382,000	$+110,000
Administrative Travel	$1,828,000	$2,433,000	$2,527,000	$+94,000
Total, Travel	$14,003,000	$16,712,000	$18,200,000	$+1,488,000

	1969	1970	1971	Change in 1971
Program Related Travel	$10,092,000	$12,007,000	$13,291,000	$+1,284,000

Program related travel is the travel most directly related to the NASA mission. It is the largest part of the travel function and accounts for approximately 73% of the travel requirements for 1971. Funding in 1971

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will increase by $1,284,000, which is largely the result of the full year funding of the cost of the increase in per diem rates approved in November, 1969. The costs are summarized as follows:

	1969	1970	1971	Change in 1971
Direction, coordination and management of programs.....	$8,441,000	$10,035,000	$11,210,000	$+1,175,000

The largest individual part of program related travel is for direction, coordination, and management of research and development and construction of facilities program activities. Because of the complexity of the programs and the distribution of contractor and subcontractor effort throughout the entire United States, coordination and management of activities requires frequent examination by personnel responsible for the program. The costs for this travel are expected to be higher in 1971 than in 1970 as the result of the full year funding of the increase in per diem rates paid to Federal employees while in travel status, approved in November, 1969 in PL 91-114. This increase is partially offset by a reduction related to the phase-out of the Electronics Research Center.

	1969	1970	1971	Change in 1971
Flight mission support.....	$1,214,000	$1,428,000	$1,485,000	$+57,000

As projects reach the flight stage, support is required for pre-launch, launch, and post-launch activities. The amount of travel required for this purpose is directly related to both the number and complexity of the launches. The increase, $57,000, results from the travel requirements for support of the approved launch schedule, and the full year funding of the increase in per diem rates.

	1969	1970	1971	Change in 1971
Overseas travel to launch and tracking sites.....	$437,000	$544,000	$596,000	$+52,000

Overseas travel to launch and tracking sites includes travel required for instrumentation of the tracking sites, and inspection of the sites prior to launch. The increase of $52,000 is related to the full year funding of conversion

of contractor functions for tracking and data acquisition effort to a civil service operation at the Goddard Space Flight Center which were formerly included as part of the contractual effort and funded under Research and Development, and to the increase in per diem rates.

	1969	1970	1971	Change in 1971
Meetings and technical seminars.....	$2,083,000	$2,272,000	$2,382,000	$+110,000

Travel to meetings and technical seminars permits employees engaged in program activities to participate at both government sponsored and non-government sponsored meetings and technical seminars with other outstanding representatives of the aerospace community. This participation allows personnel to benefit from exposure to advances in the field which arise outside NASA, as well as allowing personnel to present both accomplishments and problems to their associates. Many of the government sponsored meetings are made up of working panels convened to solve certain problems for the benefit of the government. Authorization to attend any meetings of the types described is granted only after assurance that attendance will be in the interest of NASA. The estimate for this travel in 1971 is slightly more than 1970 because of the increase in per diem rates, partially offset by a decrease related to the phase-out of the Electronics Research Center.

	1969	1970	1971	Change in 1971
Administrative travel..	$1,828,000	$2,433,000	$2,527,000	$+94,000

Administrative travel includes travel for the direction and coordination of general management matters. It includes travel by functional managers in such areas as personnel, financial management, and procurement to assure that agency policies and procedures are being implemented and carried out properly throughout the agency. Travel by senior officials to review center requirements and operations and the travel of center officials to NASA Headquarters is provided for in this category. This category also includes the cost of travel in and around the vicinity of the centers, including bus and taxi services and rental of motor vehicles, and travel of unpaid members of research advisory committees. The increase in 1971 is related to the full year cost of the increase in per diem rates.

Mr. EVINS. In travel costs we have an increase from $14 million in 1969, to $16.7 million in 1970, and to $18.2 million in 1971. You have less personnel and increased costs for travel. Why is your travel cost up?

Mr. LILLY. It would have been except for the congressional action raising the travel per diem pay, of employees, by over 50 percent—from $16 to $25.

Mr. Evins. Off the record.

(Discussion off the record.)

Mr. JONAS. Will the chairman yield?

Mr. EVINS. Yes.

Mr. JONAS. There is a little discrepancy between the figure on RPM 1–13 and your table on summary 9.

You show $19.874 million, or about $1.6 million more. Explain that discrepancy, please.

Fiscal 1971, transportation of persons, $19.874 million. Is this table out of date or is the other one out of date?

Mr. MALAGA. The table is not out of date, Mr. Jonas. The table you are looking at, which totals 16,128, includes those accounts really classified as——

Mr. JONAS. I do not see 16,128.

Mr. EVINS. On page SUM–9, the first column says travel and transportation of personnel, your third bracket is $19,874,000. Your total on page RPM 1–13 is $18.2 million.

Mr. Jonas points out the inconsistency in these amounts.

Mr. LILLY. I will straighten that out for the record. I think these are the categories or classifications of the object classes, and I think $19.874 million includes some other items that are included in that category related to travel.

Mr. JONAS. Which sum is correct?

Mr. MALAGA. Mr. Jonas, the $19.874 million classified as transportation and travel is correct. However, by bringing it down by functions, of that amount $1.466 million is assigned to administrative support and $208,000 is classified under personnel.

So when you total those up, including the travel budget we show on page 13, that would total to the $19.874 million.

Mr JONAS. You have explained the reason for the increase in 1971 over 1970, and you attribute it to the actions taken by Congress in increasing travel allowances. But I invite your attention to the fact that it went up $2.7 million last year over 1969 and you have been curtailing personnel in both years.

How can this travel keep climbing at such a steep rate, $2 million a year?

Mr. LILLY. Mr. Jonas, again the travel in 1970, as you will recall, when the increased per diem went into effect in this fiscal year, fiscal 1970, then you have the full year effect of it.

Mr. JONAS. It does not double itself again, does it? That would account for the jump from 1969 to 1970, but you jump again nearly $2 million in 1971.

Dr. Low. I believe the per diem increase was only in effect for half a year in 1970, and the full year funding is picked up in 1971.

Mr. JONAS. If that is all attributable to the increase of per diem expenses, you have a lot of people traveling. It is amazing to me that you would need to do that much travel, $18 million worth of travel in 1 year.

Who all travels?

Mr. LILLY. Mr. Jonas, the engineers and project managers at all of our centers must travel to the work that is being carried out in the plants throughout the United States. A very important part of the work of the program and project managers is to be onsite and travel to the contractors.

Mr. JONAS. Who supervises this travel? Can people travel at will or do they have to establish to some supervisors the necessity of the trip?

Mr. LILLY. Yes, sir; they certainly do.

Mr. JONAS. Who passes on it?

Mr. LILLY. These are at various levels. There is a delegation, say, from Dr. Paine to the center directors, with the center directors in turn delegating down to their responsible division directors.

Mr. JONAS. That is $1.5 million worth of travel per month.

Dr. PAINE. It represents about $600 per year per NASA employee. It is a substantial amount of travel.

Mr. JONAS. They do not all travel, I hope.

TRAVEL REDUCED BY 25 PERCENT

Dr. PAINE. No, they do not. That is the average. The necessity for this is, of course, the fact that we do have a nationwide operation. We have an Apollo program, parts being built here, parts being built there, and there is a substantial amount of travel in connection with managing this entire enterprise.

Mr. MALAGA. Of the $18.2 million for this function, $13.3 million is classified as program-related travel.

Of the $13.3 million, $11.2 million is related to the kind of travel Dr. Paine just described, travel to contractor plants, to insure the quality and reliability of the systems being built.

This, of course, as you know, is really being conducted throughout the United States. In addition to that type of travel, we do have direct flight mission support for all of our launches, people at Houston, at Marshall, must travel to the sites, some to Cape Kennedy, some of our tracking stations overseas.

Mr. JONAS. You assure the committee that somebody is riding close herd on this travel item and not letting it get out of hand and that all this travel is necessary?

Mr. MALAGA. Yes, sir.

We have reduced travel by over 25 percent in the last 3 years, the amount of travel.

Dr. PAINE. It does not show here because of these increases we have had in the costs in the last 2 years.

Mr. JONAS. It sure does not show on page 13.

Dr. PAINE. No. If we had 1968–67, it would be more visible.

PAY OF ASTRONAUTS

Mr. JONAS. I thought you were paying the astronauts travel so much per mile to the moon.

Dr. PAINE. Not by the mile, no, sir, by the day.

Mr. JONAS. No kidding, is that right?

Dr. PAINE. They do get per diem.

Mr. JONES. When they are in space?

Dr. PAINE. Yes.

Mr. JONAS. They are worth all they get.

CHARTER CONTRACT TRAVEL

Mr. EVINS. How much charter contract travel do you engage in?

Mr. LILLY. I will have to supply it.

(The information follows:)

The obligation for contract charter or lease of passenger aircraft was $77,000 in fiscal 1969. In the first half of fiscal year 1970, $52,000 was obligated for this purpose.

Mr. EVINS. One commentator says although the per diem rates have been increased, the reduction of 800 personnel in fiscal 1971 should also show a reduction in the amount of travel, but it does not.

AUTOMATIC DATA PROCESSING

Let's turn to the "Automatic data processing" section and place pages RPM 1–17 through RPM 1–19 in the record.

(The pages follow:)

RESEARCH AND PROGRAM MANAGEMENT

FISCAL YEAR 1971 ESTIMATES

AUTOMATIC DATA PROCESSING

	1969	1970	1971	Change in 1971
Automatic data processing	$23,808,000	$21,548,000	$22,710,000	$+1,162,000

DESCRIPTION:

The funds budgeted in this category provide for the acquisition of automatic data processing (ADP) equipment by lease or purchase, maintenance of NASA-owned equipment, and the procurement of programming and operation services. Both electronic data processing and ancillary electric accounting machine equipment are included. The overall requirement for ADP is divided by appropriation in accordance with the purpose served by the equipment. The Research and Program Management appropriation provides for the general purpose scientific and business data processing which support the overall installation operations and scientific and technical applications where it is impractical to distribute the funding to a directly supported program or project. Other appropriations provide for data processing systems and operations which are dedicated to specific programs or projects, or are integrated into larger systems. Additional information concerning ADP equipment requirements may be found in the special ADP analysis which appears in Volume I of this budget.

DISTRIBUTION OF FUND REQUIREMENTS BY INSTALLATION:

	1969	1970	1971
Kennedy Space Center	$1,044,000	$943,000	$943,000
Manned Spacecraft Center	5,501,000	5,743,000	5,930,000
Marshall Space Flight Center	5,908,000	7,198,000	8,042,000
Goddard Space Flight Center	5,987,000	5,042,000	5,723,000
Wallops Station	79,000	62,000	65,000
Ames Research Center	324,000	115,000	115,000
Electronics Research Center	1,206,000	590,000	---
Flight Research Center	58,000	9,000	9,000
Langley Research Center	933,000	240,000	256,000
Lewis Research Center	432,000	47,000	53,000
NASA Headquarters	2,336,000	1,559,000	1,574,000
Total	$23,808,000	$21,548,000	$22,710,000

BASIS OF FUND REQUIREMENTS:

SUMMARY OF AUTOMATIC DATA PROCESSING

	1969	1970	1971	Change in 1971
Lease of equipment.....	$12,606,000	$12,354,000	$13,017,000	$+663,000
Purchase of equipment...	2,178,000	25,000	---	-25,000
Maintenance of equipment	2,090,000	1,345,000	1,350,000	+5,000
Subtotal, equipment...	16,874,000	13,724,000	14,367,000	+643,000
Programming and operation services....	6,934,000	7,824,000	8,343,000	+519,000
Total, automatic data processing.....	$23,808,000	$21,548,000	$22,710,000	$+1,162,000

	1969	1970	1971	Change in 1971
Lease of equipment.....	$12,606,000	$12,354,000	$13,017,000	$+663,000

The lease of equipment for ADP represents approximately 57% of the total ADP costs funded from the Research and Program Management appropriation. The estimate for 1971 is $663,000 higher than the amount planned for 1970. This increase is primarily attributable to the Goddard Space Flight Center and results from the full year rental of leased peripheral equipment acquired during 1970 to support the ADP systems complex already in place at the Goddard Space Flight Center. In addition, there is a smaller increase at the Manned Spacecraft Center planned for the purpose of acquiring components for existing in-place systems. These increases are partially offset by decreases of $18,000 at the Marshall Space Flight Center and $41,000 at the Electronics Research Center. The ADP lease costs at all other installations will remain at essentially the same level as in 1970.

	1969	1970	1971	Change in 1971
Purchase of equipment.....	$2,178,000	$25,000	---	$-25,000

No purchase of ADP equipment is planned in 1971 from the Research and Program Management appropriation.

	1969	1970	1971	Change in 1971
Maintenance of equipment..	$2,090,000	$1,345,000	$1,350,000	$+5,000

The requirements for the maintenance of NASA owned ADP equipment remain about the same in 1971 as in 1970.

	1969	1970	1971	Change in 1971
Programming and operation services.....	$6,934,000	$7,824,000	$8,343,000	$+519,000

In 1971, the cost of contractor programming and operation services related to the larger and more sophisticated systems in operation is estimated to be $519,000 higher than 1970. An increase of $887,000 will be required for the Marshall Space Flight Center to provide full year funding on the increased man year cost rate for the programming and operations support services contracts currently in effect. This amount is offset, however, to a net increase of $519,000 as result of the phasing out of operations at the Electronics Research Center.

Mr. EVINS. Automatic data processing goes from $23.8 million in 1969, to $21.5 million in 1970, and to $22.7 million in 1971. This is an increase of $1,162,000.

I have visited the Kennedy Space Center and some of your other facilities and I am always amazed and greatly impressed with the tremendous number of individual computers.

I made a statement several years ago that I thought IBM had a lock on somebody in NASA. Of course it was denied. We have computers of all kinds and description and here we have a request for $13 million for lease of computers.

CAPITAL VALUE OF ADP EQUIPMENT

How much of an investment do we have in automatic data processing equipment in the NASA facilities?

Mr. TRUSZYNSKI. Capital value is $353.5 million total.

Mr. EVINS. This is shown on page SA–19 of volume 1. Place this page in the record.

(The page follows:)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Capital Value of Owned and Leased ADP Equipment
on Hand June 30, 1969

(In thousands of dollars)

	NASA-Owned Equipment	Leased Equipment	Total Capital Value
Office of Manned Space Flight....	$89,896	$60,288	$150,184
Kennedy Space Center.....	13,842	1,960	15,802
Manned Spacecraft Center.....	59,670	32,616	92,286
Marshall Space Flight Center...	16,384	25,712	42,096
Office of Space Science and Applications.....	$129,255	$24,164	$153,419
Goddard Space Flight Center....	96,958	14,387	111,345
Jet Propulsion Laboratory.....	29,899	9,698	39,597
Wallops Station.....	2,398	79	2,477
Office of Advanced Research and Technology.....	$39,480	$6,560	$46,040
Ames Research Center.....	5,659	2,737	8,396
Electronics Research Center....	3,159	1,443	4,602
Flight Research Center.....	2,309	333	2,642
Langley Research Center.....	16,765	1,016	17,781
Lewis Research Center.....	11,588	131	11,719
Space Nuclear Propulsion Office	---	900	900
Headquarters.....	$2,100	$1,796	$3,896
TOTAL.....	$260,731	$92,808	$353,539

Figure 6

Mr. EVINS. You have all the information. Thank you. How much of your equipment is idle and unused?

Mr. TRUSZYNSKI. All of our general purpose automatic data processing equipment is operating at above 90 percent of capacity at this time.

Mr. EVINS. I know when you are in flight it is used, but what about when you are not in flight?

Mr. TRUSZYNSKI. In between flights, much of it is used for simulation work and preparation of programs for the succeeding flights as well as astronaut training, for example. The equipment is used on a very continuing basis.

Dr. PAINE. Mr. Truszynski is in charge of that.

Sometimes it is hard when you look at a bank of data processing computers to tell just the extent to which it is being used. As he mentioned, the overall utilization of the agency is above 90 percent.

LEASED ADP EQUIPMENT

Mr. EVINS. Why do we need $13 million for leasing equipment?

These people get contracts constantly for purchases and leases.

Mr. LILLY. Mr. Evins, I would like to correct a number. The total capital value of the ADP equipment in the NASA installations is $353.5 million, of which only $260 million is owned by NASA. The other is the value of the leased equipment that we have there.

These are the costs on an annual basis paying for that lease.

Mr. EVINS. How many pieces of leased equipment do you have; in numbers?

Mr. TRUSZYNSKI. We have a total of 704 individual computers which are owned or leased.

OWNED VERSUS LEASED EQUIPMENT

Mr. EVINS. All right. How many are owned?

Mr. TRUSZYNSKI. Of that number——

Mr. EVINS. You do not know how many you own?

Mr. TRUSZYNSKI. Of this total, 645 are owned and 59 will be leased in fiscal year 1971.

Mr. EVINS. Fifty-nine leased. Is there any way you can cut down on this lease bill?

Mr. TRUSZYNSKI. The thing that decides whether one leases or purchases equipment is the length of time of anticipated use of the computer or the particular use to which it is put.

We have a continuing review of this equipment and, as we arrive at a lease-purchase study which indicates an economic benefit from purchase, we do purchase the equipment.

Mr. EVINS. You lease them for several years and just about pay the total cost and then you buy them.

Dr. PAINE. If that appears to be the economic thing to do.

Mr. TRUSZYNSKI. Yes.

Mr. LILLY. But only in the case where we have a lease-purchase agreement, under which the amount we paid in leases applies on the cost of purchase.

Mr. EVINS. The amount you paid in lease goes on the purchase price?

Mr. LILLY. Right.

Mr. EVINS. Do you have that pretty uniform in all your leases?

Mr. TRUSZYNSKI. Yes, indeed.

TRANSFER OF COMPUTER

Mr. EVINS. There is an IBM 360/75 at the Electronic Research Center. Is this owned by NASA? What was the cost? Will it be transferred to DOT?

Mr. TRUSZYNSKI. Mr. Chairman, this is a computer that we are transferring from the Electronics Research Center to the Jet Propulsion Laboratory, where we have a need for this class of computer.

ADP PROCUREMENT IN COMPETITIVE BIDS

Mr. EVINS. Do you have competitive bids on the data processing equipment and the computers?

Mr. TRUSZYNSKI. Yes. In both lease and purchase instances, competition is conducted.

Mr. EVINS. What do you mean "conducted"?

Mr. TRUSZYNSKI. A specification is prepared, a request for proposal is issued, and the proposals received are evaluated and then a contract award is made on a competitive basis.

Mr. EVINS. Do you buy from the low bidder, or do you reject the low bidder and take the one you want anyway?

Dr. PAINE. Wherever possible, we take the low bidder, of course, Mr. Chairman.

If there is some quality question or some question whether or not they will meet specifications, we may pick one of the others.

IBM'S SHARE

Mr. EVINS. Of all your equipment, how much of it is IBM?

Mr. TRUSZYNSKI. Currently, some 34 percent of the dollar value is IBM. In terms of the numbers of computers, however, only 15 percent is IBM. So we have quite a bit of competition in our ADP.

Dr. PAINE. This is less than IBM's percentage of the total computer business. So we are not favoring IBM, we are going in the other direction.

Mr. EVINS. We had some testimony voluntarily given by somebody about the great value of IBM, if they would go out of business how the country would suffer.

Dr. PAINE. I certainly would endorse that, Mr. Chairman. They are a great generator of overseas dollars for the United States.

Mr. EVINS. Well, you just tell them that on this side of the table there are some people a little bit suspicious of them. They are pretty sharp operators. They have a lock on Defense, NASA, nearly everybody. They have the business. They not only sell, they lease.

I want our people to be just as sharp as they are with their pencils.

Dr. PAINE. Yes, sir; that is very important.

INFORMATION SUPPLIES IN JUSTIFICATION MATERIAL

Mr. EVINS. In your 1972 justifications the committee again urges that the historical prose be limited and more specific information provided about the actual, current, and budget years programs, especially the budget year. This should substantially reduce the redundancy of the justifications without eliminating essential data.

NASA should explain to the committee, in concise terms, why programs should continue or be curtailed or be increased. There are too many words in the justification and too little relationship to the amount requested.

If you like, our staff will be available to consult with your budget staff on this matter.

FACILITIES SERVICES

Let's turn to "Facilities services" and place in the record pages RPM 1–20 through RPM 1–24.

(The pages follow:)

RESEARCH AND PROGRAM MANAGEMENT

FISCAL YEAR 1971 ESTIMATES

FACILITIES SERVICES

	1969	1970	1971	Change in 1971
Facilities services....	$85,841,000	$80,872,000	$84,083,000	$+3,211,000

DESCRIPTION:

Facilities services includes the rental of lands and buildings; the procurement of electricity, water, gas, and other utilities; maintenance of buildings and grounds; and minor construction and facility modifications. It also includes custodial services consisting of security services, janitorial services, cleaning, exterminating, and refuse handling, laundry and fire protection. Funds required also provide for the maintenance and repair of general purpose instruments, research equipment, and shop equipment. Requirements for general purpose building materials, hardware, electronics supplies and materials, as well as procurement of mechanical, laboratory and shop equipment are also included in the estimate. The requirements for major contractual service effort at the Merritt Island Launch Area and reimbursement to the Air Force for services provided to the Kennedy Space Center are also covered in this category.

DISTRIBUTION OF FUND REQUIREMENTS BY INSTALLATION:

	1969	1970	1971
Kennedy Space Center.....	$39,649,000	$38,559,000	$39,933,000
Manned Spacecraft Center.....	10,278,000	8,825,000	10,195,000
Marshall Space Flight Center.....	8,377,000	7,167,000	9,341,000
Goddard Space Flight Center.....	4,825,000	4,472,000	4,048,000
Wallops Station.....	2,272,000	2,212,000	2,205,000
Ames Research Center.....	3,659,000	3,696,000	4,073,000
Electronics Research Center.....	1,822,000	2,317,000	100,000
Flight Research Center.....	1,257,000	1,072,000	1,118,000
Langley Research Center.....	6,394,000	6,116,000	6,749,000
Lewis Research Center.....	6,881,000	6,110,000	5,995,000
NASA Headquarters.....	427,000	326,000	326,000
Total.....	$85,841,000	$80,872,000	$84,083,000

BASIS OF FUND REQUIREMENTS:

SUMMARY OF FACILITIES SERVICES

	1969	1970	1971	Change in 1971
Acquisition of Facilities				
Rental of real property.....	$1,821,000	$1,819,000	$373,000	$-1,446,000
Minor construction and modifications.	1,554,000	1,250,000	1,350,000	+100,000
Subtotal.....	$3,375,000	$3,069,000	$1,723,000	$-1,346,000
Maintenance and Related Services				
Maintenance, repair and alteration of buildings and grounds.....	$11,050,000	$9,388,000	$10,012,000	$+624,000
Maintenance and repair of equipment.....	2,023,000	2,002,000	2,160,000	+158,000
Custodial services..	10,318,000	8,044,000	9,667,000	+1,623,000
Subtotal.....	$23,391,000	$19,434,000	$21,839,000	$+2,405,000
Operation of Facilities				
Utilities.....	$13,294,000	$13,666,000	$14,050,000	$+384,000
Supplies and equipment.....	10,051,000	9,795,000	9,970,000	+175,000
Subtotal.....	$23,345,000	$23,461,000	$24,020,000	$+559,000
Range Operations.....	$35,730,000	$34,908,000	$36,501,000	$+1,593,000
Total, Facilities Services.....	$85,841,000	$80,872,000	$84,083,000	$+3,211,000

	1969	1970	1971	Change in 1971
Rental of real property.	$1,821,000	$1,819,000	$373,000	$-1,446,000

Rental of land and property is required to house personnel and provide storage and warehouse space for supplies and materials where space is not available in government-owned facilities. Funds required for this purpose

are estimated at $373,000 in 1971, a decrease of $1,446,000 under the 1970 estimate. The decrease results largely because of the phase out of the Electronics Research Center in 1971.

	1969	1970	1971	Change in 1971
Minor construction and modifications.....	$1,554,000	$1,250,000	$1,350,000	$+100,000

This activity provides for additions, modifications, and minor construction of facilities within statutory limitations. The requirements are of a continuing nature which are generated by changes in the research and development program, as well as development of new technology. The estimate for 1971 includes an increase of $325,000 at the Langley Research and the Marshall Space Flight Centers for projects deferred from 1970, partially offset by a $224,000 reduction in requirements at the Kennedy Space and the Goddard Space Flight Centers.

	1969	1970	1971	Change in 1971
Maintenance, repair and alteration of buildings and grounds.....	$11,050,000	$9,388,000	$10,012,000	$+624,000

The amount estimated for maintenance and repair of buildings and grounds is estimated at $10,012,000 for 1971, an increase of $624,000 from 1970. The estimate provides twelve months' funding at the increased man year cost rate contained in current support service contracts. The increase is partially offset by savings from the phase out of operations at the Electronics Research Center and the completion of the conversion from contractor operation of certain services at the Goddard Space Flight Center to civil service operations.

	1969	1970	1971	Change in 1971
Maintenance and repair of equipment.....	$2,023,000	$2,002,000	$2,160,000	$+158,000

Maintenance and repair of equipment consists of work necessary to keep mechanical, electrical, electronic laboratory, and shop equipment operational. The cost of these services is estimated to be $2,160,000 in 1971, an increase of $158,000 from 1970. This increase results from increased requirements at the Marshall Space Flight Center related to increased service contract cost rates for 1970 carried into 1971.

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	1969	1970	1971	Change in 1971
Custodial services..	$10,318,000	$8,044,000	$9,667,000	$+1,623,000

The estimate for custodial services, which includes janitorial, cleaning, protective, security fire protection and refuse handling services is $9,667,000 for 1971. This estimate provides twelve months funding at the increased man year cost rate contained in current support services contracts. The increase of $1,623,000 is partially offset by savings from the phase out of ERC.

	1969	1970	1971	Change in 1971
Utilities.....	$13,294,000	$13,666,000	$14,050,000	$+384,000

Funds required for utilities in 1971 are $14,050,000, an increase of $384,000. This increase results from the increased utility rate schedule charged the Marshall Space Flight Center by the Redstone Arsenal, the increased operations of wind tunnels, and the operation of other new research facilities at the Ames and Langley Research Centers in support of the aeronautics research program, being partially offset by savings due to the phase out of the Electronics Research Center.

	1969	1970	1971	Change in 1971
Supplies and equipment.....	$10,051,000	$9,795,000	$9,970,000	$+175,000

The estimate for supplies, materials, and equipment in support of the operation of NASA in-house facilities is estimated to increase by $175,000 in 1971. This increase, which is the sum of minor increases for most installations, results from the need to procure equipment replacements not made in 1970 and to replenish supply and material inventories depleted in 1970.

	1969	1970	1971	Change in 1971
Range operations.....	$35,730,000	$34,908,000	$36,501,000	$+1,593,000

Over 40 percent of the estimate for all of NASA facilities services relates to services procured at the Kennedy Space Center through major support contractors for services, utilities, and for support received from the Air Force Eastern Test Range. Services received through contractors are

primarily utilized at the Merritt Island Launch Area. These services are provided by three major support contractors and cover facilities engineering and planning, maintenance, repair and operation of facilities and utilities; maintenance of roads and grounds; supply operations; publication and graphics support; and library services. Reimbursements to the Air Force, except for utilities, are primarily for requirements at the Cape Kennedy Air Force Station complex; including maintenance and repair of buildings and equipment; security; exterminating; printing; medical services; and supply support. For convenience in understanding the total requirements, these activities are consolidated under Facilities Services, and not distributed to other categories. The estimate for range operations in 1971 is $36,501,000, an increase of $1,593,000 from the 1970 level. The following table summarizes funding requirements by purpose:

	1969	1970	1971	Change in 1971
ADP operations....	$2,746,000	$2,454,000	$2,599,000	$+145,000
Utilities.....	3,705,000	3,752,000	3,825,000	+73,000
Maintenance, repair, alterations, and operation of facilities...	12,376,000	12,905,000	14,226,000	+1,321,000
Protective services.....	6,291,000	5,800,000	5,800,000	---
Janitorial and cleaning services.....	923,000	748,000	771,000	+23,000
Support services..	9,689,000	9,249,000	9,280,000	+31,000
Total.....	$35,730,000	$34,908,000	$36,501,000	$+1,593,000

The increased fund requirements of $1,593,000 required in 1971 provide for twelve months' funding at the increased man year cost rate contained in current support service contracts, partially offset by decreased man years of effort. The increase in utilities is due to a higher rate paid to the Air Force for utilities services.

Mr. Evins. Facilities services goes from $85.4 million in 1969, to $80.9 million in 1970, and to $84.1 million in 1971.

We know what this is. Is a contract let by NASA to individual contractors or does GSA do this for you and you reimburse them?

Mr. Lilly. Yes, sir.

There are some cases we reimburse GSA, for instance, here in Headquarters we do for certain services, et cetera. At our other locations, these are on contracts let by the centers.

I may point out one big element in here, Mr. Evins, and that is at the Kennedy Space Center.

In the total launch area, we include all of our contractual services for the Merritt Island and launch area into this particular category, rather than trying to break out the individual pieces of each contract and put them into these other areas.

As you will notice, of this amount $39 million is at the Kennedy Space Center.

RENTAL OF REAL PROPERTY

Mr. Evins. What is the $373,000 for in rental of real property?

Mr. Lilly. The rental of real property is the amount of money we are paying for rent of space.

Mr. Evins. Where, with all your facilities?

Mr. Lilly. I can provide a total list of those, Mr. Evins.

You talked of one this morning at Goddard, the Institute in New York. We have lease space out here at Goddard for storage space. There is lease space in a number of our centers.

I can provide a complete list of those if you like.

LEASED PROPERTY

Mr. Evins. Supply a list of where you are leasing property.

(The information follows:)

Cognizant NASA Installation, Lease Location(s) With Type of Space Leased

Ames Research Center, Mountain View, Calif., storage.
Electronics Research Center, Cambridge, Mass., office/laboratory/storage.
Goddard Space Flight Center, Greenbelt, Md., area, office/laboratory/storage, Baltimore, Md., office/storage, New York City, office/laboratory/computer, Hawaii, technical.
Headquarters, Washington Metropolitan, office/technical/storage.
Jet Propulsion Laboratory, Pasadena, Calif., office/laboratory/storage.
Kennedy Space Center, Cape Canaveral, Fla., technical.
Marshall Space Flight Center, Huntsville, Ala., office.

CUSTODIAL SERVICES

Mr. Evins. Your custodial services program goes up from $8 million in 1970 to $9,667,000 in 1971. This is unbelievable, why should there be this increased cost?

Mr. Lilly. Basically, Mr. Evins, it is a reflection of the escalation in wages that has been occurring in the last couple of years. The increases, as you know, have ranged anywhere up to 9 or 10 percent in wages.

Also, one of the big elements is that when we were faced with reductions in 1970 we had certain contracts that were awarded during the year covering months of contractual services into the following year which we cut back.

Mr. EVINS. We just went over your facilities budget for maintenance and repairs and improvement, and we understand custodial services, but why should you have maintenance, repairs and construction also included in this budget? Why would it not have been in the other budget?

Mr. LILLY. No, sir. The numbers I gave you on the maintenance, et cetera, are not in this budget.

Mr. EVINS. Page RPM 1–22 says minor construction and modification, but the next item is large, maintenance, repair and alteration of building and ground, $10 million in 1971.

Mr. LILLY. Yes, sir.

Now you want to know the difference between those two?

Mr. EVINS. The difference between this budget and the one we just discussed, construction and facilities at various stations.

Mr. LILLY. All right. The research and program management takes care of the day-to-day maintenance, scheduled maintenance, to maintain our facilities; painting, things of this nature.

Now, the amount of the $14 million reflected in the construction and facilities budget are those amounts to do more than the day-to-day maintenance. These are repairing roofs, replacing boilers. Those kinds of major repairs and rehabilitations are in the construction budget. Those on the day-to-day maintenance that one has to do, such as——

Dr. PAINE. Fixing a light switch, that sort of thing, that is in here.

Mr. EVINS. All right. These are day-to-day. The others are contracts for major repairs.

Are these support contracts renegotiated every year and how many contractors are invited to bid?

Mr. LILLY. Most of the support contractor effort, Mr. Evins, are awarded on a 1-year basis with options to renew usually on a 3-year and sometimes up to a 5-year basis. There is full competition in all of these awards.

RANGE OPERATIONS CONTRACTORS

Mr. EVINS. Supply us a list of the contractors and amounts for your range operations.

Mr. LILLY. Yes, sir; we will be glad to.

(The information follows:)

Support contractors and amounts for range operations at Kennedy Space Center financed from research and program management appropriation

Contractor:	*Obligations, fiscal year 1970*
Trans World Airlines, Inc	$24,355,000
Federal Electric Corp	2,454,000
Service Technology Corp	2,402,000
Unitec Corp. and Mercury	249,000
Subtotal, support contractor	29,460,000
Utilities and reimbursable services provided by the Air Force	5,448,000
Total, range operations	34,908,000

Mr. EVINS. Any questions, gentlemen?

TECHNICAL SERVICES

We will take the next item, "Technical services." It goes down from $18 million in 1969, to $15.3 million in 1970, to $14.3 million in 1971.

We will place pages RPM 1–25 through RPM 1–28 in the record.

(The pages follow:)

RESEARCH AND PROGRAM MANAGEMENT

FISCAL YEAR 1971 ESTIMATES

TECHNICAL SERVICES

	1969	1970	1971	Change in 1971
Technical services...	$18,026,000	$15,272,000	$14,327,000	$-945,000

DESCRIPTION:

The estimate for technical services provides for the costs of engineering services, and of scientific and technical information and educational/informational programs. Included in the engineering services are the costs of engineering design and reliability and quality assurance studies. The scientific and technical information programs, which furnish up-to-date reporting of scientific and technical programs, provide for the support of the technical libraries located at various installations, the acquisition and dissemination of scientific and technical literature, and for educational/informational programs.

DISTRIBUTION OF FUND REQUIREMENTS BY INSTALLATION:

	1969	1970	1971
Manned Spacecraft Center.....	$1,956,000	$2,317,000	$2,275,000
Marshall Space Flight Center....	1,627,000	1,377,000	1,459,000
Goddard Space Flight Center.....	967,000	801,000	796,000
Wallops Station.....	51,000	59,000	58,000
Ames Research Center.....	41,000	9,000	9,000
Electronics Research Center.....	866,000	981,000	---
Flight Research Center.....	47,000	73,000	77,000
Langley Research Center.....	73,000	73,000	73,000
Lewis Research Center.....	737,000	36,000	90,000
Space Nuclear Propulsion Office.	67,000	---	---
NASA Headquarters.....	11,594,000	9,546,000	9,490,000
Total.....	$18,026,000	$15,272,000	$14,327,000

BASIS OF FUND REQUIREMENTS

SUMMARY OF TECHNICAL SERVICES

	1969	1970	1971	Change in 1971
ENGINEERING SERVICES	$1,845,000	$1,144,000	$552,000	$-592,000
SCIENTIFIC AND TECHNICAL INFORMATION AND EDUCATIONAL PROGRAMS				
Operation of NASA technical library	1,563,000	1,965,000	1,568,000	-397,000
Educational/informational programs	4,905,000	3,539,000	3,510,000	-29,000
Scientific and technical information.....	9,713,000	8,624,000	8,697,000	+73,000
Subtotal.....	$16,181,000	$14,128,000	$13,775,000	$-353,000
Total.....	$18,026,000	$15,272,000	$14,327,000	$-945,000
ENGINEERING SERVICES.	$1,845,000	$1,144,000	$552,000	$-592,000

Engineering services provide for reliability and quality assurance studies; engineering design services for the design of minor construction, repair and alteration projects, special tooling, equipment and machine parts; and other related engineering services.

The $552,000 requested for 1971 is $592,000 less than the $1,144,000 planned for 1970. Included in the decrease is $476,000 which relates to the phase out of the Electronics Research Center; $42,000 at the Manned Spacecraft Center, $40,000 at the Marshall Space Flight Center, $40,000 at Headquarters and $2,000 at other locations which are related to reduced requirements for these services.

	1969	1970	1971	Change in 1971
SCIENTIFIC AND TECHNICAL INFORMATION AND EDUCATIONAL PROGRAMS.....	$16,181,000	$14,128,000	$13,775,000	$-353,000

Included in these programs are the costs of the technical libraries, educational/informational programs and the scientific and technical

information services. The funding required to finance these programs is $13,775,000 in 1971, a decrease of $353,000 from the 1970 level. The costs are summarized as follows:

	1969	1970	1971	Change in 1971
Operation of technical libraries.....	$1,563,000	$1,965,000	$1,568,000	$-397,000

The cost of the operation of technical libraries in 1971 will be $1,568,000 which is a decrease of $397,000 under 1970. This decrease occurs largely at the Electronics Research Center (ERC) because of its phase out in 1971 and at Headquarters.

	1969	1970	1971	Change in 1971
Educational/Informational Programs.....	$4,905,000	$3,539,000	$3,510,000	$-29,000

The educational/informational programs provide for the gathering and dissemination of information about the agency's programs to the mass communication media, the general public, and to the educational community at the elementary and secondary levels. The cost for these programs in 1971 is estimated to be $3,510,000, $29,000 less than the estimate for 1970, which results largely from the phase out of ERC. Assistance to the mass communications media includes the gathering and exposition of newsworthy material in support of their requests. This material and assistance is in several forms such as press kits, news releases, television and radio information tapes and clips, and feature material.

Research, development, and operational missions in aeronautics and space continue to serve as an educational stimulus to students and teachers, as well as providing substantive knowledge. Response to expressed needs from students and teachers is provided by developing curriculum supplements in space-related areas such as physics, biology, chemistry, and math; assistance to over 1,000 teacher workshops and professional education meetings with over 30,000 teachers participating; sponsorship of the Youth Science Congresses and participation in science fairs. The largest single program is the Spacemobile, a touring space-science education lecture demonstration unit. Budget restraints have forced retrenchments in some of these areas. For example, the number of publications ordered for free distribution has been cut back to a few thousand, or only enough to announce their availability for purchase from the Superintendent of Documents. The number of operating Spacemobile units is reduced to 26 from 30. The staffing has been cut back and consequently, the number of bookings will decrease to approximately 10,000 from 12,000 lecture-demonstrations

a year. The program will still include over 400 demonstrations for teachers at workshops and other in-service training sessions. The estimated live spacemobile audience is over two million people with an additional eight million seeing or hearing the program on television or radio.

	1969	1970	1971	Change in 1971
Scientific and technical information.....	$9,713,000	$8,624,000	$8,697,000	$+73,000

The scientific and technical information activity includes the cost of the NASA Scientific and Technical Information Facility, documentation services, publication services, systems development and translation services. The cost of these services is estimated to increase by $73,000 in 1971 to $8,697,000. An increase of $122,000 at the Marshall Space Flight Center is partially offset by savings due to the phase out of ERC. The remaining effort will remain essentially at the same funding level as planned for 1970. The largest requirement is the NASA Scientific and Technical Information Facility under the cognizance of Headquarters, which will cost $4.1 million in 1971. The level of cost for all other information services, estimated at $4.6 million, is essentially the same as 1970. These costs are for the documentation of worldwide aerospace journal and report literature; monographs, and technical reviews; analyzing, evaluating, and testing new methods and systems in the field of scientific communications to increase the effectiveness of the technical information program; and translating foreign language technical books, reports, and journal articles required to meet the needs of NASA and its contractor scientific personnel which are used to keep abreast of world developments in the space sciences and related fields.

Mr. EVINS. Scientific and technical information increased $73,000 in 1971.

To whom is this scientific information made available?

Mr. LILLY. That is made available to the general public.

However, we do have specialized areas, such as engineering.

ADMINISTRATIVE SUPPORT

Mr. EVINS. We will turn to the "Administrative support" section and place in the record pages RPM 1-29 through RPM 1-33.

(The pages follow:)

RESEARCH AND PROGRAM MANAGEMENT

FISCAL YEAR 1971 ESTIMATES

ADMINISTRATIVE SUPPORT

	1969	1970	1971	Change in 1971
Administrative support services.....	$42,611,000	$37,822,000	$37,872,000	$+50,000

DESCRIPTION:

Included in Administrative Support Services are general services which support overall installation operations. The administrative expenses for communications, printing and reproduction, supplies, materials and equipment, transportation (motor pool, administrative aircraft services and operations, and movements by common carrier), and other services (installation operations and medical services), are provided for in this function.

DISTRIBUTION OF FUND REQUIREMENTS BY INSTALLATION:

	1969	1970	1971
Kennedy Space Center.....	$11,210,000	$10,502,000	$10,239,000
Manned Spacecraft Center.....	8,258,000	7,177,000	7,722,000
Marshall Space Flight Center..	6,837,000	4,485,000	4,631,000
Goddard Space Flight Center...	3,531,000	3,464,000	3,590,000
Wallops Station.....	982,000	789,000	808,000
Ames Research Center.....	837,000	744,000	745,000
Electronics Research Center...	1,043,000	1,397,000	500,000
Flight Research Center.....	613,000	537,000	608,000
Langley Research Center.....	2,512,000	2,563,000	2,718,000
Lewis Research Center.....	909,000	841,000	881,000
NASA Headquarters.....	5,879,000	5,323,000	5,430,000
Total.....	$42,611,000	$37,822,000	$37,872,000

BASIS OF FUND REQUIREMENTS:

SUMMARY OF ADMINISTRATIVE SUPPORT SERVICES

	1969	1970	1971	Change in 1971
COMMUNICATIONS				
Leased lines and long distance tolls.....	$4,480,000	$4,311,000	$4,308,000	$-3,000
Local telephone service.....	5,754,000	5,615,000	5,440,000	-175,000
Other communications.	1,981,000	1,955,000	2,022,000	+67,000
Subtotal.....	12,215,000	11,881,000	11,770,000	-111,000
ADMINISTRATIVE PRINTING	6,191,000	5,578,000	5,464,000	-114,000
SUPPLIES, MATERIALS AND EQUIPMENT				
Supplies and materials.....	7,171,000	5,868,000	5,758,000	-110,000
Equipment.....	1,808,000	1,408,000	1,361,000	-47,000
Subtotal.....	8,979,000	7,276,000	7,119,000	-157,000
TRANSPORTATION				
Center operations...	6,565,000	5,647,000	5,622,000	-25,000
Common carrier.....	645,000	641,000	625,000	-16,000
Subtotal.....	7,210,000	6,288,000	6,247,000	-41,000
ADMINISTRATIVE SUPPORT SERVICES				
Installation support services..	6,635,000	5,913,000	6,306,000	+393,000
Medical services....	1,381,000	886,000	966,000	+80,000
Subtotal.....	8,016,000	6,799,000	7,272,000	+473,000
Total, Administrative Support Services....	$42,611,000	$37,822,000	$37,872,000	$+50,000

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	1969	1970	1971	Change in 1971
COMMUNICATIONS.....	$12,215,000	$11,881,000	$11,770,000	$-111,000

The funds required for communications are estimated at $11,770,000 for 1971, a decrease of $111,000 from 1970. Included in this estimate are the costs of leased lines, long distance tolls, local telephone exchange services, and other communications, such as TWX and postage. Installations and their major subinstallations are located in twelve states and the District of Columbia. In addition, business is conducted with companies and institutions in all the states. Consequently, the cost of communications to integrate these centers of work is large. Costs for certain operational communications related to flight activities and dedicated leased lines are excluded from the Research and Program Management appropriation, but are included in the relevant program in the Research and Development appropriation. A summary of communication costs follows:

	1969	1970	1971	Change in 1971
Leased lines and long distance tolls.....	$4,480,000	$4,311,000	$4,308,000	$-3,000

The cost of leased lines and long distance tolls provides for the intercity telephone services for the various installations. The cost of leased lines includes the leasing of the circuits and associated equipment for rapid and reliable contact with contractor plants and other key sites. Long distance toll costs are in addition to the cost of leased lines and include both commercial tolls and reimbursement to the General Services Administration for NASA's use of the Federal Telecommunications System. The slight decrease of $3,000 estimated for 1971 is primarily attributable to the termination of the Electronics Research Center.

	1969	1970	1971	Change in 1971
Local telephone services.	$5,754,000	$5,615,000	$5,440,000	$-175,000

Local telephone service includes not only the cost of providing on-site telephone exchange services, but also the cost of off-site service in the area immediately surrounding our installations. The amount of service provided each installation is determined by the number of personnel, both civil service and contractor, served by the exchange. The decrease in 1971 is mainly due to the planned program reductions in the manned space flight activities as well as the closing of the Electronics Research Center.

	1969	1970	1971	Change in 1971
Other communications.....	$1,981,000	$1,955,000	$2,022,000	$+67,000

Other communications costs provide for costs for cable services, TWX services, and postage. The increase is primarily at Headquarters which pays postage and related fees centrally for the entire agency and is principally related to an anticipated increase in the cost of postage, as indicated by revised samples of usage.

	1969	1970	1971	Change in 1971
ADMINISTRATIVE PRINTING.....	$6,191,000	$5,578,000	$5,464,000	$-114,000

Estimates for administrative printing include funds for contractual printing and the related composition and binding operations. This includes services performed by other agencies, chiefly the Government Printing Office, or by commercial printing firms. All common processes of duplicating, including photostating, blueprinting, microfilming, and other photographic reproductions, are included. In 1971, the costs for printing are $114,000 less than in 1970. This reduction is primarily attributable to reduction in requirements at the Kennedy Space Center associated with the reduced launch schedule planned for FY 1971, and with the termination of the Electronics Research Center.

	1969	1970	1971	Change in 1971
SUPPLIES, MATERIALS AND EQUIPMENT.....	$8,979,000	$7,276,000	$7,119,000	$-157,000

Administrative supplies, materials, and equipment include those items of a general nature which service the entire installation. Excluded are supplies, materials, equipment, and related services which are related directly to a specific project (funded in the R&D appropriation) and those that are facility oriented (included in Facilities Services). Of the amount required in 1971, $5,758,000 is for supplies and materials, and $1,361,000 for purchased and rented equipment. The overall requirement decreases by $157,000. This reduction is primarily attributable to the termination of the Electronics Research Center.

	1969	1970	1971	Change in 1971
TRANSPORTATION.....	$7,210,000	$6,288,000	$6,247,000	$-41,000

Transportation services include local motor pool operations and associated services, center aircraft operations and services, as well as the movement of supplies, materials, equipment, and related items by common carrier.

The $41,000 decrease for 1971 consists of a major reduction of $320,000 due to the closing of the Electronics Research Center offset by small increases at several other installations.

	1969	1970	1971	Change in 1971
ADMINISTRATIVE SUPPORT SERVICES	$8,016,000	$6,799,000	$7,272,000	$+473,000

Administrative support services include installation support services and center medical services. The funding required for 1971 is $7,272,000, $473,000 more than in 1970. These costs are summarized as follows:

	1969	1970	1971	Change in 1971
Installation support services	$6,635,000	$5,913,000	$6,306,000	$+393,000

Installation support services include those services which support the installation generally; such as logistics support, supply operations, mail and messenger services, and other related services. The cost estimate is based on twelve months funding of the increased man year cost rate for support service contracts currently in effect.

	1969	1970	1971	Change in 1971
Medical services	$1,381,000	$886,000	$966,000	$+80,000

Medical services include the cost of the installations' health units and of employee health maintenance programs. The cost estimate for medical services is based on twelve months funding of the increased man year cost rate for support services contracts at installations where health units are not staffed with civil service personnel.

Mr. EVINS. The administrative support budget goes from $42.6 million in 1969, to $37.8 million in 1970, with a slight increase in 1971.

Are there any questions?

We are not going to take up these individual installations. We have been over them.

NASA HEADQUARTERS

We will turn to the "Headquarters" section and place in the record pages RPM 2-98 through RPM 2-101.

(The pages follow:)

RESEARCH AND PROGRAM MANAGEMENT

FISCAL YEAR 1971 ESTIMATES

NASA HEADQUARTERS

MISSION:

The mission of the National Aeronautics and Space Administration Headquarters is to plan and provide executive direction for the programs authorized by the Congress, and to implement the national objectives stated in the National Aeronautics and Space Act of 1958, as amended. The principal statutory functions are:

1. To conduct research into, and for the solution of, problems of flight within and outside the earth's atmosphere and to develop, construct, test, and operate aeronautical and space vehicles for research purposes.

2. To conduct activities required for the exploration of space with manned and unmanned vehicles.

3. To arrange for participation by the scientific community in planning scientific measurements and observations to be made through use of aeronautical and space vehicles, and conduct or arrange for the conduct of such measurements and observations.

4. To provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof.

The following offices at Headquarters assist management in carrying out the technical aspects of this mission:

Office of Manned Space Flight - Responsible for all NASA activities directly involving manned space flight missions. Programs include:

Apollo - Based on the national capability for manned space exploration, as demonstrated by the manned lunar landing missions of Apollo 11 and Apollo 12, to conduct scientific exploration of the moon through lunar orbital and lunar surface operations.

Space Flight Operations - To expand the participation and capabilities of men in scientific technological and applied observations in space through flights of increasing duration and complexity, initially using Apollo hardware or derivatives of Apollo hardware and progressing to an orbital space station resupplied by a fully reusable logistics system.

Advanced Missions - To plan a broad program of explorations which will achieve and maintain a position of space leadership for the United States.

The Office of Manned Space Flight has launch responsibility for major manned and unmanned missions. The three installations primarily concerned with the manned space flight programs are: the George C. Marshall Space Flight Center, including Mississippi Test Facility, Michoud Assembly Facility, and Slidell where a computer facility is located; the Manned Spacecraft Center, including NASA activities at the White Sands Test Facility; and the John F. Kennedy Space Center, NASA, including NASA activities at the Eastern and Western Test Ranges.

Office of Space Science and Applications - Responsible for the NASA automated space flight program directed toward scientific investigations of the solar system utilizing ground based, airborne, and space techniques including sounding rockets, earth satellites, and deep space probes; for scientific experiments to be conducted by man in space and for assisting in the training of astronaut-scientists; for the research and development of space flight applications in such areas as meteorology, communications, navigation, geodesy, and earth resources surveys, and for the support of operational systems using these developments; and for the development, procurement and use of light and medium class launch vehicles.

The Office of Space Science and Applications has overall institutional responsibility for NASA installations primarily involved in space science and applications programs. These are the Goddard Space Flight Center, Wallops Station, the Jet Propulsion Laboratory (a Government-owned facility operated for NASA by the California Institute of Technology), and the NASA Pasadena Office, a component field activity of Headquarters.

Office of Advanced Research and Technology - Responsible for the planning, direction, execution, evaluation, documentation, and dissemination of the results of all NASA research and technology programs that are conducted primarily to demonstrate the feasibility of a concept, structure, component, or system and which may have general application to the nation's aeronautical and space objectives. This office is also responsible for coordinating NASA's total program of supporting research and technology related to carrying out specific flight missions in order to avoid unnecessary duplication and to insure an integrated and balanced agency research program.

In addition, this office has over-all institutional responsibility for the research centers primarily involved in carrying out NASA's advanced research programs. These installations are: the Ames Research Center, the Flight Research Center, the Langley Research Center, the Lewis Research Center, and the Space Nuclear Propulsion Office.

The NASA Pasadena Office - Pasadena, California, is a component field activity of the NASA Headquarters Office of Space Science and Applications. Its responsibilities are to negotiate and administer NASA contracts with the

California Institute of Technology for the operation of the Jet Propulsion Laboratory; provide patent and technology utilization services as they relate to prime and subcontracts at the Jet Propulsion Laboratory; and perform such additional procurement, contract administration, public affairs, communications, financial management, and other functions as may be assigned by the Associate Administrator for Space Science and Applications.

DESCRIPTION:

The NASA Headquarters is located at 400 Maryland Avenue, S.W., Washington, D.C., and also occupies other buildings in the District of Columbia and nearby Virginia. Except for some office space leased in the District of Columbia and a storage area in Virginia, personnel occupy Government-owned buildings. The NASA Pasadena Office is physically located at the Jet Propulsion Laboratory in Pasadena, California.

SUMMARY OF RESOURCES REQUIREMENTS:

	FUNDS		
Functions	1969	1970	1971
Personnel	$38,002,000	$41,929,000	$42,653,000
Travel	2,539,000	3,135,000	3,262,000
Automatic data processing	2,336,000	1,559,000	1,574,000
Facilities services	427,000	326,000	326,000
Technical services	11,594,000	9,546,000	9,490,000
Administrative support	5,879,000	5,323,000	5,430,000
Total, fund requirements	$60,777,000	$61,818,000	$62,735,000

PERSONNEL

	1969	1970	1971
1. Permanent Positions by Program:			
Manned Space Flight			
Apollo	196	153	143
Space flight operations	127	188	188
Advanced missions	52	40	40
Space Science and Applications			
Physics and astronomy	60	60	59
Lunar and planetary exploration	53	56	55
Bioscience	33	33	29
Space applications	52	55	56
Launch vehicle procurement	26	26	25
Advanced Research and Technology			
Basic research	29	30	29
Space vehicle systems	41	41	41
Electronics systems	31	31	30
Human factor systems	22	23	22
Space power and electric propulsion systems	28	28	28
Chemical propulsion	22	22	21
Aeronautical vehicles	29	30	29
University Affairs			
Sustaining university program	12	12	9
Tracking and Data Acquisition	54	55	54
Technology Utilization	18	18	18
Subtotal, positions by program	885	901	876
2. Indirect Positions:			
Director and staff	433	445	435
Administrative support	272	262	252
Research and development support	503	515	510
Subtotal, indirect positions	1,208	1,222	1,197
Total, permanent positions	2,093	2,123	2,073

Mr. EVINS. The mission of NASA is to plan and provide executive direction, conduct research, conduct activities for the exploration of space, arrange for participation of the scientific community, and provide for widest practicable and appropriate dissemination of information.

We had a budget of $60.8 million in 1969, $61.8 million in 1970, and $62.7 million in 1971. This is about a $1 million increase next year, although your jobs are slightly down.

SPECIAL ANALYSIS, JPL

We will now turn to the "Special analysis for the Jet Propulsion Laboratory."

Mr. Reporter, place in the record pages RPM 2-103 through RPM 2-106.

(The pages follow:)

RESEARCH AND PROGRAM MANAGEMENT TYPE COSTS

FISCAL YEAR 1971 ESTIMATES

JET PROPULSION LABORATORY

The Jet Propulsion Laboratory (JPL) is a Government-owned facility managed and operated by the California Institute of Technology under a contract with NASA. The cost of operating the Laboratory is funded from the Research and Development appropriation, except for the lease of administrative aircraft and the purchase of passenger motor vehicles which are funded from the Research and Program Management appropriation and are included in the NASA Headquarters budget presentation. The Research and Program Management type costs are presented for information only and are not a part of the NASA Research and Program Management budget.

MISSION:

The Jet Propulsion Laboratory performs a variety of engineering, scientific, and management missions including:

1. Project management of complete automated spacecraft systems for planetary exploration.

2. Operation of the Deep Space Network including tracking and data acquisition activities required by planetary flights, as well as backup to the Manned Space Flight Network.

3. A continuing program of supporting research and technology.

Specific examples of the Jet Propulsion Laboratory's activity in these areas are:

Planetary Exploration - The Mariner series of automated spacecraft was designed at the Jet Propulsion Laboratory. The Laboratory has been responsible for the project management of all Mariner missions including the integration, assembly, and testing of the spacecraft. Mariner II accomplished the first successful flyby of Venus in 1962, and in 1965, Mariner IV photographed the surface of Mars as it passed within 6,200 miles of the planet's surface. Mariner V was launched in June 1967 and four months later passed within 2,131 miles of Venus providing information on the atmospheric composition of the planet and other scientific data. Mariners VI and VII have just completed a successful dual mission to Mars in 1969. Mariner VI made its pass within 2,100 miles of Mars and photographed the planet's equatorial region, while Mariner VII photographed the southern hemisphere including the polar cap of Mars from 2,100 miles. Both spacecraft returned high quality pictures of the planet's surface. Photographs and science data provided by Mariners VI and VII have significantly increased man's knowledge of the Red Planet. Additional Mariner missions to the planets are planned for 1971 and 1973.

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Supporting Research and Technology - The Jet Propulsion Laboratory maintains a strong program of supporting research and technology, and advanced development. Much of the knowledge gained from active research in such areas as fluid physics, electrophysics, materials, applied mathematics, and guidance and control will continue to be applied to problems in space exploration.

Another activity of considerable importance is the development and fabrication of scientific experiments to be flown on vehicles other than Jet Propulsion Laboratory spacecraft. These include high-altitude balloons, Aerobee rockets, NASA aircraft, and Earth orbiters. The scientific teams involved in these experiments frequently include faculty members of various universities and staff members from NASA field installations.

Tracking and Data Acquisition - The Jet Propulsion Laboratory is responsible for the design and operation of the worldwide Deep Space Network. The Deep Space Network is comprised of the Space Flight Operations Facility in Pasadena as well as tracking and data acquisition stations located in California, Spain, South Africa and Australia. The Space Flight Operations Facility is the central communications and control facility for the conduct of flight missions. The Deep Space Network provides support not only to Jet Propulsion Laboratory managed flight missions, but also for all manned Lunar Missions, and for projects such as Pioneer and Helios which are managed by other NASA field installations.

DESCRIPTION:

The Jet Propulsion Laboratory is located in Pasadena, California, approximately 20 miles north of downtown Los Angeles. Subsidiary facilities are located at Goldstone, California (tracking and data acquisition), Edwards Air Force Base, Muroc, California (solid propellant formulation and testing), and Table Mountain, California (open air testing and astronomy).

At Pasadena, the Laboratory occupies 175.9 acres of land of which 145.9 acres are owned by NASA and 30 acres are leased. At Goldstone, facilities are located on land occupied under permit from the Army. At Edwards Air Force Base, facilities are located on land occupied under permit from the Air Force. Facilities at Table Mountain are located on land occupied under permit from the Forest Service of the Department of Agriculture. The capital investment of the Jet Propulsion Laboratory, including the Deep Space Network and contractor-held facilities, as of June 30, 1969, was $193,425,000.

SUMMARY OF RESOURCES REQUIREMENTS:

FUNDS

Functions	1969	1970	1971
Personnel	$59,380,000	$67,160,000	$71,211,000
Travel	2,468,000	2,259,000	2,472,000
Automatic data processing	3,531,000	5,379,000	5,375,000
Facilities services	5,995,000	6,572,000	6,556,000
Technical services	674,000	784,000	779,000
Administrative support	2,420,000	2,495,000	2,462,000
Total, fund requirements	$74,468,000	$84,649,000	$88,855,000

PERSONNEL

	1969	1970	1971
1. Permanent Positions by Program:			
Manned Space Flight			
Apollo	29	43	36
Advanced missions	17	17	17
Space Science and Applications			
Physics and astronomy	12	11	8
Lunar and planetary exploration	949	903	859
Bioscience	30	30	30
Space applications	30	67	71
Launch vehicle procurement	2	7	7
Advanced Research and Technology			
Basic research	117	109	109
Space vehicle systems	39	39	39
Electronics systems	71	88	88
Human factor systems	2	-	-
Space power and electric propulsion systems	77	94	94
Chemical propulsion	48	58	58
Aeronautical vehicles	-	2	2
Tracking and Data Acquisition	454	494	494
Subtotal, positions by program	1,877	1,962	1,912
Direct Support	515	545	533
2. Indirect Positions	1,598	1,693	1,655
Total, permanent positions	3,990	4,200	4,100

The Jet Propulsion Laboratory is a Government-owned facility managed and operated by the California Institute of Technology under a contract with NASA.

The capital investment of the Jet Propulsion Laboratory, including the Deep Space Network and contractor-held facilities is $193,425,000. In 1969, the funding level for JPL was $74,468,000. In 1970, it is $84,649,000 and in 1971, it is $88,855,000.

This is more than $10 million increase from 1969 to 1970 and a $4 million increase from 1970 to 1971, or a $14 million increase in 2 years. Every time you have a contract, it goes up.

That is what I speculated a while ago. You put $1 million extra facility in there, they will come up with a $2, $3 or $5 million increase next year. Is there any way to hold down these costs, Mr. Administrator?

Dr. PAINE. This of course reflects the level of the program activity at JPL. It does reflect increased activity, as we move up to the Mariner-Mars exploration and preparation for the other planetary programs.

Mr. EVINS. Mr. Administrator, I want to say that we are proud of our astronauts, we are proud of this great scientific team and we look with great pride upon it, we boast about it daily. But when we look at the costs, we must be prudent in our deliberations.

Dr. PAINE. Mr. Chairman, I think you see in the budget before you a very heroic attempt on the part of the Space Agency to trim its costs, while giving the Nation the best possible space program to do this with a substantially lower budget.

Mr. BOLAND. One of the remarkable feats of your Apollo program is that it was done with the amount of money with which it was done.

Dr. PAINE. I think that is true. There was the question of whether it could be done at all in the 1960's. I feel this was done in a way that it gave the taxpayers their dollars' worth.

Mr. EVINS. We cannot quarrel with success. We can only commend you.

GENERAL SUMMARY

We will place in the record the summary sheets, pages SA–1, SA–2, and SA–7.

(The pages follow:)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1971 ESTIMATES

SUMMARY OF APPROPRIATION BUDGET PLANS BY INSTALLATION

(In millions of dollars)

Installation	Research and Development			Construction of Facilities			Research and Program Management			Total		
	1969	1970	1971	1969	1970	1971	1969	1970	1971	1969	1970	1971
John F. Kennedy Space Center, NASA	386.2	269.6	226.8	8.0	12.5	.6	95.8	97.5	98.2	490.0	379.6	325.6
Manned Spacecraft Center	1,091.1	1,036.9	623.5	1.3	1.7	.9	98.9	104.5	107.8	1,191.3	1,143.1	732.2
Marshall Space Flight Center	693.9	694.3	576.2	---	---	.5	116.3	121.7	124.7	810.2	816.0	701.4
Michoud Assembly Facility	---	---	---	.4	---	---	---	---	---	.4	---	---
Goddard Space Flight Center	419.1	430.6	476.4	---	.7	2.0	73.2	84.8	87.7	492.3	516.1	566.1
Wallops Station	7.9	8.5	7.4	.5	.5	---	9.1	9.5	9.8	17.5	18.5	17.2
Jet Propulsion Laboratory	132.2	163.5	156.8	---	---	2.0	---	---	---	132.2	163.5	158.8
Ames Research Center	60.2	63.5	73.9	.4	---	1.5	34.0	36.4	38.2	94.6	99.9	113.6
Electronics Research Center	24.1	22.6	---	---	---	---	17.2	19.5	4.5	41.3	42.1	4.5
Flight Research Center	17.1	12.4	15.0	---	---	---	9.7	10.1	10.5	26.8	22.5	25.5
Langley Research Center	84.2	95.9	104.4	---	4.8	---	63.0	68.0	70.7	147.2	168.7	175.1
Lewis Research Center	112.0	112.5	131.8	---	---	---	67.9	72.4	75.2	179.9	184.9	207.0
Space Nuclear Propulsion Office	31.5	33.9	35.6	---	---	3.5*	2.1	2.2	2.3	33.6	36.1	41.4
NASA Headquarters:	(141.9)	(169.6)	(178.3)	(---)	(---)	(---)	(60.8)	(61.8)	(62.7)	(202.7)	(231.4)	(241.0)
Headquarters	138.7	167.0	176.8	---	---	---	59.1	60.0	60.8	197.8	227.0	237.6
NASA Pasadena Office	3.2	2.6	1.5	---	---	---	1.7	1.8	1.9	4.9	4.4	3.4
Various Locations	---	---	---	20.5	29.5	18.6	---	---	---	20.5	29.5	18.6
Facility Planning and Design	---	---	---	1.0	3.5	5.0	---	---	---	1.0	3.5	5.0
Total Budget Plan	3,201.4	3,113.8	2,606.1	32.1	53.2	34.6	648.0	688.4	692.3	3,881.5	3,855.4	3,333.0

* Nuclear Rocket Development Station.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1971 ESTIMATES

DISTRIBUTION OF RESEARCH AND DEVELOPMENT BUDGET PLAN BY INSTALLATION AND FISCAL YEAR

(Thousands of dollars)

PROGRAM OFFICE	Total	J. F. Kennedy Space Center, NASA	Manned Spacecraft Center	Marshall Space Flight Center	Goddard Space Flight Center	Jet Propulsion Laboratory	Wallops Station	Ames Research Center	Electronics Research Center	Flight Research Center	Langley Research Center	Lewis Research Center	Space Nuclear Propulsion Office	NASA Headquarters	NASA Pasadena Office
Office of Manned Space Flight															
1969	2,177,500	382,800	1,070,028	680,333	50	100	---	165	---	---	250	---	---	43,796	---
1970	2,031,745	367,918	1,013,748	638,707	200	814	---	3,457	410	---	2,048	---	---	64,443	---
1971	1,474,200	223,700	605,200	559,700	---	---	---	1,870	---	---	330	---	---	85,400	---
Office of Space Science and Applications															
1969	453,238	3,450	10,861	2,176	201,989	61,246	1,447	34,404	3,478	---	25,448	51,580	---	57,159	---
1970	519,718	1,717	14,416	1,851	215,203	91,103	1,408	31,493	3,147	---	40,995	52,058	---	66,327	---
1971	565,700	3,068	14,030	2,390	255,825	73,235	1,085	37,760	---	---	45,370	67,273	---	85,704	---
Office of University Affairs															
1969	9,000	---	---	---	---	---	---	---	---	---	---	---	---	9,000	---
1970	7,000	---	---	---	---	---	---	---	---	---	---	---	---	7,000	---
1971	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Office of Advanced Research and Technology															
1969	278,220	---	4,961	11,104	8,790	23,163	1,073	25,675	20,493	15,079	57,048	60,446	31,497	15,699	3,192
1970	272,302	---	8,690	12,098	8,830	20,428	1,115	28,514	18,974	10,530	51,989	60,401	33,925	14,200	2,608
1971	264,200	---	6,300	13,783	8,440	17,410	100	34,222	---	13,365	57,538	64,310	35,600	11,397	1,535
Office of Tracking and Data Acquisition															
1969	279,672	---	5,300	300	208,221	47,694	5,409	---	100	2,000	1,450	---	---	9,198	---
1970	278,000	---	---	1,460	206,405	51,150	5,985	---	60	1,875	845	---	---	10,020	---
1971	298,000	---	---	400	212,127	66,143	6,240	---	---	1,630	1,160	---	---	10,300	---
Office of Technology Utilization															
1969	3,800	---	---	---	---	---	---	---	---	---	---	---	---	3,800	---
1970	5,000	---	---	---	---	---	---	---	---	---	---	---	---	5,000	---
1971	4,000	---	---	---	---	---	---	---	---	---	---	---	---	4,000	---
Total Budget Plan															
1969	3,201,430	386,250	1,091,150	693,913	419,050	132,203	7,929	60,224	24,071	17,079	84,196	112,026	31,497	138,650	3,192
1970	3,113,765	369,635	1,036,854	694,316	430,638	163,495	8,508	63,464	22,591	12,405	95,877	112,459	33,925	166,990	2,608
1971	2,606,100	226,768	625,530	576,233	476,392	156,788	7,425	73,852	---	14,995	104,398	131,583	35,600	176,801	1,535

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1971 ESTIMATES

CONSOLIDATED SUMMARY

FOR AVIATION TECHNOLOGY

	(Dollars in millions) 1969	1970	1971
OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY			
Research and development:			
Aeronautical vehicles	$74.7	$75.9	$87.1
Electronics systems	11.1	10.5	5.8
Human factor systems	3.0	3.6	2.1
Basic research	5.9	6.2	6.6
Space power and electric propulsion systems	---	.2	.4
Subtotal	94.7	96.4	102.0
Research and program management: Support of aeronautical vehicles program	73.4	85.1	83.5
Construction of facilities	---	4.8	---
Total	$168.1	$186.3	$185.5
Number of direct positions associated with Aviation Technology budget activity	3,140	3,286	3,197

Mr. EVINS. You phased out a couple of facilities, your personnel is less. We understand the general reductions in the space program. Your achievements have been monumental.

We have talked of the future of space and the next decade in space. What we are considering here is launching the next decade in space with some bold new programs, which the President calls bold but balanced.

You are supporting the budget as recommended by the President and the Budget Bureau?

Dr. PAINE. That is correct.

Mr. EVINS. We again commend you all. We thank you all very much. Are there any further questions?

Mr. BOLAND. I just want to commend the Administrator on the great job he has done in this very difficult task and his very fine backup team.

Mr. EVINS. Do you gentlemen have any observations?

I know you join in these accolades and commendations. We commend you, Mr. Administrator.

Thank you very much, Mr. Administrator.

APRIL 7, 1970.

AMENDMENT TO VETERANS' ADMINISTRATION BUDGET FOR 1971

WITNESSES

D. E. JOHNSON, ADMINISTRATOR
F. B. RHODES, DEPUTY ADMINISTRATOR
R. H. WILSON, ASSOCIATE DEPUTY ADMINISTRATOR
J. D. SHYTLE, CONTROLLER
J. Q. BINFORD, ACTING DIRECTOR, BUDGET SERVICE
J. J. CORCORAN, GENERAL COUNSEL
F. R. HOOD, DIRECTOR, INFORMATION SERVICE

DEPARTMENT OF MEDICINE AND SURGERY

DR. M. J. MUSSER, CHIEF MEDICAL DIRECTOR
DR. B. B. WELLS, ACTING DEPUTY CHIEF MEDICAL DIRECTOR
DR. J. D. CHASE, ASSISTANT CHIEF MEDICAL DIRECTOR FOR PROFESSIONAL SERVICES
R. W. WISE, DIRECTOR, BUDGET STAFF, D.M. & S.
DR. D. D. KRAJICEK, ASSISTANT CHIEF MEDICAL DIRECTOR FOR DENTISTRY

DEPARTMENT OF VETERANS BENEFITS

O. B. OWEN, CHIEF BENEFITS DIRECTOR
J. C. PECKARSKY, DEPUTY CHIEF BENEFITS DIRECTOR
E. R. SILBERMAN, DIRECTOR, BUDGETING AND PLANNING SERVICE
J. T. TAAFFE, DIRECTOR, COMPENSATION, PENSION, AND EDUCATION SERVICE

Mr. EVINS. The committee will come to order.

We will consider the budget amendment for the Veterans' Administration. With us is Mr. D. E. Johnson, the Administrator, accompanied by those set out above.

Mr. Johnson, we will be pleased to hear you.

General Statement

Mr. Johnson. I appreciate this opportunity to discuss with you today the 1971 budget amendments for the Veterans' Administration.

We have additional 1971 requirements that increase the budget estimates submitted to you in February by $50 million for medical care and $275.5 million for readjustment benefits.

Last week, the President transmitted to you an amended 1971 budget estimate, increasing our medical care appropriation request by $50 million, from $1,702,200,000 to $1,752,200,000. This increase will provide funds for:

The additional cost (over the amount budgeted) of specialized medical service and spinal cord injury units to be activated in the fourth quarter of this fiscal year, $8.2 million.

Increased staffing for inpatient and outpatient activities and for certain special treatment units, $29.8 million.

Increasing costs and usage of drugs and medicines, including the introduction into the system of certain new drugs, $2 million.

And reduction in equipment and maintenance and repair backlogs, $10 million.

The additional funds will provide an increase of 3,600 in fiscal year 1971 average employment for medical care—from the 134,254 originally requested to a total of 137,854. This is 5,723 more than estimated for the current fiscal year. The substantial increase will permit us to make significant improvements in the scope and quality of the medical care and services we are able to provide our veterans.

Enactment, last month, of the Veterans Education and Training Amendments Act of 1970 increased our 1971 readjustment benefits fund requirements by $275.5 million. A budget amendment in this amount is in process and will be transmitted shortly. Rate increases, effective February 1, 1970, approximate 35 percent. The new law also sets up special programs for servicemen with educational handicaps and provides for an intensification of VA's outreach program. The additional request of $275.5 million will provide a total of $1,354.5 million in fiscal year 1971 for readjustment benefits, an increase of $281.8 million over the current fiscal year, including anticipated supplementals. As you know, these requirements are for statutory benefits and are not subject to administrative control.

This concludes my general statement. We will be pleased to provide any additional information you may desire.

Summary of Supplemental Request

Mr. Evins. Thank you, Mr. Administrator. Gentlemen, we will place the summary table in the record.

VETERANS' ADMINISTRATION—1971 AMENDED APPROPRIATION REQUIREMENTS

[In thousands of dollars]

	President's budget	H. Doc. 91-294	Public Law 91-219 requirements	Total
Medical care	1,702,200	50,000		1,752,200
Readjustment benefits	1,079,000		275,500	1,354,500
Other	5,853,828			5,853,828
Total	8,635,028	50,000	275,500	8,960,528

Mr. EVINS. We considered the VA budget in March for $8,635,-028,000. With the $50 million amendment for medical care and the higher rate for training amendment for 1971, $275 million, this brings the 1971 amended budget for the VA to $8,960,528,000.

READJUSTMENT BENEFITS

You have a rather precise figure on the $275 million on readjustment benefits.

Mr. OWEN. Yes, sir.

Mr. EVINS. I suppose the same arguments apply for 1971 as applied to the 1970 supplemental as far as estimates of more trainees, more people, more veterans entering on readjustment benefit programs.

Mr. OWEN. No.

Mr. SILBERMAN. It is essentially a rate increase.

Mr. EVINS. By new law?

Mr. SILBERMAN. Yes, sir.

Mr. OWEN. Approximately 35 percent rate increase in the benefits payable.

POST-KOREAN VETERANS

Mr. EVINS. Give us a little rundown on page 3. The request pending for post-Korean veterans, $990 million; proposed amendment, $254 million.

How do you arrive at this proposed amendment?

The original cost per trainee was $673; the new law adds $173 more to it.

Mr. OWEN. Yes, sir. It gives a rate of $846 per trainee.

Mr. EVINS. What is the nature of increase in cost per trainee—more books, more machinery, more equipment?

Mr. OWEN. No, sir; except in one program, which is rather small, we do not furnish books or machinery or tools. Basically the 35 percent increase from the $130 a month basic rate to $175 a month for single men; or with one dependent, $155 per month to $205.

Mr. EVINS. This $673 cost per trainee, is that a year or 9 months?

Mr. SILBERMAN. Yes, it is a trainee year per participant.

Mr. EVINS. Each veteran receiving education and training, costs about $673 per trainee period for the type of training he undertakes.

Mr. OWEN. That is right.

Mr. EVINS. $173 more will be added under new law.

Mr. OWEN. Yes, sir; this is under chapter 34.

Mr. EVINS. The number of trainees remains the same in each category, but the cost per trainee goes up.

Mr. OWEN. That is right.

SONS AND DAUGHTERS

Mr. EVINS. Sons and daughters, $285. The other goes up $173; why do the sons and daughters go up more?

Mr. SILBERMAN. The mix in the sons and daughters is slightly different than you have in the post-Korean veterans going to school. We find that post-Korean is a mixture of types of training whereas the sons and daughters are at the college level. So we find the unit cost for those to be considerably higher than those in the other area. Additionally, a lot of our post-Korean veterans have gone to schools below the college level which is at a lower unit cost.

Mr. EVINS. Why are unit costs per trainee greater for wives and widows?

Mr. OWEN. The same reasoning applies here. They also tend to stay in school for a longer period of time and that increases the unit cost.

Mr. JOHNSON. Mr. Chairman, in the first category, the post-Korean conflict veteran, of that nearly million and a half trainees, about 52 percent are in college training. The other 48 are in the other categories allowed, apprenticeships, correspondence schools, et cetera. The bulk of your sons and daughters, wives and widows are all in college training.

Mr. EVINS. We will place in the record House Document No. 91–312 and page 3 of the justification.

(The information follows:)

VETERANS' ADMINISTRATION—READJUSTMENT BENEFITS

Budget appendix page	Heading	Request pending	Proposed amendment	Revised request
836	Readjustment benefits..... (Delete the first paragraph under this heading and insert in lieu thereof the following:) For the payment of readjustment and rehabilitation benefits to or on behalf of veterans, as authorized by law (38 U.S.C. chapters 21, 31 (except section 1504), and 33-39), *and Public Law 91-219, approved March 26, 1970,* [$742,200,000] *$1,354,500,000,* to remain available until expended.	1,079,000,000	275,500,000	1,354,500,000

This amendment to the budget would provide funds for increased benefit payments authorized by the Veterans Education and Training Amendments Act of 1970 (Public Law 91–219), approved March 26, 1970. These payments are for education and training allowances under the Vietnam era GI bill.

VETERANS' ADMINISTRATION READJUSTMENT BENEFITS

Funds in the amount of $275,500,000 will be required, in addition to the $1,079 million initially estimated for 1971. This increased requirement is due completely to the enactment of the "Veterans Education and Training Amendments Act of 1970," (Public Law 91–219, approved March 26, 1970), subsequent to the presentation of the 1971 budget. Obligations incurred against these funds arise by operation of law and as such are not administratively controllable.

Public Law 91–219, approved March 26, 1970, amended chapters 31, 34, and 35 of title 38, United States Code, in order to increase the rates of vocational rehabilitation, educational assistance, and special training allowance paid to eligible veterans and persons under such chapters and to make certain improvements in the educational programs for eligible veterans and dependents.

In addition to increasing educational assistance allowance rates approximately 35 percent, the law includes several new areas of educational assistance. Among these are, (1) assist eligible veterans to pursue postsecondary education through tutorial assistance where required, (2) encourage and assist veterans in preparing for their future education, training, or vocation by providing them with an opportunity to enroll in and pursue a program of education or training prior to their discharge or release from active duty with the Armed Forces, known as the predischarge education program (PREP), (3) elementary level education; i.e., encourage and assist veterans who have academic deficiencies to attain a high school education or its equivalent and to qualify for and pursue courses of higher education, and (4) promote the veterans outreach services program.

The following table reflects the impact of Public Law 91–219, on the pending 1971 budget request:

	Request pending	Proposed amendment	Revised request
Post-Korean conflict veterans:			
Number of trainees	1,472,000	1,472,000	1,472,000
Cost per trainee	$673	$173	$846
Total cost	$990,415,000	$254,400,000	$1,244,815,000
Sons and daughters:			
Number of trainees	46,600	46,600	46,600
Cost per trainee	$903	$285	$1,188
Total cost	$42,065,500	$13,300,000	$55,365,500
Wives and widows:			
Number of trainees	21,000	21,000	21,000
Cost per trainee	$1,000	$371	$1,371
Total cost	$21,000,000	$7,800,000	$28,800,000

Medical Care

Mr. Evins. Mr. Reporter, place House Document 91–294 and the justification material for medical care in the record.

(The material follows:)

VETERANS' ADMINISTRATION—MEDICAL CARE

Heading	Request pending	Proposed amendment	Revised request
Medical care	$1,702,200,000	$50,000,000	$1,752,200,000

This proposed amendment would provide $50 million to be distributed as follows: (1) Improvement of VA hospital staffing ratios including the activation and operation of various specialized medical services, such as intensive/coronary care units, prosthetic treatment centers, hemodialysis units, et cetera, $29,800,000; (2) reduction of equipment and maintenance backlogs, $10 million; (3) annualization of fiscal year 1970 activations of specialized medical services, including spinal cord injury, $8,200,000; and (4) introduction of new drugs, $2 million.

In order to implement the improvement in VA hospital staffing ratios, an increase of 3,700 full-time permanent end-of-year personnel positions will be required.

This amendment is necessary because of the increasing inpatient and outpatient care demands generated by the release of discharged servicemen and the need to upgrade the quality of care in these programs.

Veterans' Administration Medical Care Explanation of Budget Amendments

The fiscal year 1971 budget request for this appropriation is amended to reflect an increase of $50 million to an adjusted level of $1,752,200,000. In conjunction with the increase of funds is an increase in employment levels consisting of 3,700 additional full-time permanent employees with a full-time equivalent employment level of 3,600.

The specific elements involved in this funding and employment increase are as follows:

(*a*) To provide the funding necessary for a full year's operation in fiscal year 1971 of each of those specialized medical services to be activated during the fourth quarter of fiscal year 1970. In addition, to continue in fiscal year 1971 the providing of acceptable staffing support for spinal cord injury units which is to be initiated during the fourth quarter of fiscal year 1970. $8,200,000.

(*b*) To improve the staffing at VA medical facilities to accommodate the increasing inpatient and outpatient demands of the Vietnam era veterans. Increases in such specialized treatment modalities as alcohol and drug abuse and prosthetic treatment centers will require substantial additions to present staffing levels during the course of fiscal year 1971. Primarily though, the greatest need remains in providing adequate staff within presently ex-

isting facilities for physicians, nurses, nursing aides, and other medical and paramedical personnel to effectively and efficiently provide the quantity and quality of patient care required by eligible veteran beneficiaries, $29,800,000.

(c) To cover the continuing increases experienced in the cost and usage of drugs and medicines and to introduce within our system new drugs such as L–DOPA in the care and treatment of VA patients, $2 million.

(d) To make limited inroads on the growing equipment and maintenance and repair backlogs. During the past several years the operating replacement equipment backlog has grown steadily and is now about double the backlog existing at the inception of the replacement program. These backlogs have grown from $20.3 million in fiscal year 1965 to an estimated $47.4 million in fiscal year 1971. The additional equipment and building service equipment demands and backlogs have also continued to grow. In addition, included in this request is an initial increment of $2.0 million to meet the provisions of Executive Order 11507, concerning environmental pollution corrections. Ultimately, future appropriations of the residual of maintenance and repair funds totaling $8,730,000 will be required for the correction of VA deficiencies in boiler and incinerator systems for the control of gaseous, liquid, and solid waste materials, $10 million.

Mr. EVINS. Pages 5 and 6 are the breakdown. Of the $50 million increase for 1971, $8,200,000 is for specialized medical services which are to be activated in the fourth quarter of 1970, which is included in the other recommendation. This would carry the increases over through 1971.

Mr. WILSON. That is right, sir.

HOSPITAL STAFFING IMPROVEMENTS

Mr. EVINS. What is the ratio of the VA staffing now as compared to private hospitals and how much will this provide in the way of an increase in the way of staffing?

Dr. MUSSER. This will provide some 3,600 additional personnel, and according to our calculations it ought to be able to increase our staffing ratio in our general medical and surgical hospitals to approximately 1.60 employees to 1 patient and in our psychiatric hospitals to a ratio of approximately 1 to 1.

On terms of how this relates to the private hospitals, this is very difficult to do.

Mr. EVINS. Say that again, Doctor. Let us review the average G.M. & S. hospitals—your active hospitals. How many employees do you have average per patient?

Dr. MUSSER. Presently it is about 1.5 to 1. These additional people will enable us to increase this to approximately 1.60 to 1. Presently it is a little over 1.5.

Mr. EVINS. 3,600 more staffing is to be added to the hospitals.

Dr. MUSSER. By virtue of this money, yes, sir. But you must recall that the original 1971 budget did provide for some increased personnel.

Mr. EVINS. Assuming that the 1971 budget is approved, and the amendment is approved, as far as staffing is concerned, your ratio will be about 1.60 to 1.

Dr. MUSSER. Yes, sir.

Mr. EVINS. Analyze the staffing for a hospital of 500 beds. How many are doctors, how many nurses, how many food service, how many janitors, how many maintenance, et cetera. In addition what is the cost of each. There is a lot of concern that there is not adequate staffing for the hospitals.

Mr. JOHNSON. Mr. Chairman, I would like to address myself to this as it is one of the things we had to face, that is, the comparisons being made with the private hospital. We believe that there has been no suitable criteria developed yet to make a determination as to what adequate staffing is in a veterans hospital and it cannot be related in its entirety to the private sector. For example, we have in the veterans hospital an almost exclusively male population, which is not true in the private hospital. Secondly, in the private hospital you have many disciplines and many modalities that are not necessary in the veterans hospital. For example, the obstetrics ward, or the pediatrics, or whatever else it might be. In both of these instances cited it requires a high level of staffing, 5 and 6 to 1, so it is not comparable at all to the veterans hospital.

We do believe that there can be some comparison made in the area of specialized medical services. For example, the intensive coronary care unit. At a private hospital they could or should probably compare with the VA hospital. We are now in the process of developing a series of criteria to be used in specialized units. We feel there would be a goal that is somewhat higher perhaps—and this is really off the top of our head—than the 1.60. But with the limitations in recruitability, and also with the constraints of the total national budget, we have to establish a goal and work toward that over a period of time.

This pattern of increased staffing has developed through your good offices and the offices of the other committees with whom we have dealt over the years. As to the second part, or really the first part of that question, for the breakdown among the professionals and nonprofessionals, I do not know what standard you might have, doctor.

Dr. MUSSER. We will have to get that for the record, sir. I can tell you, though, that in all of our 500-bed hospitals there is no consistent pattern of staffing, because to a large extent your staffing has to be developed to accommodate the particular design of the hospital and to accommodate your patient mix. We set up certain standards in terms of numbers of patients and how doctors and nurses relate to those.

By and large we use these as a guide for the staffing. For instance, we estimate that there needs to be one internist per 20 patients.

You will have variations on this theme but we do have these standards which govern us to a fair extent. We would be very happy to pick out what we think is a reasonably typical hospital and show you the staffing pattern in all categories for that.

Mr. EVINS. Supply this for the record.

(The information follows:)

SELECTED DATA OF TYPICAL MEDIUM SIZE GENERAL HOSPITAL

AVERAGE OPERATING BEDS:	
Psychiatry	73
Surgery	157
Other	194
TOTAL	424

OUTPATIENT VISITS:	
Medical	55,689
Dental	2,313
TOTAL	58,002

ANALYSIS OF AVERAGE FTE EMPLOYMENT BY FUNCTION BY PROGRAM

DIRECT CARE	HOSPITAL	OUTPATIENT	MISCEL. SERVICES FURNISHED OTHER APPROP. OR DEPTS.	TOTAL
Medical	58.2	6.7		64.9
Surgical	32.2			32.2
Psychiatry	8.2	1.1		9.3
Social Work	6.8	5.6		12.4
Radiology	18.5	12.5		31.0
Laboratory	25.8	3.7		29.5
Pharmacy	1.5	6.2		7.7
Medical Illustration	1.9	.1		2.0
Libraries	3.5			3.5
Psychology	2.9			2.9
Aud. & Speech Path.	.3	5.5		5.8
Nursing	214.5	6.6		221.1
PM&R	11.3	.3		11.6
Dietetic	53.2	5.9		59.1
Chaplains	1.5			1.5
Dental	4.2	4.8		9.0
Mental Hygiene		4.5		4.5
Day Care Center		4.0		4.0
Prosthetics		2.0		2.0
Sub-Total	444.5	69.5		514.0
ADMINISTRATIVE SUPPORT				
Executive Direction	8.6	1.3		9.9
Medical Admin.	36.0	38.5		74.5
Fiscal	11.2	1.3	.2	12.7
Personnel	6.1	.9		7.0
Supply	25.0	3.5	.1	28.6
Sub-Total	86.9	45.5	.3	132.7

ENGINEERING OPER.	HOSPITAL	OUTPATIENT	MISCELLAN. SVCS FURNISHED OTHER APPROP. OR DEPTS.	TOTAL
Supervision	10.0	.3		10.3
Plant	10.5	.5		11.0
Other	8.8	1.0		9.8
Sub-Total	29.3	1.8		31.1
ENGINEERING - M&R				
Buildings	8.6	.9		9.5
Bldg. Svc. Equip. & Sys.	8.7			8.7
Utility Systems	.5			.5
Operating Equip.	4.2	.4		4.6
Sub-Total	22.0	1.3		23.3
BUILDING MANAGEMENT				
Housekeeping	35.3	.5		35.8
Laundry & Dry Cl.	11.9	.1		12.0
Linen Service Op	4.0			4.0
Sub-Total	51.2	.6		51.8
TOTAL	633.9	118.7	.3	752.9

SUMMARY OF AVERAGE EMPLOYMENT BY TYPE OF PERSONNEL

Consultants	1.2
Nurses	111.1
Dentists	9.1
Physicians	84.3
Psychologists	2.9
Wage Rate Employees	142.1
Purchase and Hire	2.1
Other Personnel	400.1
TOTAL	752.9

Mr. EVINS. This $29.8 million is to be largely expended for personnel—for 3,600 more staffing for hospitals.

Dr. MUSSER. Yes, sir.

Mr. EVINS. Do you have a demand at some hospitals that want more personnel, while others think it is adequate and sufficient?

Dr. MUSSER. We relate this to the needs of the hospital. We recently completed a survey of our hospitals and have tried to identify the actual needs which exist in each one. There are some hospitals that are getting along pretty well. Obviously they do not have the same needs for additional staff as some of the others.

Mr. EVINS. You are going to supply where the greatest needs are?

Dr. MUSSER. Absolutely.

Mr. EVINS. Any questions, gentlemen?

LOS ANGELES PROBLEMS

Mr. BOLAND. I quote an official of the Los Angeles, Calif., VA hospital who responded to the Veterans' Affairs Committee questionnaire:

> We are giving subminimal patient care now, and this situation is ready to explode as a major crisis.

He said in his report that he needed, and could recruit, 200 personnel at a cost of $2 million if he had the additional funds. Will the $50 million increase provided in the 1971 amended budget request make available the $2 million to that hospital? And to the rest of the hospitals to meet their requests?

Dr. MUSSER. In response to Committee on Veterans Affairs' questionnaire concerning pressing problems, the director of the Los Angeles hospital stated:

> The excellence of direct patient care is maintained in the presence of an inadequate and outdated hospital plant in the presence of one of this country's largest training and research programs.

The staffing ratio in the general hospital at Los Angeles currently is 2.1 employees per patient including residents and interns. This substantially exceeds the staffing ratio existing in most VA general hospitals. Fiscal year 1971 fund distribution at individual stations are not yet determined. VA expects, however, that staffing ratios generally will be improved at all hospitals.

BOSTON PROBLEMS

Mr. BOLAND. In my home State of Massachusetts, the doctors, the nurses and other staff of the Boston VA hospital threatened action—some interpreted it as a strike threat—unless a list of 11 demands was met. None of the demands were for anything for the staff, but all for better medical care for patients. They noted shortages of personnel—nurses, doctors, technicians—and stated:

> It is impossible to render adequate health care to our patients in this situation.

The situation was termed a crisis. That was in mid-February. Now, I'm informed the hospital management has been told that fiscal year 1971 funds are $270,000 short to meet just the present number of house staff. This came after interns and residents had been notified of their acceptance by the chief of medicine. Will this condition be corrected with the additional $50 million?

Dr. WELLS. Yes sir; resident and intern programs will be able to continue at present levels throughout next year.

$50 MILLION AMENDMENT

Mr. SHIPLEY. Congressman Olin Teague has been expressing concern about understaffing for months. He reports that VA has denied any major problems. Could you give us a chronology of VA's dealing with the Bureau of the Budget on this $50 million request?

Mr. JOHNSON. At the time of my appointment last June, the President instructed me to make a study of the problems that might exist in the medical care program. This study was actually begun in September by the Department. From this study, we developed our additional requirements for 1971 which were discussed with the executive office. A request for $50 million was submitted to the Bureau of the Budget on March 26, 1970, and was transmitted to you by the President on April 2, 1970.

USE OF SUPPLEMENTAL FUNDS

Mr. SHIPLEY. Administrator Johnson is quoted as saying medical care is adequate, that a record amount is going to medical care. Has, indeed, the increase been sufficient to cover anything more than pay increases?

Dr. MUSSER. Yes, sir. In addition to covering the pay increase, the amended budget will provide for activation of three new hospitals, improvement of staffing ratios in existing hospitals, establishment of specialized medical services in many locations, allowances for increased usage and cost of drugs, medicine, utilities, et cetera, and a reduction in equipment and maintenance and repair backlogs.

ADEQUATE MEDICAL CARE

Mr. SHIPLEY. How many additional medical care positions do you plan to add with this additional $50 million? Dr. Musser, have you previously requested more funds than this $50 million? Do you believe your staffing ratio of employees for each patient is sufficient to provide adequate medical care in VA general hospitals?

Dr. MUSSER. The $50 million includes funds for 3,600 additional average employment which together with the 2,123 increase provided in the original fiscal year 1971 budget should raise our staffing ratio to about 1 to 1 in NP hospitals and 1.60 employees per patient in general hospitals. The $50 million increase is exactly what I requested and was based on our best estimate of a realistic recruitment potential. With these staffing ratios I believe VA will provide excellent medical care.

HINES VA HOSPITAL

Mr. SHIPLEY. This rumor we are talking about here has caused a great deal of problems for all of us on this committee. I remember that about a year ago we first started hearing rumors of this, and I started getting correspondence. I am sure most members on the committee did also because we are the funding committee. I went to the Hines VA Hospital as you very well know, and I was quite surprised

after talking to Dr. Schlesinger and the staff there when they assured me without any doubt at all that they are adequately staffed.

They are looking forward to moving into the new facility. They admitted there was a shortage of nurses but it is well known that there is a shortage of nurses all over the country. This was really the exact opposite of what I expected to find in Hines.

I don't understand all of the discrepancies between the TV program and the information I received from the staff—and we talked to the staff people, and everybody else there. They assured us that they had adequate staff and adequate funds to run this installation.

I feel we have done a very poor job somewhere in getting this story across to some of the people here in Congress and some within the Administration, too. I do not know what we have to do to correct this, but certainly we lack somewhere along in our public relations to get this story across.

I am going to ask you again, to your knowledge, there is not any shortage of staff at the Hines Hospital is there? As you say, basically all hospitals could use more staff.

Mr. JOHNSON. It may not be optimum and I am not specifically sure about Hines, but we recognize the need for increased staffing throughout the system. This is what we have been working for and it really follows a pattern that has been built up over several years now. There has been a steady increase in the staffing ratio. It is somewhat slow but it has been moving upward. The $50 million in additional 1971 funds, and the related number of personnel will make another dramatic increase this year. We can only move at a certain rate because of the shortage of professional manpower, and some of the subprofessionals.

They are just not there to hire. We have to train them. We have to compete with the private sector as well as the other public institutions. There has to be a distribution throughout all of the health delivery systems. I want to point out in addition that the impact so far of Vietnam has not really been a traumatic impact. As of today there are about 6,000 Vietnam veterans in our hospitals and half of them are service-connected, with this number in our hospitals today, when you are talking about a 100,000 bed system, you are not talking about a big impact.

INTENSIVE/CORONARY CARE UNITS

Mr. EVINS. How many hospitals will have intensive care units after this appropriation is provided?

Dr. MUSSER. Approximately 88.

Mr. EVINS. How many will not?

Dr. MUSSER. Of our general medical and surgical hospitals, it will leave 41 without.

Mr. EVINS. You will have 88 with intensive care units. You will have about 41 that will not.

Dr. MUSSER. Yes, sir.

Mr. EVINS. How many hospitals in the private sector in the country do not have intensive care units?

Dr. MUSSER. I can tell you my experience in North Carolina, which is relatively recent. There are 137 general hospitals in North Carolina. When I went there in 1966 there were seven hospitals that had coronary care units. By 1969 there were 90 hospitals.

Mr. EVINS. Say that again.

Dr. MUSSER. There were 90 hospitals with coronary care units out of 137 hospitals in 1969. But that still left 47 without coronary care units.

Mr. EVINS. Your percentage of coronary care units is much higher than in the private hospital system.

Dr. MUSSER. Yes, sir.

We have figures for Alabama, too, in the private sector.

Mr. TALCOTT. How about some other States that might be more comparable to the nationwide average, such as California.

Dr. MUSSER. These two States are not too far removed from the Nation's average.

It is true in your large metropolitan areas, in the larger hospitals, they move more rapidly into the coronary care units. Your biggest problems are what you do with the 30- and 50-bed hospitals scattered through the rural areas. Certainly in my relationship with the regional medical program I had no reason to believe that either Alabama or North Carolina were tremendously different from the Nation at large.

Mr. TALCOTT. The VA hospital is usually considered more of a metropolitan type hospital.

Dr. MUSSER. That is right. I think we have been in the forefront of coronary care unit development from the very beginning.

Mr. EVINS. Doctor, when you look at the Administration, is the VA medical care program moving along satisfactory?

Dr. MUSSER. I think it will if we get this additional money.

MEDICINE AND EQUIPMENT REQUIREMENTS

Mr. EVINS. You have two other items here, $2 million for introduction into the system of new drugs. What do you propose in this program?

Dr. MUSSER. As you are well aware, L-Dopa has become very popular because of its particularly significant benefits in the treatment of Parkinson's disease. Up to now it has been an entirely research drug. It has been tested and we are finding an increased demand for its use for veterans and, we happen to have a fair number of veterans with Parkinson's disease. So we think we ought to be responding to these needs because it is the best treatment for this disease.

Mr. EVINS. You also are requesting $10 million to take care of your backlog of equipment, including $2 million for environmental pollution corrections.

Is this an amount we can make a reduction on?

Dr. MUSSER. I do not see how we can.

Mr. EVINS. Tell us why this is needed at this time and why it has such a high priority.

Dr. MUSSER. Actually we have a $47.4 million backlog in equipment replacement requirements.

Mr. EVINS. You have a $47 million backlog in equipment needs?

Dr. MUSSER. Plus the procurement of new and more modern X-ray equipment, laboratory equipment. This is the day of electronics in medicine. Unless you have adequate equipment to support this——

Mr. EVINS. Is it more TV and more computers or what is the nature?

Dr. MUSSER. No, sir, it is not like television nor do we have many computers in our system. This is handled by the data management

people. This is essentially equipment for operation of hospitals. We do have a large backlog for a variety of reasons.

Mr. EVINS. We can understand that every hospital wants new equipment and new machinery and new facilities. I imagine the demand of every hospital is to have the newest and most modern. You propose to spend about $8 million of this for new equipment.

Mr. JOHNSON. Mr. Chairman, I would like to supplement what Dr. Musser has said. We have been able to make this study in which we were involved for the President, we found this $47 million backlog in hard equipment. I told Dr. Musser I did not want any wishbone requests in here but this could be documented as equipment badly needed for patient care. I then said to him, how much of this could you get and install and put into operation, and do it in a systematic and business-like way. This is the figure he came up with.

There are going to be some, because this is now in the record, that say, why don't you get the whole $47 million all at once? It is our contention that we need to correct whatever was not done in the past in a systematic and business-like way, and the doctor has assured me that he and his staff, and the directors of the various hospitals, could get this implemented. Speaking to the $2 million for pollution control, under the Executive order we are directed to move ahead on this. We do still have in many installations coal-burning boilers and this sort of thing. I am particularly aware of that because I got a letter from my own Governor the other day telling me to do something about one of our hospitals.

Dr. MUSSER. Sir, we have a rather embarrassing situation in that as communities become more concerned about their environment and they find our hospital with the coal furnace is pouring out smoke, they will say, how can you, as the Federal agency, be contributing to the pollution?

Mr. EVINS. Doctor, how will you spend the $2 million? Are you going to have a report, a study; will you have somebody to look at the atmosphere? How will you spend the $2 million?

Dr. MUSSER. This is to replace equipment in our boiler plants and incinerators that now contaminate the environment.

Mr. EVINS. Are you going to buy new boilers or are you going to stop the smoke coming out of the existing furnaces?

Dr. MUSSER. We are not going to buy new boilers or incinerators unless we have to. We will eliminate the contaminants.

Mr. SHIPLEY. If the Chairman will yield, this is not study money, this is to stop the pollution you are doing now.

Mr. JOHNSON. Yes, sir.

Mr. EVINS. Do we have the technology to stop it now?

Mr. JOHNSON. Yes, sir. The boiler plants and the sewage disposal situation. These are the two big areas, and we have those spotted. This has had priority before the Executive order.

Mr. TALCOTT. Will you only spend this in compliance with local ordinances? You won't do anything that will put you in a position of exceeding local ordinances?

Mr. JOHNSON. Only unless the Federal standards are higher.

Mr. TALCOTT. Local or Federal, whichever is higher.

Mr. JOHNSON. Yes, sir.

Mr. EVINS. Doctor, with this $8 million for new equipment, will you have the staff to handle this new equipment or will you have to have another supplemental for more staff to handle the new equipment?

Dr. MUSSER. No, sir. This new equipment relates to the staff positions the other moneys would provide.

Incidentally, if you would like we would be happy to provide for the record the planned projects for the $2 million relating to environmental control.

Mr. EVINS. I think that would be informative and helpful for the record. We are all concerned about it. We are spending a lot of money on pollution and we want some action instead of reports.

(The information follows:)

Air pollution abatement—Correction of medical and general refuse incinerators

	Station	Amount (thousands)
1.	VAH, Montrose, N.Y	$15
2.	VAH, Lyons, N.J	7
3.	VAH, Chicago, Ill. (Research)	26
4.	VAH, Philadelphia, Pa	26
5.	VAH, Wilmington, Del	15
6.	VAH, Coatesville, Pa	10
7.	VAH, VAC, Los Angeles, Calif	22
8.	VAH, Long Beach, Calif	10
9.	VAH, Sepulveda, Calif	9
10.	VAH, St. Louis, Mo	13
11.	VAH, Bedford, Mass	7
12.	VAH, West Roxbury, Mass	10
13.	VAH, Livermore, Calif	25
14.	VAH, Pittsburgh, Pa	12
15.	VAH, Buffalo, N.Y	25
16.	VAH, Kansas City, Mo	59
17.	VAH, Fort Howard, Md	44
18.	VAH, Perry Point, Md	20
19.	VAH, Newington, Conn	8
20.	VAH, West Haven, Conn	47
21.	VAH, Providence, R.I	12
22.	VAC, Dayton Ohio	23
23.	VAH, Phoenix, Ariz	5
24.	VAH, Dallas, Tex	8
25.	VAH, Birmingham, Ala	17
26.	VAC, Mountain Home, Tenn	15
27.	VAH, Salem, Va	5
28.	VAH, Wood, Wisc	75
29.	VAH, Brecksville, Ohio	15
30.	VAH, Martinsburg, W.Va	8
31.	VAH, Wilkes-Barre, Pa	8
32.	VAH, Vancouver, Wash	10
33.	VAH, Altoona, Pa	15
34.	VAH, Huntington, W.Va	17
35.	VAH, Batavia, N.Y	30
36.	VAH, Gainesville, Fla	35
37.	VAH, St. Cloud, Minn	13
38.	VAH, Lebanon, Pa	45
39.	VAH, Richmond, Va	25
40.	VAC, Hampton, Va	16
41.	VAH, Fort Wayne, Ind	20
42.	VAH, Clarksburg, W.Va	18
43.	VAC, Hot Springs, S.Dak	7
44.	VAH, Knoxville, Iowa	8
45.	VAH, Iowa City, Iowa	23
46.	VAC, Souix Falls, S. Dak	9
47.	VAH, Omaha, Nebr	21
48.	VAH, Lincoln, Nebr	30
49.	VAH, New Orleans, La	10

Air pollution abatement—Correction of medical and general refuse incinerators— Continued

Station	Amount (thousands)
50. VAH, Marion, Ind	23
51. VAC, Wichita, Kans	10
52. VAH, Iron Mountain, Mich	25
53. VAC, White River Junction, Vt	18
54. VAH, Poplar Bluff, Mo	14
55. VAC, Dublin, Ga	15
56. VAH, Miles City, Montana	13
57. VAH, Murfreesboro, Tenn	22
58. VAH, Topeka, Kans	10
59. VAC, Cheyenne, Wyo	5
60. VAH, Tuskegee, Ala	15
61. VAH, Montgomery, Ala	16
62. VAH Grand Island, Neb	10
63. VAH, Marion, Ill	23
64. VAH, Alexandria, La	18
65. VAC, Bonham, Tex	10
66. VAC, Temple, Tex	17
67. VAH, Kerrville, Tex	11
68. VAH, Big Spring, Tex	10
69. VAH, Marlin, Tex	14
70. VAH, Fresno, Calif	16
71. VAH, Fort Meade, S. Dak	15
72. VAH, Albany, N.Y	8
73. VAH, Albuquerque, N. Mex	5
74. VAH, Baltimore, Md	8
75. VAH, Bay Pines, Fla	10
76. VAH, Biloxi, Miss	5
77. VAH, Boston, Mass	8
78. VAH, Brockton, Mass	12
79. VAH, Brooklyn, N.Y	7
80. VAH, Buffalo, N.Y	15
81. VAH, Chillicothe, Ohio	12
82. VAH, Danville, Ill	35
83. VAH, Durham, N.C	9
84. VAC, Fort Harrison, Mont	15
85. VAH, Fort Lyons, Colo	8
86. VAH, Houston, Tex	16
87. VAH, Jackson, Miss	7
88. VAH, Madison, Wis	9
89. VAH, Manchester, N.H	10
90. VAH, Miles City, Mont	24
91. VAH, Northampton, Mass	15
92. VAH, Des Moines, Iowa	15
93. VAH, Saginaw, Mich	14
Subtotal, incinerators	1,550
Boiler conversion or replacement from coal to gas	
VAH, Wilkes Barre, Pa	200
VAH, Marion, Ill	250
Subtotal, boiler conversion	450
Grand total	2,000

Mr. EVINS. Doctor, tell us how many doctors are in the VA medical program in total round numbers.

Dr. MUSSER. Slightly over 5,000.

Mr. EVINS. How many nurses?

Mr. JOHNSON. 15,000 nurses.

Mr. EVINS. How many technicians?

Dr. MUSSER. That runs in the neighborhood of 7,000 or 8,000.

Mr. EVINS. How many attendants?

Dr. MUSSER. Our total employment presently is 137,000.

Mr. EVINS. In the hospital system alone?

Dr. MUSSER. That is right. The large bulk of these are in the attendant, food workers, et cetera, class. This is where your figure gets large.

Mr. EVINS. Give us a breakdown. There are two concerns, the ratio of attendant per patient and the amount of money for medical care.

Is it your opinion that these amendments will provide this satisfactory medical care for which you aspire as the Chief of the Department?

Dr. MUSSER. Yes, sir.

Mr. EVINS. I want a direct statement from you, Doctor. If these funds are being provided as requested what is your estimate of the quality of the medical care that will be provided to our veterans?

Dr. MUSSER. It will enable us to round out the completeness of our care and will be very beneficial.

Mr. EVINS. Mr. Administrator, do you want to supplement what the doctor said on this?

Mr. JOHNSON. No, sir.

Mr. EVINS. We would like to have your estimate of the quality of the medical care if these funds are provided.

Mr. JOHNSON. I believe if these funds are provided that we can give the kind of care and the quality of care that the American people and the American Congress expect us to deliver.

Mr. EVINS. To the veterans of this Nation.

Mr. JOHNSON. Yes, sir.

Mr. EVINS Are there any questions?

Mr. TALCOTT. I have no questions.

(Discussion off the record.)

Mr. EVINS. Thank you, Mr. Administrator.

Mr. JOHNSON. Thank you, Mr. Chairman.

AMENDMENT TO GENERAL SERVICES ADMINISTRATION BUDGET FOR 1971

OPERATING EXPENSES, PROPERTY MANAGEMENT AND DISPOSAL SERVICE

SURVEY OF FEDERAL REAL PROPERTY

Mr. EVINS. Mr. Reporter, we will insert into the record, at this point, a budget amendment for 1971 from the General Services Administration. This amendment is for an additional $600,000 for operating expenses, property management and disposal activities. This additional amount is for GSA to conduct a survey of all Federal real property as specified in Executive Order 11508, February 10, 1970, in order to identify unutilized or underutilized properties which might be developed for parks and recreation. We will also insert the justification statement.

(The matter referred to follows:)

[H. Doc. 91-305]

GENERAL SERVICES ADMINISTRATION

PROPERTY MANAGEMENT AND DISPOSAL ACTIVITIES

Budget appendix page	Heading	Request pending	Proposed amendment	Revised request
816	Operating expenses, property management, and disposal service	$32,479,000	$600,000	$33,079,000

This amendment to the budget would enable the General Services Administration to conduct on a continuing basis a survey of all Federal real property, as specified in Executive Order 11508, February 10, 1970, in order to identify unutilized or underutilized properties which might be developed for park and recreational use.

OPERATING EXPENSES, PMDS

Summary reconciliation of 1971 estimate to comparable amounts for 1970

1970:	
Appropriation in annual act	$29,000,000
Proposed supplemental for pay act increases	796,000
Comparable total for 1970	29,796,000
Decreases in 1971:	
Acquisition—exchange	258,000
Rotation	238,000
Upgrading	44,000
Storage operations—recurring depot costs	80,000
Depot relocation costs	300,000
Total	−920,000
Increases in 1971:	
Personal property—strategic and critical materials disposals	2,910,000
Personal property—utilization and donation	80,000
Storage of materials—other costs	363,000
Administrative operations	250,000
Total	+3,603,000
1971:	
Estimate pending	32,479,000
Budget amendment for real property disposal	600,000
1971:	
Estimate (amended)	33,079,000

ANALYSIS BY ACTIVITIES

Activities	1970	Decrease	Increases	1971 request pending	1971 revised request
1. Property management	$13,903,000	−$920,000	$363,000	$13,346,000	$13,346,000
2. Real property disposal	3,882,000			3,882,000	4,482,000
3. Personal property disposal	8,139,000		2,990,000	11,129,000	11,129,000
4. Program support	1,123,000			1,123,000	1,123,000
5. Service direction	653,000			653,000	653,000
6. Administrative operation	2,096,000		250,000	2,346,000	2,346,000
Total	29,796,000	−920,000	3,603,000	32,479,000	33,079,000

GENERAL STATEMENT

"This amendment would provide funds to permit the Administrator of GSA to carry out his responsibilities, as specified in Executive Order 11508, February 10, 1970, for conducting on a continuing basis a survey of all Federal real property to identify properties not utilized or underutilized." (Quoted from H. Doc. 305.)

	Request pending	Proposed amendment	Revised request
1. Property management	$13,346,000		$13,346,000
2. Real property disposal	3,882,000	+$600,000	4,482,000
3. Personal property disposal	11,129,000		11,129,000
4. Program support	1,123,000		1,123,000
5. Service direction	653,000		653,000
6. Administrative operations	2,346,000		2,346,000
Total	32,479,000	+600,000	33,079,00

JUSTIFICATION

Executive Order No. 11508, dated February 10, 1970, directs the head of each executive agency of the Government to institute immediately a vigorous and complete survey of all real property under his control and to make a report to the Administrator of General Services within 60 days of the date of the order, listing any such property, or portion thereof, and state whether it is not utilized, is underutilized, or is not being put to its optimum use. The order further directs that the Administrator of General Services shall within 60 days of the date of the order, and in implementation of the policies set forth in Bureau of the Budget Circular No. A–2, Revised, establish uniform standards and procedures for the identification of real property that is not utilized, is underutilized, or is not being put to its optimum use, and the heads of other executive agencies shall thereafter conform their policies, regulations, and practices to the provisions of such standards and procedures.

The order provides also that the Administrator of General Services shall within 60 days of the date of the order institute, and thereafter conduct on a continuing basis, a survey of the real property holdings of all executive agencies to identify properties which in his judgment are not utilized, are underutilized, or are not being put to optimum use. In addition, he shall make reports to the President, listing any property or portion thereof (identified either by executive agencies or as a result of the administrator's survey) which has not been reported excess and which in the administrator's judgment is either not utilized, is underutilized, or is not being put to its optimum use, and which in his judgment should be reported as excess property.

There are now in the United States approximately 17,000 Federal properties, not including installations located on public domain lands, comprising about 50 million acres which GSA must survey to determine their optimum use and/or potential for disposal, to be delineated in a report to the President.

Every effort will be made to absorb the additional financing required in 1970 from funds currently available through the exercise of even greater stringencies and economies. This, however, will be a virtual impossibility in 1971 due to the sharp workload increases in other areas, mainly resulting from the President's directive to accelerate stockpile disposals.

As this program progresses there is a distinct possibility that a substantial increase may be necessary in 1971, depending upon certain factors which will undoubtedly develop, i.e.:

The number of properties voluntarily reported by Federal agencies as not utilized, underutilized, or not being put to optimum use.

The frequency cycle required for continuing surveys by GSA of all federally owned property.

The complexities of the properties and negotiating problems involved in having them reported excess by the owning agencies.

The number of excess properties generated by the surveys.

An initial assessment indicates that an additional $600,000 will be required in 1971 to handle the increased workload in the real property area.

The objects of expense included in the proposed amendment are delineated as follows:

EXPLANATION OF DISTRIBUTION BY OBJECTS (SEE ACTIVITY DATA SHEET)

11 *Personnel compensation and staffing.*—$420,000 for 34 permanent positions, all to be located in the field offices.

	Permanent positions	Average employment
Realty specialists	29	29
Clerical positions	5	5
Total	34	34

12 *Personnel benefits.*—$34,700. Includes $29,400 for direct contribution to retirement fund, $3,470 for health benefits, and $1,830 for group insurance in support of the above positions.
21 *Travel and transportation of persons.*—$90,000. Includes $80,000 for travel based on 2,200 days and $10,000 for motor pool services required for survey of properties.
22 *Transportation of things.*—$30,000 for movement of household goods in the transfer of personnel to new posts of duty.
23 *Communications services.*—$1,300 for telephone services.
25 *Other services.*—$23,000. Includes payment to buildings management fund for office moves, $6,600; working capital fund primarily for distribution of excess and surplus real property listings, $7,400; Federal Telecommunications Fund, $1,000; security clearances, $3,100; health room charges, $1,000; and $3,900 miscellaneous expense.
26 *Supplies and materials.*—$1,000 for normal supplies and materials.

TESTIMONY OF MEMBERS OF CONGRESS AND INTERESTED INDIVIDUALS AND ORGANIZATIONS

TUESDAY, APRIL 7, 1970.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

WITNESS

HON. JOSEPH KARTH, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF MINNESOTA

Mr. EVINS. We have with us our distinguished and able colleague, Joseph Karth from Minnesota. He has a statement for the committee.

Mr. Karth, we will be pleased to hear you.

Mr. SHIPLEY. Mr. Chairman, may I say he is one of the most outstanding members of the 1958 club?

Mr. EVINS. I wouldn't limit it to the club. I would say in the Congress.

Mr. KARTH. Thank you very much, Mr. Chairman. I will try to summarize if you prefer. I do think this is critical and important or I wouldn't be here. This is the first time, as you know, in my 12 years as a charter member of the Legislative Committee, that I have taken this step.

Mr. EVINS. You may proceed as you wish. Your statement will appear in the record.

(The statement follows:)

Mr. Chairman, and members of the committee: I appreciate the opportunity to appear before this committee to offer some observations and recommendations regarding proposed appropriations for the National Aeronautics and Space Administration for fiscal year 1971.

As a member of the Science and Astronautics Committee, which has the responsibility for authorizing the NASA program each year, I would like to call

your attention to certain aspects of that program which I believe are deserving of the closest scrutiny of the Congress.

As you are aware, the largest portion of the NASA budget during the past decade has been earmarked for the manned space flight program, largely for support of the Apollo project. Since 1965, however, the NASA budget has declined each and every year; yet, because of the national commitment to land men on the moon and return them safely to earth before the end of last decade, Apollo was fully funded all during the last 5 years.

I supported the large expenditures for Apollo during this period, not only because I approved of the objectives of Apollo, but also because to have done otherwise would have disrupted the pace of the program, introduced inefficiencies, and resulted in dramatic increases in costs.

Nonetheless, it should be recognized that one of the chief effects of the sustained effort on Apollo and its attendant high costs, taken together with 5 years of declining NASA budgets, is that the space program as a whole has been thrown out of balance.

Now that the Apollo mission has been accomplished, the time has come for a reassessment of the space program, and it seems appropriate that primary emphasis should be placed upon achieving a better balance between the manned and the unmanned aspects of the program.

Unfortunately the program presented to Congress by NASA this year is not calculated to redress the imbalance in the space effort; rather, it constitutes the initial step in pursuit of an extremely ambitious space program for the decade of the seventies, with all increases in future budgets going toward manned missions. NASA's projected budgets go from $4 billion in fiscal year 1972 to $6.8 billion in fiscal year 1970.

NASA proposes to begin large-scale expenditures in fiscal year 1971 for development of a so-called space shuttle/station program. This program is directed toward development, first, of a reuseable chemically fueled two-stage shuttle which will operate between the surface of the earth and low earth orbit in an airline-type mode.

Second, the project looks to development of a space station module which is conceived to be a permanent structure in orbit designed initially to support six to 12 occupants. By joining together such space station modules, NASA proposes ultimately to erect a space base capable of accommodating 50 to 100 men. But what 100 men in earth orbit would be called upon to do that 12—or even six—cannot do, is not explained.

NASA's preliminary cost estimates for development of the space shuttle/station total almost $14 billion. However, NASA officials readily concede that these preliminary estimates are not to be relied upon. Testimony was received by our committee to the effect that "studies of the space station and shuttle, which are in progress during fiscal year 1970 and will continue into fiscal year 1971, will provide a much more comprehensive definition of the development of operational programs with a related improvement in the quality of our cost estimates. Experience indicates a strong probability that these more refined cost estimates will vary significantly from the preliminary values shown."

Other manned space flight hardware development projects, for which no funds are requested during fiscal year 1971 but which NASA plans to undertake in future years, are (1) a reuseable nuclear orbit transfer stage, and (2) a reusable chemically fueled space tug, the preliminary development costs of which are estimated at $2.6 billion. Again, these preliminary cost estimates are not reliable. Ten year's service on the Science and Astronautics Committee has convinced me that preliminary costs estimates are uniformly low, often, only a fraction of ultimate costs. Project Viking has, for example, increased from roughly $400 million to $800 million in less than 1 year.

It is important to understand that such development costs represent only the first increment. The operational costs of a space program utilizing such expensive hardware will be extremely large.

In any case, it is my contention that NASA proposes to embark upon a new space program based upon new hardware almost entirely in support of a few manned missions with a manned Mars landing as the prime objective in the mid 1980's. For example, it is estimated by NASA that 68 percent of its total budget will be spent on manned space flight missions in fiscal year 1979 with $1 billion designated for the manned Mars landing in fiscal year 1979.

While I am not opposed to the eventual development of a space shuttle, the large space station, the chemical space tug, and the nuclear transfer stage, I sub-

mit that it is unwise to undertake an accelerated program of the type envisioned by NASA during the next decade. I believe that the next few years should be a period of consolidation of the gains made in the space program to date, a fuller utilization of existing hardware and technology, and with special emphasis on a more aggressive exploitation of our space capabilities for useful application. Space systems have already demonstrated their enormous potential for direct economic pay-off in such fields as international communications, navigation and air traffic control, analysis and forecasting of weather, and in surveying the earth's resources.

Let me now turn to the specifics of the fiscal year 1971 NASA budget. The Committee on Science and Astronautics adopted a report offered by the Manned Space Flight Subcommittee which increased the administration's request for the Manned Space Flight program by approximately $300 million. Under the heading space flight operations, authorization was specifically increased by $80 million for the space shuttle/station.

In committee, I offered an amendment to delete the proposed increase of $80 million for this program, as well as $110 million which had been requested by the administration for this purpose. Thus, if my amendment had carried, it would have provided for a total reduction of $190 million for the space shuttle/station but leave untouched, $80 million for design work in OART. This amendment failed on a voice vote.

The purpose of my amendment was not to kill the project, but simply to establish a realistic pace for development. I fully support the research work proposed to be done by OART in this regard.

Before the space shuttle can be a reality, many difficult technological advances must be made in such areas as heat protection, guidance and control, and propulsion, to name some of the more obvious ones. While NASA officials appear optimistic that these technical problems can be solved, they admit maximum innovation from the aerospace industry will be required, and that alternative approaches to these difficult problems will need to be studied. Maximum innovation approaches a "Crash" program in my judgment!

It is by no means certain that the space shuttle can be developed using existing technology, or that the task can be accomplished within the time frame proposed by NASA. Moreover, it is very doubtful that the space shuttle can be built at a cost even close to NASA's preliminary estimate. Most important, it is far from clear that the space shuttle is needed; NASA has not defined the program of the future in terms of numbers, and size, and cost of payloads that will require a space shuttle. Expendable launch vehicles, which account for a relatively small percentage of total mission costs, may be the most effective method of placing payloads in orbits for a long time to come. In fact, launch vehicle costs are a minor part of most, if not all, program costs.

In short, the United States can have a meaningful manned space flight program using existing equipment during the next decade. The space shuttle, which is designed to replace much of this existing hardware, should be developed in an orderly fashion, the basic technological problems should be resolved prior to design and development, and the cost effectiveness of the entire system should be clearly established before the project is undertaken.

In order to make resources available for the space shuttle/station development project, NASA has made several questionable policy decisions. Among others, production of Saturn V launch vehicles will, according to the testimony of NASA officials, be discontinued with vehicle No. 515. The decision to suspend production of Saturn V launch vehicles in order to make funds available to begin development of a space shuttle/station in fiscal year 1971 seems to me especially unwise. The Saturn V is a proven launch system which NASA concedes will be needed for future manned missions, and for testing of the nuclear stage in which NASA is continuing to make large investments. Suspension and restart of production of Saturn V vehicles has been estimated by Dr. Wernher von Braun to cost additional hundreds of millions of dollars. In spite of this, the decision to suspend production appears to be firm.

In view of the enormous costs involved, if production is in fact discontinued, there is no assurance that it will be resumed. Yet, the Science and Astronautics Committee also authorized an additional $100 million, under the Apollo line item, for "long lead time hardware" for improvement of the Saturn V launch vehicle. It makes no sense whatever to authorize additional expenditures of $100 million in fiscal year 1971 for "improvements" to a launch vehicle which may never again be produced.

Before concluding, let me make one additional point. The Science and Astronautics Committee increased the administration request for the Skylab project by $75 million. This project, formerly known as Apollo Applications, is an earth orbiting manned station designed to establish the feasibility of manned operations in the space environment over extended periods of time. It utilizes modified hardware already developed in the Apollo program.

NASA does not yet know whether men can indure and work effectively in space for extended periods. We will not know until the results of the Skylab project are in.

Skylab is scheduled to be launched in late 1972. In my view, it is unreasonable to pursue development of the space shuttle/station project until Skylab has clearly demonstrated that long-term manned spaceflight is feasible and cost effective. For this reason, although I hesitate to recommend any increases in the NASA budget for fiscal year 1971, there is logic behind the committee's action in support of a more vigorous Skylab project. Certainly, these projects should be undertaken sequentially, not concurrently.

Mr. KARTH. I did feel this year, Mr. Chairman, I wanted to come over and talk to your subcommittee about it.

Mr. EVINS. Identify for the record your position on the Science and Astronautics Committee.

Mr. KARTH. Mr. Chairman, I am the second ranking member of the full committee and I am chairman of the Space Science and Applications Subcommittee. I have been a member of that committee ever since its inception. It started in 1959.

I am here not in support of the total NASA budget proposal this year and I am here not in support of the Legislative Committee's final actions which were taken some 2 weeks ago.

Mr. Chairman, I am here to call your attention to an opportunity to save the taxpayers from $20 to $35 billion during the 1970's and from $50 to $100 billion, depending upon whose estimate you are willing to accept, between now and 1986.

That, Mr. Chairman, is a lot of money. I am speaking specifically about the montage of new, expensive manned space flight programs that are proposed for the first time as new starts in this fiscal year 1971 budget proposal. I identify that program specifically as the so-called space shuttle-space station program.

NASA proposed this year $110 million in the space flight operations portion line item of the budget for the space shuttle-space station. The committee added another $80 million to that $110 million and there is another $80 million for that program in the Office of Advance Research and Technology within NASA.

That, Mr. Chairman, comes to nearly $300 million for a program that is just starting, while we are phasing out at the same time a program that we have spent upwards of $25 billion to initiate and to bring to development up to this point, specifically, the Saturn V-Apollo program.

However, the space shuttle-space station program has no value standing alone, Mr. Chairman, and that is why I say I am talking about from $20 to $35 billion during the 1970's and from $50 to $100 billion between now and 1986.

The space shuttle and the 50- to 100-man space station—and that is what we are talking about when we talk about the shuttle station line item—has, in addition to it as an objective, a chemically fueled tug, a nuclear tug, a possible lunar base, a possible lunar orbiting space station and the real objective or purpose of its initiation this year, a manned Mars landing program in 1986 or thereabouts.

Let me call to your attention one of the exhibits I have given you. I have marked it exhibit E in your folder. It has a red E in the upper right-hand corner. You will notice in fiscal year 1977, 1978, and 1979 I have red penciled three figures, $100 million in 1977, $300 million in 1978, and $1 billion in 1979.

If you will follow that line to the extreme left, you will find it says "Manned Planetary Exploration."

There is, Mr. Chairman, no manned planetary exploration program except a manned landing on Mars. That is the beginning of the funding that NASA is proposing to us for a manned Mars landing program. I know of no man in the Congress of the United States—when it was initially proposed by, I think, the Vice President, some many months ago, that we land a man on Mars by 1986 or thereabouts, who was in agreement with that. Chairman Miller of California was in disgreement publicly; Chairman Anderson of the Senate committee was in disagreement publicly; I know of no Member of the Congress who agreed with it. I am not even sure that the Vice President was serious. I think he was just suggesting something to see what the reaction would be. Nonetheless, Mr. Chairman, it is in fact in this budget as a start in fiscal year 1971. Without the shuttle space station, without the nuclear tug, without the chemically refueled tug, there is no possibility for us to go to Mars and so I say that this is the start, this year, fiscal year 1971 is the start of a program that will cost between now and then from $50 to $100 billion, depending upon whose estimates you are willing to accept.

Mr. EVINS. On your own chart here, on exhibit E, there are no funds shown to be budgeted for the manned planetary exploration in 1971, 1972, 1973, 1974, 1975, 1976. There would possibly be a lead—beginning in 1977, according to your figures.

Mr. KARTH. Yes, sir, that is correct. My point is, you could not begin to fund that program until such time as the "space shuttle-space tug" has been designed and is in its final stages of development.

Mr. EVINS. If the space shuttle and the space tug are successful, you then envision, beginning in 1971, they would go from there on to Mars in 1977.

Mr. KARTH. Yes, sir.

Mr. TALCOTT. Do you know what they will use the space shuttle or space tug for?

Mr. KARTH. They are proposing that the space shuttle be used to ferry men back and forth. That is, from earth, to earth orbit. The so-called large space station, and back from the space station to earth again.

We are not even sure at this point in time, and we won't be until we launch the so-called Sky Lab program, which is the 6- to 12-man Earth-orbiting program—we are not sure at this point in time that it is even feasible for man to operate in space and will not until such time as we get the results from that program.

It just seems to me, Mr. Chairman, that we ought to hold in abeyance moving as aggressively as they suggest.

Mr. EVINS. Testimony was received before this committee that the Vice President had had a report entitled "The Future in Space," with three options, three alternatives.

Another report entitled, "The Next Decade in Space," was a more conservative report which called for a more moderate approach. Not

the crash program to Mars, not cutting out the program altogether. The Next Decade in Space, which was a more conservative report, indicated that this country should move ahead at a deliberate pace.

I feel that we have reached the stage now where there have been several reports on the next decade in space, the future in space; the President has made a determination, the Bureau of the Budget has made a determination. The space agency has made a determination. The space committee has made a determination and now it is before this committee to decide what the funding will be.

Mr. TALCOTT. I was only trying to ascertain if Mr. Karth is interested in the space shuttle program and the space tug program, whether he wanted to cut them out, too.

Mr. KARTH. Mr. Chairman, in answer to the question, I am interested. The fact of the matter is the amendment I offered in committee would delete the $110 million NASA proposed in the "Space flight operations" line item plus the $80 million that the Manned Space Flight Subcommittee added to it.

That would leave for research and development work on the shuttle/station $80 million in the Office of Advance Research and Technology.

It may well be, Mr. Chairman, that we want to develop this program eventually.

The only point I make is that to begin this program with a $300 million investment, that is going to cost by their own figures some $25 billion in the next 7 or 8 years, is moving too fast.

Mr. EVINS. The authorizing committee authorized not only the $110 million, but they also authorized $80 million in addition and you oppose both of those?

Mr. KARTH. Yes, sir; and so does a very strong minority of the committee.

Mr. EVINS. Seven members, I believe.

Mr. KARTH. Seven members out of those who were present and there was not a——

Mr. EVINS. How many members are there on the Space Committee?

Mr. KARTH. There are 31 members.

Mr. EVINS. Seven signed a minority report?

Mr. KARTH. Yes. Some could not be reached. I am confident that there are more than seven who disagree with the speed with which we are approaching this new start.

Mr. EVINS. The committee appreciates your testimony. We are trying to arrive at a judgment and evaluate what is proper and right. All I was doing in summary was saying that several decisions have been made and your position happens to be the minority position at this time.

Mr. KARTH. Yes.

Let me just say this Mr. Chairman, I am supporting doing some of the preliminary research, basic research work that ought to be done on a program that is as technologically difficult as this one. Let me say this, this is more technologically difficult in my judgment than landing a man on the moon by far. I don't think jumping into it on an almost crash program basis is a wise way to proceed. I think $80 million in the Office of Advance Research and Technology for this year is enough.

Wernher von Braun, for example—undoubtedly the best rocket expert in this country—disagrees with NASA and I gave you this, I think. It says "The task group disagrees with von Braun on expend-

able booster for shuttle. The master of all booster experts said on April 2, just a couple of days ago, that he felt the question had not yet been answered as to whether or not the first stage of the shuttle would be a nonreusable booster. He said he thought it might be necessary to have a nonreusable booster instead of a reusable one.

Mr. EVINS. Whom do you refer to as the master?

Mr. KARTH. Dr. Von Braun. This is exhibit B that you have in your folder.

Mr. EVINS. Place in the record all of the exhibits to which our colleague has alluded in connection with his testimony.

Mr. KARTH. Let me say, too, within the industry there is a strong minority who disagree with the speed with which this thing is being approached and that is exhibit C that I have put in your folder.

(The exhibits follow:)

FISCAL YEAR 1971 NASA AUTHORIZATION—SUMMARY OF COMMITTEE ACTIONS

Program/project	NASA request	Committee action (thousands)	H.R. 16516
Research and development:			
1. Apollo	$956,500	+$145,000	$1,101,500
		(+$45,000)—Lunar payloads and Apollo 20	
		(+$100,000)—Saturn V improvements	
2. Space flight operations	515,200	+$155,000	670,200
		(+$75,000)—Apollo applications	
		(+$80,000)—Space shuttle/station	
3. Advanced missions	2,500	−$1,500	1,000
Subtotal MSF	1,474,200	+$298,500	1,772,700
4. Physics and astronomy	116,000	−$5,600—Explorers	110,400
5. Lunar and planetary exploration	144,900	Approved request	144,900
6. Bioscience	12,900	do	12,900
7. Space applications	167,000	+$5,600—ATS F. & G	172,600
8. Launch vehicle procurement	124,900	Approved request	124,900
Subtotal SSA	565,700	No change	565,700
9. Space vehicle systems	30,000	Approved request	30,000
10. Electronics systems	22,400	+$1,500—Avionics	23,900
11. Human factor systems	17,900	+$400—Air crew stress	18,300
12. Basic research	17,600	+$400—Aeronautics	18,000

TASK GROUP DISAGREES WITH VON BRAUN ON EXPENDABLE BOOSTER FOR SHUTTLE

Persons in NASA were wondering yesterday where Dr. Wernher von Braun got the information that the decision is still to be made whether the space shuttle will have a completely reusable booster.

The space agency's Space Shuttle Task Group is unaware of any projected studies for an expendable booster system, and backed by industry, DOD, and its own investigations, is proceeding with plans for a completely reusable system.

Von Braun, at his first news conference Tuesday since his transfer as Director of Marshall Space Flight Center to NASA headquarters as a deputy associate administrator, said that it is too early to determine whether the shuttle will have a reusable booster system, that this question has not been answered yet (Daily, April 1).

One source speculated that von Braun "really wasn't ready for a press meeting. You guys caught him flatfooted." However, von Braun volunteered the information at the press conference, and reporters later questioned him about it.

A spokesman for the shuttle task group said that as far as our office is concerned, we have no intention of studying an expendable booster system.

The spokesman said the task force was sticking with the objectives of the President's Space Task Group report, and with a summary of its own issued December 10 to "everybody, including Dr. von Braun," both of which stressed the complete reusability concept.

VON BRAUN QUESTIONS COST

In his remarks Tuesday, von Braun said that it is questionable whether shuttle traffic in the next 10 to 15 years would justify an initial multibillion dollar investment in a reusable booster, or whether it would be "smarter" to stick to throwaway stages for a while.

The shuttle task group report, however, said that "studies consistently show that the fully reusable shuttle system is the most cost effective system when any significant operational program is taken into account."

The report said studies show that the cheapest vehicle for more than 70 program flight is the fully reusable. For a 10-year program this would mean approximately seven flights per year is the economic crossover, which is substantially below the projected NASA/DOD baseline traffic model of 30 to 60 flights per year for the later 1970's, early 1980's respectively.

The report then delved into numerous studies to substantiate its conclusion, including studies in-house and from Lockheed, and the Institute of Defense Analyses.

According to the report, it is probable that 70 percent of the booster design and development job is accomplished by having developed the orbiter * * * Thus an expendable booster with the reusable orbiter approach would probably be as costly a program as developing the two-stage fully reusable flyback system.

The report said if a reusable booster is the desired goal, the expendable booster approach is dead-ended after a heavy investment in design and development resources.

INDUSTRY OFFICIAL CRITICIZES SPACE GOALS REPORT

The Space Task Group report prepared by Vice President Spiro Agnew on new national space goals suffers from serious deficiencies, a Martin Marietta vice president has told Congress.

Frank X. Bradley, vice president-marketing, Denver division, told the House Manned Space Flight Subcommittee under Rep. Olin Teague, Democrat of Texas, in February that the Space Task Group report contributes to a credibility gap in regard to our space planning.

He said that the United States needs a realistic plan, a believable plan, an affordable plan, an approved plan—one that will be followed, one that will be supported by budget and in which the schedules are meaningful."

Representative Teague led four other Representatives and two subcommittee staff members on a tour of aerospace plants last month (Daily, Feb. 11). Bradley told the Congressmen that, "As you go around today and in the next few days, you'll hear all of us complain and plead. But the Nation will not get full value received for its dollars until it faces the basic problem—must eliminate the high-cost, the inefficient, the marginal contractors.

"You can't keep supporting us all without paying too much for what you are getting," Bradley said.

He criticized the space program for excess capacity and warned against too large a technological jump too soon as being disastrous.

Bradley characterized the Space task Group report as: "Conceived in hope, presented with fanfare; endorsed by inference; received (by the aerospace industry) with relish; supported with words; and funded with promises." He charged that the report caused considerable wheel spinning because some contractors started space shuttle work based on its recommended funding and timetables.

The report "fails in depth and in detailed analysis," Bradley said. It is hardware rather than mission-oriented and there are "some real questions about the economics of the space shuttle in terms of payload size, launch rates, and so forth," he added.

The Martin Marietta official listed as serious deficiencies inadequate treatment of payload costs. "Even if the shuttle booster were free, could you afford payloads of that size at the launch rate envisaged? And payloads for what?" he asked rhetorically.

Detailed system definition is required "if budgets and contract costs are not to be overrun," Bradley said. As far as the Space Task Group report is concerned, he said that "perhaps we were, to a degree, blinded by desire."

Turning to his criticism of excess capacity, Bradley said that large cuts in the NASA budget have been made without proportionate cuts in organization or structure. "Overhead is eating up the budget and the United States is paying

too much for its hardware. Tremendous excess capacity in virtually every product line," Bradley said.

Material requested for the record on page 301 by Congressman Karth during the House Science and Astronautics Committee on February 25, 1970.

Question. Identify the dollar amounts in OART budget for the space station, tug, nuclear engine, chemical propulsion, and other development programs.

Answer. The assignment of dollar amounts applicable to various development areas cannot be accurately identified per each development area. By its very nature research and technology has broad application and multiple assignments will occur. This will result in assigning dollar amounts to each area which when added together exceed the total funding of the program. With this in mind, the following dollar amounts are provided for the space technology activity. They do not include research and technology of broad general applicability.

Research and technology more directly applicable to specific program areas:

	Million
Space Shuttle[1]	$30–$40
Space Station and Space Base[1]	30– 40
Earth orbital science and applications	15
Planetary exploration	20
Nuclear propulsion module[1]	40

5. What portion of a realistic projected space budget will the space shuttle development eat up during the next 6–10 years and therefore, how much will it reduce launch rates during the same period of time, tending to defeat the purpose for which it is being developed? In fact, what proposed launches will it affect? What will be the projected magnitude of the annual space budget needed to support AAP, an operational space shuttle and space station, and in what calendar year will those requirements occur? What percentage of a realistic projected space budget will these programs consume during the years when their development costs are at a maximum?

Funds requested in fiscal year 1971 for the definition effort of the space shuttle and space station do not represent a commitment to undertake development per se, nor is a given time schedule implied. Such determinations will be made in future budget years. Our preliminary estimate of the space shuttle development costs is $6 billion. Definition studies being conducted in fiscal year 1970 and fiscal year 1971 will provide a much more comprehensive basis for estimates of development and operational costs for the shuttle.

Concerning estimates of what NASA's total budget might be for the next 10 years, the budget request for NASA in future years will be a part of the total executive budget for which the President is responsible. In arriving at final decisions and recommendations, the President will necessarily weigh all of the needs of the Federal Government against each other and against the revenues available to meet such needs.

As one base point as to realistic future space budgets, the President's space task group report option II, which included provision for concurrent development of the space shuttle and station, was estimated to require the following magnitude of funding expressed in 1969 dollars:

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[1] Using the high figures in these categories, the fiscal year 1971 budget has $120,000,000 in it (Office of Advanced Research and Technology) for the space shuttle/station and nuclear propulsion module.

Add to this the $190,000,000 in the line item space flight operations for space shuttle/station and the fiscal year 1971 authorization bill now proposes $310,000,000 for that new start.

	Fiscal year—							
	1972	1973	1974	1975	1976	1977	1978	1979
Manned programs:								
Manned earth Orbital AAP (Skylab)[1]	0.5	0.2						
Space station/base including experiments [1]	.1	.2	0.8	1.1	1.4	1.3	1.0	0.8
Space shuttle	.2	.9	1.2	1.4	1.3	1.0	.6	.3
Manned lunar exploration and support [1]	1.0	.8	.9	.7	.7	.6	.6	1.0
Nuclear shuttle and space tug [1]				.1	.2	.3	.7	1.3
Manned planetary exploration						.1	.3	1.0
Unmanned flight programs	.7	.7	.7	.7	.7	.7	.9	.9
Aerospace technology	.3	.3	.3	.3	.3	.3	.3	.3
Tracking and data acquisition	.3	.3	.3	.3	.3	.3	.3	.3
Supporting activities	.9	.9	.9	.9	.9	.9	.9	.9
Total, NASA funding requirement	4.0	4.3	5.1	5.5	5.8	5.5	5.6	6.8

[1] See table below:

	Fiscal year—							
	1972	1973	1974	1975	1976	1977	1978	1979
Manned flight as a percent of total expenditures	46	50	53	60	62	60	60	65

Mr. KARTH. Mr. Bradley, who is the vice president of the Martin-Marietta Co., told this to the Teague subcommittee when they were out there. He said that the "U.S. needs a realistic plan, a believable plan, an affordable plan, and an approved plan—one that will be followed, one that will be supported by budget and in which the schedules are meaningful."

Mr. EVINS. It is unusual to find a concern like Martin-Marietta, a big contractor with NASA, opposing their proposals, isn't it?

Mr. KARTH. It is very unusual, Mr. Chairman. I know of no other instance when that has occurred.

Mr. EVINS. Proceed.

Mr. KARTH. The article goes on to say—

> Representative Teague led four other representatives and two subcommittee staff members on a tour of the aerospace plants last month. Bradley told the Congressman that, "As you go around today and in the next few days, you will hear all of us complain and plead. But the nation will not get full value received for its dollars until it faces the basic problem: you must eliminate the high-costs, the inefficient, the marginal contractors. You can't keep supporting us all without paying too much for what you are getting." Bradley said. He criticized the space program for "excess capacity" and warned against too large a technological jump too soon as being "disastrous."

Bradley characterized the space task group report, which is what we are talking about, coming from the Vice President, as "conceived in hope, presented with fanfare, endorsed by inference, received by the aerospace industry with relish; supported with words; and funded with promises." He charged that the report caused "considerable wheel-spinning" because some contractors started space shuttle work based on its recommended funding and timetable.

The report he said "fails in depth and in detailed analysis." It is hardware rather than mission-oriented and there are "some real questions about the economics of the space shuttle in terms of payload size, launch rates, et cetera," he added.

The Martin-Marietta official listed as serious deficiencies inadequate treatment of payload costs. "Even if the shuttle booster were free, could you afford payloads of that size at the launch rater envisaged?

And payloads for what? Detailed system definitions are required if budget and contract costs are not to be overrun."

"As far as the STG report is concerned, perhaps we were too agreeably blinded by desire."

Turning to his criticism of excess capacity, Bradley said "large cuts in the NASA budget have been made without proportionate cuts in organization or structure. Overhead is eating up the budget and the United States is paying too much for hardware. Tremendous excess capacity in virtually every product line."

That is what I quoted, sir. I have a complete context of this statement which I would be happy to furnish to you as chairman if you would like.

Mr. EVINS. Mr. Karth, what do you recommend as an authority, as one who has studied this program in depth and who is chairman of a subcommittee, what do you recommend would be wise by way of funding for this committee?

Mr. KARTH. Mr. Chairman, I recommend that the $110 million that NASA proposed in the space flight operations line item, plus the $80 million that the Subcommittee on Manned Space Flight recommended and which was approved, I recommend those two figures be deleted. I recommend that the $80 million in the Office of Advanced Research and Technology for this program be allowed to stand.

I recommend that the $75 million additional, that the committee recommended for Apollo applications be approved because I think that before we go into a program like the space shuttle and the 50- to 100-man space station, we ought to find out whether the small space station really works and whether or not the man has proved to be feasible while in that space station. Is there anything he can do? Is it harmful to his health? My subcommittee held hearings on it and there is a vast difference of opinion within the medical community on that.

I recommend that the $100 million additional put in by the committee for Saturn V improvement be eliminated because the last Saturn V, Mr. Chairman, in NASA's plan is being produced this year and comes off the assembly line in December of 1970. How can we propose to spend an additional $100 million for improvements of a vehicle that will be out of production in December 1970, and with no firm plan that I know of in NASA to ever again begin production although they say they might?

How can we spend $100 million to uprate, to improve a vehicle that will be out of production at the end of this year? That is slush money, Mr. Chairman, and I think it ought to be eliminated.

I agree that the additional $45 million they put in for lunar payloads in Apollo 20 ought to be approved. We have gone to the moon; we have landed man there; I think now we ought to do the science that is on the moon, and the total effort on our part, insofar as the Apollo program is concerned, and the remaining flights, ought to be scientific in character.

I approve that addition. I approve the $75 million addition for Apollo applications. Not that I am against manned space flight programs at all. I think we ought to prove them out, however, before we make this next giant step at the taxpayers' expense.

Mr. EVINS. Thank you, Mr. Karth, for your excellent, thoughtful, provocative, and very helpful statement.

The committee will give consideration to your testimony and the exhibits which you have submitted.

Thank you for coming before the committee.

Mr. KARTH. Thank you, Mr. Chairman, I appreciate it.

Mr. EVINS. The $75 million for the Apollo applications could be used in your opinion?

Mr. KARTH. Yes.

WEDNESDAY, APRIL 8, 1970.

GENERAL SERVICES ADMINISTRATION, CONSTRUCTION OF FEDERAL BUILDINGS

GRAND RAPIDS COURTHOUSE AND FEDERAL OFFICE BUILDING

WITNESS

HON. GERALD R. FORD, MINORITY LEADER, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF MICHIGAN

Mr. EVINS. The committee will come to order. We will consider testimony of a number of our colleagues this morning, including first the Honorable Gerald R. Ford, the distinguished minority leader, a very able and effective Member of Congress.

We will be delighted to hear you.

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

Members of the subcommittee, I appreciate the opportunity of testifying to indicate for the record my support for the budget recommendation of $9,411,000 for a Federal building in Grand Rapids, Mich. My staff is in the process, Mr. Chairman, of bringing down a picture of the downtown area of Grand Rapids, which will show the community and the location of this particular Federal building in an urban renewal area, which is what we call the Vandenberg Civic Center. The civic center is named after the late Senator Arthur H. Vandenberg. It involves a city-county complex, a city-county hall of justice, two new substantial bank buildings, and a number of other commercial buildings in the area. It also includes a new State office building, as well as this particular Federal building.

At the present time in Grand Rapids, as in a number of communities, we have all Federal agencies spread out all over the community. The Internal Revenue Service is in one rented facility, social security is in another, and the various agricultural organizations are in other parts of the community. This project was conceived in the early 1960's and authorized in 1964. The original funding for the acquisition of the site came, I think, in the 1967 appropriation bill. Subsequently, we had funds made available for the design, and so forth, and this is the actual construction money. This is the center of Grand Rapids on this photograph. This is the bisecting Interstate Highway System which is all complete now.

The area in which we are involved is right in here. These buildings are all down. Here is an old city hall, an old county building. They are all down. We have a new county building, a new hall of justice, where we have our local court system.

Right here on this corner would be the Federal building and right here would be the new State building and the State expects to appropriate its money for its construction in the current legislative session.

It means that all Federal agencies would be housed in this facility except for the Weather Bureau and the Post Office Department.

Mr. EVINS. This is a very impressive display of downtown Grand Rapids and the plan which you have outlined certainly appears to promote efficiency.

Mr. FORD. I am sure the General Services Administration has given to the committee, as they have given to me, the detailed justifification showing how many Federal agencies and how many Federal employees would be housed. The figures they have given me indicate there would be over a period of the life expectancy of the building a saving to the Government of around $10 million, roughly speaking.

Mr. EVINS. This building would have, as I understand, a gross area of about 263,000 square feet and about 550 employees.

Mr. FORD. It is in the final part, with the State building, of this complex which will make an outstanding example, I think, of good urban renewal.

Mr. JONAS. It is not a postal facility?

Mr. EVINS. This is a courthouse and Federal building project.

Mr. FORD. We have an old post office building which included the Post Office Department, the two court rooms for the Federal District Court of the Western District of Michigan, and so forth. This old building is at least 50 years old, if not older.

About 10 years ago, under one of the lease arrangements, we built a new post office at this location (pointing to map).

Mr. JONAS. In this same Government complex?

Mr. FORD. Right in the same area. Although this particular site is not there within the urban renewal area limitations, but it is right adjacent to it.

When the new Federal building is constructed, they intend to sell the old Federal building which would cost a great deal of money to rehabilitate. They are going to dispose of it and they will consolidate the court, the IRS, Social Security, and so forth, all in the new facility.

Mr. EVINS. Mr. Ford, we thank you for your presentation. I merely want to make one further observation. You referred to this as the Vandenberg Center. We think we ought to call this the Ford Building.

Mr. FORD. Thank you very much, Mr. Chairman. I just wanted to be sure that you knew of my personal interest. I have talked to you and other members of the committee. I am deeply grateful for your attention and the time.

Mr. EVINS. The committee will try to help you. Thank you for coming in.

WEDNESDAY, APRIL 8, 1970.

NATIONAL SCIENCE FOUNDATION AUTHORIZATION AND APPROPRIATION

WITNESS

HON. EMILIO Q. DADDARIO, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF CONNECTICUT

Mr. EVINS. We have with us the Honorable Emilio Q. Daddario, a distinguished and able Congressman from Connecticut. Mr. Daddario, you appear here in connection with the appropriation of the National Science Foundation. The committee will be pleased to hear you.

Mr. DADDARIO. Mr. Chairman and gentlemen, the subcommittee on Science Research and Development of the Science and Astronautics Committee, has handled the NSF authorization. The subcommittee has unanimously voted out a recommendation for the National Science Foundation of $525.63 million plus $2 million excess foreign currencies, which is an increase of $27.63 million over and above the recommendation made by the Bureau of the Budget. Of the $2 million of excess foreign currencies the same amount as that granted last year, $1 million is for translations and the other million for research in various areas throughout the world.

I would like to explain why we have made these recommendations. There are a few figures I would hope you gentleman would take into consideration, because any increases, at a time when we are all under strict budget restrictions, should be very strictly explained.

First of all, the total includes $15 million for the International Decade of Ocean Exploration. This is a new program which is not an NSF program, but one which it has been assigned to administer by the administration. Therefore the total starts off swollen by the amount of $15 million, compared to last year's.

The other figure to consider is the obligation rate for fiscal 1970, which will be $451.5 million.

The subcommittee that I chair has for some years been concerned about the effect of budget cutbacks in the various mission-oriented agencies in the area of basic research. We felt that over the course of time this would gradually occur, but that the dislocations which would result would not be as severe as they now appear to be. This severity is caused by the fact that the natural adjustments of research from the mission-oriented agencies to the National Science Foundation have been accelerated to a tremendous degree by the Vietnam conflict and by the pressures that have been placed on the mission-oriented agencies by the Mansfield amendment, which stresses the need for relevance in each research project.

It is because of this rapid acceleration of transfers the need we see to eliminate or reduce some of the impact of this, that we have asked for the additional funds.

The Bureau of the Budget, last year when the budget was being formed, took into consideration the transfers of research projects from mission-oriented agencies. Only insofar as it applied to the Department of Defense, they figured that this would be somewhere around $20 million. They discounted that figure by 50 percent, and

granted the National Science Foundation $10 million to take care of this particular problem.

The fact is, as time has gone on, the impact has become much more severe than that. The impact is something on the order of $55 million to $60 million. It affects not only the Department of Defense, but NASA, the Atomic Energy Commission, NIH, the Office of Saline Water in Interior as well. We felt that the National Science Foundation should have, following that logic but at even at a greater discount, an additional $10 million to handle these transfers. It is estimated that 80 percent will be competitive with other National Science Foundation proposals for NSF support.

We have also felt that the cutback of graduate traineeships needs to be slowed down. There is a cutback here in NASA, NIH, and NSF. We have two reasons for asking for additional support here. The first is we are in disagreement with the Bureau of the Budget on the fundamental question of whether or not this country has all the scientific manpower it needs in these areas. We believe that it does not. This is supported by numerous studies, which we need not get into at this time.

I would hope you would take this manpower argument at face value. Our action will permit this program to be supported so that instead of having to cut back by some 1,700 traineeships, we can support some 3,000 people in this particular program. But, even if you disagree with the manpower situation, I would like to stress one further point: These traineeship funds go directly to the universities and colleges throughout the country. Practically every university and college in the country is affected. Every congressional district is certainly affected in some way. Our work over the course of the last several years shows that the universities and colleges throughout this country are all in a very bad financial situation, and to have a cutback of this kind in funds that go directly to them, could cause a tragic set of consequences.

We had four of the people who have a practical involvement with these programs testify before our committee. I would like to refer to the statement made by Dr. Thomas Jones, President of the University of South Carolina. He described this as a "ripple effect," where small percentage cutbacks at the excellent institutions caused catastrophic percentage reductions in the emerging schools. I do believe that this financial question, beyond the question of manpower, is one of extreme importance.

Mr. EVINS. Congressman Daddario, if I understand the thrust of your testimony, you are not only appearing in support of the full budget, but also for an increase above the budget for the National Science Foundation?

Mr. DADDARIO. For these reasons, Mr. Chairman.

I have just two more points to make.

We have asked for an increase in the college science improvement program of $4 million. This is a program for which there were requests of some $24 million in fiscal 1967. We believe this additional support is necessary because it goes to the small colleges from which come a disproportionate number of the doctorate candidates. We looked carefully into this program, and it had tremendous support from all of the

members of the subcommittee, most of whom do come from small colleges and will recognize the importance of small college participation.

We also added $4 million for the support of scientific research, which would allow us to immediately take advantage of facilities which presently exist for research on environmental problems. In recognition of the magnitude of these problems, I do not believe we need wait for the proposed legislation which is before us. Our belief is supported by hearings held 3 years or so ago on a more flexible use of our Federal laboratories. We do believe that if you go back and look at that record, our recommendations about doing more research in these Federal laboratories making them more national in scope, taking off the control of the single agency which sponsors and controls them that this would be a tremendous asset to the country and should be the direction in which we should go.

A number of recommendations made in this particular area support this idea, and come from a multitude of Members of the House and Senate. Our hearings some 3 or 4 years back showed that various laboratories—in particular Oak Ridge, which has already begun new activities in housing, social sciences and other areas—had a tremndous capability to do environmental work, if properly supported.

We believe that the legislation which is coming up will certainly be passed eventually. The President is supporting the need to maintain the balance of nature in our environment, and money will be saved in great amounts if we quickly take advantage of what is available to develop the kind——

Mr. EVINS. Your committee is proposing the utilization of existing laboratories, making them national in scope, and converting them to the antipollution work in which there is great national concern.

Mr. DADDARIO. That is right, Mr. Chairman. This course is supported by recommendations that we have made in the past; it is supported by recommendations that you and others have made in legislation presently before the Congress, and we propose—for the reasons that I have indicated—that $4 million be granted to the National Science Foundation for this environmental research in Federal laboratories.

Mr. EVINS. You propose to utilize existing laboratories rather than establish a series of new antipollution laboratories all over the Nation. That seems to me to make practical sense.

Mr. JONAS. I agree, but I am not sure that the National Science Foundation has the responsibility to do this or that it would be the proper agency.

Mr. DADDARIO. The National Science Foundation is unique in this area. It is established to perform a basic research function. It is being constantly asked to do that. If you take a look at the way in which its programs have begun developing over the course of the last few years, you can see a tremendous growth in the area of interdisciplinary research.

It has always been my theory that the basic research activity which is supported by the National Science Foundation should be cut away as completely and quickly as possible when it gets to the point where it can be operational, and assigned to a more appropriate agency. We have done this before in weather modification and other areas.

This is widely recognized. Chet Holifield not long ago got some legislation passed which recommended that funds from other agencies be used within some of these AEC-supported national laboratories.

We believe that this ought to be taken into consideration.

Mr. EVINS. Congressman, your position, as I understand it, is that we have these national laboratories that are identified with one commission and you are saying let them be used for other national purposes, is that right?

Mr. DADDARIO. In the discussion on this particular question, Mr. Holifield said of section 7 of H.R. 13934, which amends the Atomic Energy Act:

> Fundamentally this authority is intended to permit the AEC to utilize its facilities, equipment, and personnel to help solve important health and safety problems such as those relating to environmental pollution.

That is it in a nutshell, really.

I do think that the basic research ability in the National Science Foundation does allow it to become involved in this area and we propose that it make arrangements with an agency like the AEC to use a laboratory such as Oak Ridge for this purpose.

Mr. EVINS. You have answered my question. You propose the National Science Foundation use some of its appropriations to contract with the AEC to do work in the field of pollution.

Mr. DADDARIO. And this falls in line with the recommendations our committee made a few years ago that the National Science Foundation develop capabilities in this area not just with the universities, but with national laboratories as well.

Mr. EVINS. We would like to have your views on graduate trainee programs.

Mr. DADDARIO. We have made recommendations that graduate traineeships be increased by $9.5 million.

Mr. EVINS. We would also like to have your views regarding the summer institute training program. This committee has expressed an interest for teachers, and there is a cutback for that in the budget this year.

Mr. DADDARIO. Mr. Chairman, you will recall we have had some discussions about this on the floor in the past. I recognize your committee's feeling about this. But I do think that at a time when there is so much going on in this area, restrictions should not be imposed on the National Science Foundation so that a part of its budget be fixed when everything else needs to be flexible. That is one important point.

The next point is, in this particular area things have changed somewhat. Dr. McElroy is developing not a new philosophy, but new programs which they are trying to prove out. There are other ways in which you can attack this particular problem of secondary teacher training, and I believe he, as the new Director, ought to be given some latitude. This is really all I am asking.

Mr. JONAS. I am glad the Chairman of the subcommittee brought out that last point. I think there was some reluctance on the part of the National Science Foundation originally to go into this area. We have taken a little credit and are entitled to whatever blame I think attaches to it for getting these summer institutes set up. I, for one, have been concerned over the aggressive attitude of the

National Science Foundation in wanting to phase them out. It was not a budgetary decision; it was a decision of the Foundation. I never have been able to understand their reasoning. I still believe the place to first start training scientists is at the high school level or even below it.

I take a dim view of putting all our money in graduate fellowships and I think some of it ought to be spent in these summer institutes training these high school science teachers to do a better job training their pupils.

Mr. DADDARIO. Mr. Jonas, I think what the Director, Dr. McElroy, said about this would be helpful in eliminating your concern that they have a different approach to this particular question. I don't think there is any disagreement with you that there needs to be stronger rather than weaker instruction at the high school levels.

We asked Dr. McElroy about this and his statement supported the idea that more needs to be done. More needs to be done in developing the kind of curriculum at the high school level so they will graduate better students. NSF is talking about a more flexible curriculum, a more adaptable curriculum for different schools in different parts of the country; a less rigid approach which, I believe, could be very helpful. I do believe he ought to be given the opportunity to try this approach, and this is really what he is asking to do not to have less emphasis, but to have a different kind of emphasis, but including those they presently have.

Mr. JONAS. I agree with the idea about the curriculum. I think that is the place to start, but I believe you can train a hundred teachers in one seminar more efficiently and at less cost than to train them one at a time in the high schools where they teach, and that is what he wants to do.

Mr. DADDARIO. We could discuss this point further. One of these programs has been at my school, Wesleyan University, and I think it has been successful. On the other hand, I do believe there are some negative effects in the summer programs. Part of it is that you are really teaching teachers who have already received their college experience and in many instances they are not as involved in new techniques as younger ones.

Mr. EVINS. The information we have from the National Science Foundation is that those who have taken advantage of the program are generally the repeaters. The program is not reaching out to a great number.

Mr. DADDARIO. They don't say it is not a good program; they just want to make it more flexible, taking into consideration what they have learned from this program over a long period of time. Obviously they must have learned a lot, and what they are recommending to you is the result of the experience they have had with this program.

Mr. EVINS. This committee recognizes that you are an authority in this field and we appreciate your views.

Mr. TALCOTT. I would like to say one thing: I echo the sentiments of the Chairman but I hear criticism of the National Science Foundation favoring large, prestigious universities over the small universities. I happen to be in a district that has the largest and most pretigious university but, nevertheless, there is criticism that the smaller universities are kicked around by the National Science Foundation.

Mr. DADDARIO. May I say on that score, it is a matter of balance, I think. Some years ago we held hearings on the geographical distribution of federal funds. We found out that certainly the great universities were being used more than others, and this was because that was where the quality resided. But there was also an opportunity to develop centers of excellence throughout the country. This should be taken advantage of, and I think there has been solid accomplishment in that direction, which you gentlemen have supported.

The reason we are making our recommendations for traineeships and the college science improvement program is to get money back to the kind of colleges you are talking about, the smaller colleges, the colleges in areas in the country that aren't usually supported. If we do not do this, I believe there may be a trend back toward the situation which we had some years ago where we had support only for the high quality schools. I think this is a wrong emphasis as well. I think we can redress this by taking the actions we recommend here.

Mr. TALCOTT. I want the money to go to the quality schools. I think supporting an inferior school is wrong, but I think we should support the small quality schools as well as the prestigious universities.

Mr. DADDARIO. There have been tremendous improvements in our universities and colleges over the course of the years. If you will take a look at what is going on throughout the country, you can see new centers of academic development which lift up the least common denominator levels. They are places within which quality can develop. It is not just throwing money into inferior places. NSF, under this policy, is supporting good programs in places that usually got no support.

Mr. EVINS. Thank you, Chairman Daddario, for your fine contribution.

WEDNESDAY, APRIL 8, 1970.

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT APPROPRIATIONS

WITNESS

HON. DAN KUYKENDALL, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF TENNESSEE

Mr. EVINS. The committee will hear next our colleague, Dan Kuykendall of Tennessee, who represents the great city of Memphis. I believe you appear here in connection with the HUD appropriations.

Mr. KUYKENDALL. That is correct, Mr. Chairman.

Mr. EVINS. May I add that this is my distinguished colleague from Tennessee, who is very eloquent, efficient, and forceful.

Mr. KUYKENDALL. I don't believe Mr. Pryor was here when I testified on the subject of the 235 and 237 programs, particularly on the 237, which is the one with emphasis on counseling for low-cost homeownership.

As we well remember, this committee, in its wisdom, did not see fit to fund the 237 counseling program last time. To be frank with you, in retrospect, you can be quite philosophical and I think that as a re-

sult of some happenings since then that you were probably wise in not funding 237 a year ago.

We went to the HUD people as a result of an independent home-building foundation that we have operating in Memphis, we showed them what we are doing down there in the way of building homes for the poor, we showed them that we already had a counseling program and that we were just out of donated money and told them that if they wanted to really see how counseling could work, that we needed a small experimental grant for an experimental test of counseling prior to homeownership and after homeownership.

They gave us a 9-months' grant to be used on a graduated basis of $30,000 and its primary purpose was to see and test out whether or not counseling was necessary and could be used properly. So that is why I am here today, to tell you, as I have already told both the FHA people in Mr. Gulledge's office, and also the people in Mr. Finger's office, together, in a presentation about 2 weeks ago; to briefly tell you what this organization is and what it has done. The name of the organization is HOME, Housing Opportunity Memphis Enterprise. It is a nonprofit foundation formed approximately a year and a half ago.

As of April 7, 1970, we have either closed, under construction or committed financially—when I say "committed," we have both the construction and the permanent money, 434 homes, which will range in cost from about $12,000 to $15,500. Our maximum cost for a three-bedroom home is $15,500 and for a four-bedroom home is $17,000.

We have received from the mortgage lenders across the Nation no subsidized FNMA money. Every single dime of this money has been solicited from Metropolitan, New York Life, Prudential, Equitable, National Trust Life of Memphis, First National Bank of Memphis, National Life & Accident of Nashville, Leader Federal Savings & Loan of Memphis, and Universal Life of Memphis. The latter, incidentally, is a black insurance company. Totaling $5,100,000 of money they have put into this program at a maximum of 3 percent discount. At times when the discounts were averaging from 8 to 10 percent.

The commercial banks in Memphis have given us at 8.5 percent par no discount, a revolving construction fund to be used of $3,200,000, to be used for building these low-cost homes. This is construction money to be furnished.

Now, under the HOME program so far, under the counseling program that we began as a voluntary program, using one of my employees, a black woman, Mrs. Killibrew, she started out doing this thing on a volunteer basis. She has become what FHA up here says is one of the real experts in the country on the subject of counseling or credit rehabilitation; so we have already occupied 113 homes that we have counseled, some of them up to about 12 months, and in process and in construction we have 271 for a total of 384 families that we have had under our counseling program.

Now, we have presented to the HUD people—FHA and HUD people—our proposals of what we think a full-scale counseling program for a city the size of Memphis should be. Our expenditures in a period of about 7 months have amounted to a total of $16,619. Our administrative costs per house have been $32.26 per house and the administrative cost per family counsel has only been $36.50.

We know these are not realistic figures. We know they are entirely too low. We have volunteer help and contribution of time.

Mr. EVINS. This $36 cost for counseling is for a 9-month period per family?

Mr. KUYKENDALL. This is for the total number of families we have handled. Some of them not to completion, Mr. Chairman.

Mr. EVINS. Not for a month but for the full period?

Mr. KUYKENDALL. That is correct.

The presentation we have made to FHA asks for, instead of our office which has an executive director, part of which his salary, is being paid, part of it a grant, part by the financial community in Memphis. We have one counselor. That is all we have now. She is handling the entire counseling load which is twice or three times what any person should be handling. We have a secretary and an interesting thing I think I should add: The chief counsel is black; her secretary is white, and she is there by her own choice. Another former member of my staff who asked to go down and take this job. She was here and wanted so badly to work in this low-cost housing.

Mr. EVINS. I think this committee will commend you for your guidance and excellent work in the field of counseling. Your HOME project is doing good work.

Mr. KUYKENDALL. Mr. Chairman, may I add one thing here? The full budget we have presented for a counseling program in the city the size of Memphis is $106,000, which will be on the counseling load we know you can handle—this is a question I understand you asked both Mr. Finger and Mr. Gulledge, and they didn't have our figures at the time and I am sorry—is $130 per family annual cost of the first year.

Mr. EVINS. In other words, every family would cost $130 for first year counseling.

Mr. TALCOTT. Just for 1 year?

Mr. KUYKENDALL. The followup counseling, I can't imagine why it would ever cost more than $10 or $15 a year on a continuing basis, per year.

Mr. JONAS. Can you give us any practical results we can put our teeth into?

Mr. KUYKENDALL. Yes, sir; Mr. Jonas. This is the most important thing. We have taken 434 families. Almost 200 of them are in homes right now. These families have had bad credit records for so long that it took 20 or 30 items to list the delinquencies. We have counseled these people, put them on a budget. We don't approve anybody who has not reconciled their past credit totally. We don't ask anybody to mark off a debt and we have had absolutely no foreclosures to date, and no lates to date.

The maximum length of time we have is about 13 or 14 months on a few of them.

We have exhibits over at HUD which are lengthy. We have the before and after credit situations to show you. Extremely bad situations.

Mr. JONAS. Do you go into the field of counseling tenants in public housing?

Mr. KUYKENDALL. No, sir. This is homeownership only, Mr. Jonas. This is the only thing we have gotten into. We are not in rent supplement. We are not in public housing. We are in homeownership only on the 237-type program.

Mr. EVINS. In homeownership, people have an incentive to own their home and have a pride in homeownership, but HUD proposes a massive program of counseling in all public housing throughout the Nation and we can't estimate the cost in the years ahead. We have thought that voluntary groups such as church groups, labor groups, fraternal groups, and individual groups, would render a significant service and participation.

Mr. KUYKENDALL. Mr. Chairman, this idea you just suggested, at the cost of $100,000 per group per year, can handle upwards of 700 homes a year. Now, this we know. We have done it. We know what we can do. We have the proof. We have people in the homes. We know this.

I am not an advocate of the other counseling.

Mr. EVINS. Based upon your experience, do you think it is a good idea to stimulate volunteer groups such as yourself who have come forward and done this good work?

Mr. KUYKENDALL. It is my opinion—and I would like to see you all put out a limited funding to expand the Memphis program to about 15 cities—from one to 15, to take the next step. The reason I am glad you didn't fund it last year is because I think we need this time to test methods. If you had gone nationally at first, it would have been the biggest mess in history, I am convinced of that.

I think you should go to about 15 cities and fund a group that is reputable to do a counseling program based on the Memphis model.

Mr. EVINS. There is much counseling going on throughout the nation in the big metropolitan areas. I was told recently that in the Regency House which HUD purchased, they have a pretty good counseling service. They arrange tours throughout Washington for all the occupants. They say the counseling service is excellent.

Mr. KUYKENDALL. Anything that doesn't deal directly with homeownership doesn't have any business in counseling.

Mr. TALCOTT. You don't give political advice, social advice, or population control advice?

Mr. KUYKENDALL. Thank you for that question and the answer is "absolutely not." We help these people budget their money so they can pay for this house. Period.

Mr. EVINS. That is contributing to homeownership and good citizenship.

Mr. TALCOTT. You can support this. If they can pay $100 or $125 for a $15,000 investment and eliminate defaults and keep that family in there, that is a very sound investment. The problem with some of the counseling which has been recommended to us in public housing, has just been money completely wasted.

Mr. KUYKENDALL. Mr. Talcott, I am of the opinion that subsidized interests in 235 must have counseling to assure success but it must have counseling based on nothing in the world but assuring the ability of those people to pay off that mortgage. If they own the home, they are going to have the pride. If they own this home, they are going to take care of it, if they know how, and this is what you are going to try to help them do. That is all.

Mr. EVINS. You have given us an effective and helpful statement and we appreciate your appearance.

WEDNESDAY, APRIL 8, 1970.

VA MEDICAL CARE IN MONTANA

STATEMENT OF REPRESENTATIVE JOHN MELCHER OF MONTANA

Mr. EVINS. Our colleague, John Melcher, of the State of Montana, called and said he would be unable to appear at this time in connection with the medical needs of the Montana Veterans Hospital. He asked that we place his statement in the record at this time.

(The statement follows:)

STATEMENT OF CONGRESSMAN JOHN MELCHER

Mr. Chairman, I appreciate having the opportunity to discuss the medical care needs of Montana veterans and the necessity for increased expenditures to provide the level of care we owe them.

Funding of Veterans' Administration facilities has been seriously inadequate. We have had far too many letters from constituent veterans back home pointing out the affronts they have faced because of a lack of funds to care for them. We have received letters that never should have to be written. Veterans who have protected America in hours of crisis should not have to beg for medical care they need; help we promised we would give them but which has met with budgetary inadequacies.

Mr. Chairman, they write to me from Montana, where the Fort Harrison and Miles City VA hospitals do not have the funds necessary to do the job. The personnel at these institutions are struggling along, watching anxiously for a funding supplement that only occasionally comes along. A December 1969 inquiry by the House Veterans' Affairs Committee showed that there was a shortage of more than $400,000 to operate approximately 256 hospital beds serving nearly 100,000 Montana veterans plus some veterans from bordering States. Supplemental allowances since then have been helpful, but they have had the effect of trying to cure major arterial bleeding with a band aid. Staffing deficiencies severely hamper the two hospitals.

Compared to the average staff ratio of 2.72 employees per patient for general medical community hospitals and State and local government hospitals across this land, the Fort Harrison hospital operates with a 1.5 staff-patient ratio, while the Miles City facility works with a 1.49 relationship. Is this the top-flight care, we say, our veterans deserve? To help alleviate the funding shortages for direct medical care programs, the hospital directors have reported the necessity to juggle their books to divert funds from maintenance, repair, and equipment budgets. My latest information shows significant personnel needs to bring facilities operations to at least the barebone minimum levels. At the Fort Harrison Center: six nurses, two persons in building management, two in engineering, three in medical administration, and one dental technician. At Miles City: one nurse, three nursing assistants, one typist, one preventive maintenance inspector, one electrical mechanic, and one plumber.

If we were to raise the staff-patient level to at least 2, then the Fort Harrison hospital would need about 40 additional employees at an annual cost of about $380,000 and the Miles City facility would require 21 more persons at a yearly expense of more than $146,000. I do not want to hear again of threatened closures of hospital wings at a time when the need for beds is increasing acutely.

The dental care program, its importance broadened sharply by the flow of returning Vietnam veterans, is a classic example of the severity of the funding problem. In December 1969 the funding level for this was figured to be short about $98,000 at Fort Harrison. The latest VA supplemental brought a promise of $96,000 to back up this long-delayed program for the remainder of fiscal 1970. But the backlog in the dental care division is great. There never should have been a backlog. The damage is done, however, for the faith of many young returning Vietnam veterans in their Government already has been shaken. Their teeth hurt, but the promise of one-time care in the 12 months following service discharge have been set aside.

The situation has been so bad in Montana that the director of the Montana Veterans Welfare Commission, Mr. Harry E. Sawyer of Helena, found it neces-

sary to try to warn servicemen not to expect VA dental care promised to them before they left Vietnam. Mr. Sawyer sent out a news release that appeared in many Montana newspapers in March. In his report, he pointed out Fort Harrison was not able to authorize any one-time treatment between August 1, 1969, and January 1, 1970, and when some funds were released, they were only about one-fifth of the amount needed. His article concluded:

> "Persons having relatives in service who are due for separation or discharge should urge them to get dental care, if at all possible, before being released. The fact that the Veterans' Administration will promptly furnish needed dental care is not true. In fact it would probably be a good idea to clip this news item and send it to the person who will soon be separated."

Mr. Chairman, the entire matter of medical care for our veterans boils down to one simple point: It is imperative that we keep our commitments, whatever the cost. Dollars and cents really have no part in this; it is a moral question. Our Republic owes her very existence today to her thousands of servicemen and women who set aside their private lives to protect her from her enemies. Some never picked up those private lives again; many who did face new lives marred by ill health and disabilities. If we turn our backs on our veterans, we undermine our whole moral structure and hopelessly weaken our country's future. We pride ourselves on keeping our commitments in the world arena. Can't we keep them in our own hospital wards? If our national interests are well served by our power balance of commitments, they are no less fortified by the servicemen and women who are the custodians of our security and well being. We have a pact to keep with our own conscience and ethics.

I thank the distinguished chairman and members of this committee for the opportunity to speak on behalf of veterans in Montana and all America.

Commission on Government Procurement

STATEMENT OF REPRESENTATIVE CHET HOLIFIELD OF CALIFORNIA

Mr. Evins. At this point we will place in the record a statement from Congressman Chet Holifield regarding the Commission on Government Procurement.

(The statement follows:)

Statement of Congressman Chet Holifield

Mr. Chairman and members of the Independent Offices Subcommittee, I want to take this opportunity to convey to you the importance of adequate funding for the Commission on Government Procurement, created by Public Law 91–129. As you know, the Bureau of the Budget requested $2.5 million in a lump sum appropriation for the work of the Commission. The reasons for this request were set forth by Mr. Dwight Ink, the Budget Bureau representative, at the time of the hearing on the last supplemental. He stressed the need for the lump sum appropriation in order that the Commission might intelligently plan its work and allocate its resources for the many important talks to be done. I emphasized the same points in my letter of December 1, 1969 to Chairman Evins.

Although the Senate subcommittee was favorable to the complete appropriation in one enactment, the House subcommittee members proposed a first increment of $500,000 and indicated that additional funds would be provided after the Commission had become organized and could present a plan of work. The conference decision, as you know, was to appropriate $700,000 for initial funding.

Both the House and Senate Committee on Appropriations have clearly endorsed the objectives of the Commission, and I will not attempt to restate its potential importance for effecting large improvements and savings in Government procurement. I will say that the interest expressed in the Commission, and the widespread recognition that it has a real job to do, have been truly remarkable and continue with undiminished intensity.

Unfortunately, the Presidential appointments to the Commission have been delayed, the Commission has not yet been organized, and consequently it is not yet in a position to present a work plan and budget. However, the President announced his appointments on Friday, April 3, 1970, thus completing the full Commission membership (listing attached). We plan to have a first meeting on

April 22 and to start on the duties given by our legislative mandate as soon as possible. I am confident that this Commission will work hard and do an outstanding job, and I know that Congressman Horton, my Republican colleague on the Commission from the House side, shares this view.

Our funding problem still remains: we need enough funds to plan a work program and allocate resources for assigned tasks. I recognize that the subcommittee would prefer to have such appropriations handled through the regular appropriation bills rather than in supplementals. Therefore, I would hope that the subcommittee sees its way clear to make another increment of $1 million available for the Commission in the pending appropriation bill. This will give us a good basis to get underway and carry our work through the appropriation year.

I can promise you that as soon as the Commission is in a position to develop its work plan and specific funding requirements, these will be promptly conveyed to this subcommittee. Please call upon me if additional information is required.

Attachment: Commission on Government Procurement Membership.

MEMBERS OF THE COMMISSION ON GOVERNMENT PROCUREMENT

PRESIDENTIAL APPOINTEES

Robert L. Kunzig, Administrator, General Services Administration.
Frank Sanders, Assistant Secretary of the Navy.
Paul W. Beamer, % Wyman-Gordon Co., Worchester, Mass.
Peter Dierks Joers, % Weyerhauser Corp., Dierks Division, Hot Springs, Ark.
E. Perkins McGuire, Washington, D.C.

APPOINTEES BY THE SPEAKER OF THE HOUSE:

Chet Holifield, U.S. House of Representatives.
Frank Horton, U.S. House of Representatives.
Joseph W. Barr, American Security and Trust Co., Washington, D.C.

APPOINTEES BY THE PRESIDENT OF THE SENATE:

Henry M. Jackson, U.S. Senate.
Edward J. Gurney, U.S. Senate.
Richard E. Horner, % Northrop Corp., Beverly Hills, Calif.

STATUTORY APPOINTEE:

Elmer Staats, Comptroller General of the United States.

ALASKAN HOUSING

LETTER OF REPRESENTATIVE HOWARD W. POLLOCK OF ALASKA

Mr. EVINS. Our distinguished colleague from Alaska, the Honorable Howard W. Pollack has submitted a letter in support of Alaskan housing. The letter will be included at this point in the record.

(The letter follows:)

CONGRESS OF THE UNITED STATES,
HOUSE OF REPRESENTATIVES,
Washington, D.C., April 8, 1970.

Hon. JOE L. EVINS,
Chairman, Independent Offices, Housing and Urban Development,
Rayburn House Office Building,
Washington, D.C.

DEAR MR. CHAIRMAN: The Model Cities Act of 1966 contains a provision authorizing the expenditure of $10 million for housing construction in remote areas of Alaska. In spite of the fact that deplorable housing conditions continue to emphasize the need for an accelerated home building program in rural Alaska, the administration has not requested any further funding for the Alaska remote housing program in its fiscal year 1971 budget.

While I strongly support the President's efforts to control inflation by reducing Federal spending, I believe that the remote housing program is so desperately needed by such large numbers of Alaska's Native people that it should not be eliminated even now when the administration and the Congress are working so diligently to reduce the level of Federal expenditures.

Perhaps, it would be helpful for me to describe briefly the situation which has caused me to conclude that the remote housing program is indispensible even in this year of budget cutbacks in many Federal programs. At this relatively embryonic stage in Alaska's development, it is not uncommon in the remote regions of the State to find as many as eight or 10 people crowded together in one or two small rooms of a dilapidated shack, which is not sufficiently insulated to protect the residents from the bitter winter cold. As a result of the crowding, the cold, and the poor ventilation, tuberculosis and other respiratory diseases are an ever-present threat. Because there are virtually no sanitation systems to dispose of human waste, water resources are often contaminated. Such conditions are difficult to endure in the relatively warm summer months. In the bitter cold of an Alaskan winter, they are nearly unbearable.

The $10 million for Alaska remote housing, which is contained in section 1004 of the Model Cities Act, represents a promising partial solution to the immense problems that I just described. Last year, the initial $2 million appropriated by the Congress for the remote housing program was used to build 160 houses in 10 Native communities. Many more housing starts are planned for the future.

In order to comprehend the dimensions of the proposed solution to Alaska's rural housing needs, it is helpful to look at the original implementation plan for the construction of remote housing. This plan called for the building of 400 dwelling units in 1970 at a cost of $2 million, 600 units costing $3 million in 1971, and 800 units in 1972 at a cost of $4 million. Because past Federal allocations have not ben sufficient to meet this construction schedule, the progress of remote housing construction in Alaska has necessarily been impeded. To compensate for past budget deficiencies and to insure the continuing existence of the much needed Alaska remote housing program, I respectfully request that the House Committee on Appropriations recommend the appropriation of enough funds to permit the construction timetable proposed in the original implementation plan to be met. If I may be of any assistance to you or your technical staff in your consideration of my urgent request, please do not hesitate to let me know.

In closing, I once more want to emphasize the importance of the remote housing program to the inhabitants of rural Alaska. Devoid of proper shelter, many of Alaska's rural citizens are doomed to a life of sickness and misery. Recognizing the deplorable housing situation which now exists in the remote regions of Alaska, the State legislature has passed legislation which will significantly increase the State's participation in the building of rural homes for Alaska's Natives. However, the problems are immense, and the State's financial resources are still severely limited, for it will be several years before the $900 million which Alaska received last fall from the sale of North Slope oil leases can be fully utilized. Thus, I believe that the Congress should continue the obligation which it undertook in the Model Cities Act of 1966.

Mr. Chairman, I respectfully request that this letter be included in the hearing record which is now being completed in connection with your consideration of the fiscal year 1971 budget for the Department of Housing and Urban Development.

Cordially,

HOWARD W. POLLOCK,
Congressman for Alaska.

LETTER OF REPRESENTATIVE OLIN E. TEAGUE OF TEXAS

Mr. EVINS. At this point we will place in the record a letter from Congressman Olin Teague of the Committee on Veterans' Affairs.

(The letter follows:)

U.S. HOUSE OF REPRESENTATIVES,
COMMITTEE ON VETERANS' AFFAIRS,
Washington, D.C.

Hon. JOE L. EVINS,
Chairman Subcommittee on Independent Offices, Housing and Urban Development, Appropriations Committee, House of Representatives, Washington, D.C.

DEAR MR. CHAIRMAN: On March 26, 1970, Public Law 91-219 was approved. Chapter 34 of title 38 includes a new provision to extend the veterans outreach service program. The following reference was made to this program as part of the statement of the managers in the conference report:

"The veterans outreach service program which would be established by this subchapter represents a clear congressional determination that a more extensive and intensive program of veterans benefits counseling, contact and outreach effort is badly needed. Such a program can be of great service, not only to the educationally disadvantaged veteran, but also to any veteran who is unclear about the extent of his entitlement and where his future lies. This subchapter provides clear authority for the use of special telephone tielines to provide outreach services to cities and communities removed from Veterans' Administration offices and contact centers. This subchapter also encourages the expansion of Veterans' Administration contact offices into major communities and population centers where Veterans' Administration offices and services are not readily available or where there are large concentrations of veterans, such as disadvantaged veterans with specialized problems. It is expected that the Veterans' Administration will immediately proceed to survey its contact and outreach facilities and develop plans for expanding these services in line with the provisions of this subchapter. It is expected that Veterans' Administration will develop these plans promptly for submission to appropriate committees of Congress in order that this expanded program may receive appropriate budgetary support in fiscal year 1971 budget.

"The agreed-on conference language eliminated the provisions for a relocation assistance allowance for veterans in need of job assistance. The removal of this provision by the conference should not be construed to imply a lack of interest on the part of the conference in job placement assistance for returning veterans. It may be that some of these provisions are appropriate for insertion in general manpower and training legislation. On the other hand, the veterans' employment service is presently operated on a very modest scale and should be supported to the extent necessary to give effective assistance to returning veterans in need of job placement assistance. Additional support of the veterans employment service and identification of the veterans special needs through general manpower and training legislation could greatly improve the prospects for returning servicemen obtaining jobs."

Prior to the passage of this legislation, this committee conducted an extensive survey on how this outreach program could best be implemented especially to meet the new demands of the returning Vietnam veterans. It was concluded that establishment of 29 new contact offices in cities of substantial size, which do not now have Veterans' Administration service, and the establishment of 74 new special FX telephone systems, which would bring telephone contact with the VA within the reach of millions of veterans without a toll charge, would be the most efficient and economical method of implementing this program. These expanded facilities would cover standard metropolitan statistical population areas of a population exceeding 40 million. I recommend that $11 million be added to general operating expenses of the 1971 VA budget to fund this program.

In testimony before the Subcommittee on Hospitals on April 14, 1970, the Administrator of Veterans Affairs indicated that despite the request for $9.8 million in supplemental 1970 funds for free dental care, a backlog of approximately 40,000 cases would still exist as of June 30, 1970. It has been the experience of this committee that from the time a veteran applies for dental care until he is actually treated ranges from 4 to 6 months which is entirely too long a

period of time to wait. Accordingly, I recommend that an additional $3 million be added to the 1971 VA medical care request to give more timely dental care to our returning Vietnam veterans.

The investigation which this committee has been conducting indicates that almost all VA hospitals are seriously understaffed. I referred to this matter in some detail in my April 7, 1970 letter to your committee requesting an increase in the 1970 supplemental appropriation. At the end of February 1970, the number of full-time permanent positions in the medical care program totaled 120,028. Testimony given yesterday by the Chief Medical Director before the Hospital Subcommittee indicated that even with the $50 million additional funding requested by the President on April 2 over the original budget submitted to the Congress in January, VA could raise the full-time permanent employment level to only 127,348 which is 1,164 FTP positions below the FTP employment level of the Department of Medicine and Surgery as of June 30, 1966—the employment level roll back date called for in the Revenue and Expenditures and Control Act of 1968. Accordingly I recommend that $9 million be added to the VA medical care budget request to provide for approximately 1,000 additional FTP positions which our investigation discloses are recruitable. This will help bring the hospital staffing level up to a more reasonable level to treat an estimated 780,500 veterans in 1971, which is almost 50,000 more than were treated in 1966.

Our investigation has also disclosed that due to lack of funds, in the 1971 budget request, as amended by the President on April 2, 1970, it has been necessary for the Veterans' Administration to plan a 10 percent cut back on its commitments for residents and intern house-staff employees who are directly involved in patient care. Such a cut back would seriously impair the quality of care for our hospitalized veterans. I therefore recommend that $3.5 million be restored to the 1971 medical care budget request for this purpose.

Our investigation has also disclosed a need for the expansion of the Veterans' Administration rehabilitation technician training program which deals primarily with veterans who are fitted with prosthetic devices. The high rate of limb loss among returning Vietnam veterans requires an accelerated expansion of this program which is not provided for in the current VA medical care budget. It is recommended that $500,000 be added thereof for this purpose.

Both the President and the Secretary of Health, Education, and Welfare have decried the current "medical manpower crisis" and have recommended a program to train physician assistants to help augment hospital staffing. The 1971 medical care budget for the Veterans' Administration for this purpose is totally inadequate and at least $2 million should be added for fiscal year 1971.

A review of the 1971 VA budget request also discloses a 10 percent reduction was made in their request in training programs for technicians in the Paramedical and Allied Health Services field. This directly relates to the "massive medical manpower crisis" which the Administration indicates needs most urgent attention. Accordingly, I recommend that the 1971 VA medical care budget be increased by $3 for this purpose. For the same reasons, it is recommended that $1 million be added to the medical care budget to expand the training program for nurse technicians to staff "Specialized Medical Services" such as coronary care, and other intensive care, hemodialysis, organ replacement, pulmonary emphysema and pulmonary function units.

I also recommend that $250,000 be added to medical care in the 1971 VA budget to properly fund the biomedical instrumentation technician program. Personnel for this specialty are in very short supply and are vitally needed to deliver proper medical care for our seriously sick and disabled veterans.

As you know from my April 7 letter, millions of dollars of equipment and maintenance funds in the Veterans' Administration have been diverted to pay staffing and other operating costs over the past few years. New treatment techniques and procedures which have developed at a rapid rate in the past 5 to 7 years require use of this new equipment to save and prolong lives. Because of inflation and other reasons, the VA has not been able to keep up with the purchase of this new type equipment nor has it been able to properly maintain the physical plants of many of its hospitals so as to insure the best of medical care for America's veterans. In testimony before our committee on April 14, the Administrator of Veterans Affairs indicated that an equipment backlog existed of over $49 million. While I have already asked that $5 million be added to the 1970 supplemental for equipment. I believe that another $10 million should be added to the 1971 medical care budget to give the most urgently needed relief to this serious backlog.

In summation, I recommend amendments to the 1971 Veterans' Administration budget as follows:

Medical care:	
Equipment	$10,000,000
Dental care	3,000,000
Hospital staffing	9,000,000
Resident and intern house staffing	3,500,000
Expansion of rehabilitation technician training program	500,000
Expansion of physician assistant training program	2,000,000
Restore funds for training of paramedical and allied service program	3,000,000
Expansion of training program for nurse technicians for specialized medical services	1,000,000
Biomedical instrumentation technicians program	250,000
Total	32,250,000
General operating expense	
To implement new "Outreach" provision of Public Law 91-219	11,000,000
Total	43,250,000

I strongly recommend your support of these items which are so urgently needed to provide America's veterans with better medical care and more prompt service on claims which our returning Vietnam veterans are filing with the Veterans' Administration.

Sincerely,

OLIN E. TEAGUE, *Chairman.*

FEDERAL OFFICE BUILDING, WILMINGTON, DEL.

LETTER OF SENATOR J. CALEB BOGGS OF DELAWARE

Mr. EVINS. The committee has a letter from Senator Boggs of Delaware that he wishes included in the record. The letter urges approval of the $9,127,000 in the budget for construction of the Federal office building and courthouse at Wilmington. We will be pleased to include the letter in the record at this point.

(The letter follows:)

U.S. SENATE,
COMMITTEE ON APPROPRIATIONS,
Washington, D.C., April 10, 1970.

Hon. JOE L. EVINS,
Rayburn House Office Building,
Washington, D.C.

DEAR CONGRESSMAN EVINS: Among the General Services Administration proposals for fiscal year 1971 is $9,127,000 to construct a Federal office building in Wilmington, Del.

This building was authorized by the Congress in 1960 and is the oldest authorized but unfunded building in the United States.

Its construction is the cornerstone for the rebuilding of downtown Wilmington, which is considered absolutely essential by all concerned with the city and the area.

The construction of the building has been supported by all segments of the community and by a succession of political leaders of both parties from the State. Mr. Robert L. Kunzig, the GSA Administrator, firmly supports the appropriation. He said in a letter to me: "Wilmington carries a top priority with me and I will do everything in my power to see it moves ahead rapidly when funds become available."

In addition to its importance on a social and economic basis in Wilmington, the building would bring together in one place the U.S. courts and other Federal agencies now scattered throughout the city.

I would deeply appreciate any consideration you can give to retaining this proposal in the 1971 budget for the General Services Administration.

With highest regards and best wishes, I am

Sincerely,

J. CALEB BOGGS.

WEDNESDAY, APRIL 8, 1970.

VETERANS' ADMINISTRATION APPROPRIATION

WITNESSES

CHARLES E. MATTINGLY, ASSISTANT LEGISLATIVE DIRECTOR, THE AMERICAN LEGION
E. H. GOLEMBIESKI, NATIONAL REHABILITATION DIRECTOR, THE AMERICAN LEGION
BERNARD A. NOLAN, ASSISTANT DIRECTOR, NATIONAL REHABILITATION COMMISSION, THE AMERICAN LEGION

Mr. EVINS. We have Mr. Charles E. Mattingly, Assistant Legislative Director, American Legion. He appears in connection with the appropriations for the Veterans' Administration. And Mr. Golembieski, National Rehabilitation Director of the American Legion.

Mr. MATTINGLY. First of all, I want to thank you for the privilege to appear before your subcommittee to present the American Legion's views on funds for the Veterans' Administration.

I would like to introduce Mr. B. A. Nolan, Mr. E. H. Golembieski.

With your permission, at this point I would like to introduce our National Rehabilitation Director, Mr. Golembieski, who will present a summary of his statement.

Mr. EVINS. Your full statement will appear in the record at this point.

(The statement follows:)

STATEMENT OF E. H. GOLEMBIESKI

Mr. Chairman and members of the subcommittee:

We welcome the privilege extended to the American Legion to appear here today to express our views on Veterans' Administration appropriations for fiscal year 1971.

According to data prepared by the Veterans' Administration in connection with their 1971 budget requests, the veteran population will attain 27.6 million by 1970, and 28.4 million by 1971.

On June 30, 1969, there were approximately 65.3 million family members of living veterans, and 3.3 million survivors of deceased veterans. Thus, about 47 percent of the population of the United States are potential recipients of veterans benefits provided by the Federal Government.

Although the VA budget proposed by the President is the largest appropriation request in the history of the Veterans' Administration, the American Legion believes that significant increases must be made in the appropriations proposed for medical care.

We know that the solution to many of the problems affecting the VA medical care program will take time. We believe, though, that an immediate effective move to solve these problems is more money. For this reason, Mr. Chairman, the full text of my statement is directed to the appropriations for medical care, and construction and modernization of facilities and equipment.

On enactment of Public Law 293 of the 79th Congress, the Department of Medicine and Surgery of the Veterans' Administration embarked upon a program without precedent in the history of Federal hospitalization. Under this Magna Carta for veterans medical care, schools of medicine and surgery and other teaching centers would cooperate with the Veterans' Administration for the threefold purpose of (1) giving the veteran the highest quality of medical care; (2) affording the medical student veteran the opportunity for postgraduate study which he was compelled to forgo in serving his country, and (3) raising, generally, the standard of medical practice in the United States by the expansion of facilities for graduate education. This act underscored the purpose of the Veter-

ans' Administration—to afford the veteran a much higher standard of medical care than could be given him with a wholly full-time medical service.

Under the aegis of this legislation, the Veterans' Administration developed and maintained for a number of years following World War II an unparalleled program of medical and hospital care for veterans.

After watching this great system of medical and hospital care for veterans flourish for more than 20 years, it becomes distressing to the American Legion to see the beginning of its deterioration because of budgetary restrictions.

To appreciate our point of view, we must look at what the VA Department of Medicine and Surgery has contributed, not only to the medical and hospital care of war veterans, but also to the medical health and manpower needs of the Nation. According to some authorities, fully one-half or more of the trainees in this country, if we include sophomore medical students, get some part of their medical training in VA medical hospitals. This is particularly true of the postgraduate specialties.

To fully appreciate VA's participation in health service training—from the physician and dentist level through the professional and technical levels to the aide level—we must look to the fact that the Veterans' Administration provided training to 37,889 persons in 1969, with a goal of about 87,000 trainees in 1975. The magnitude of the national role of the Veterans' Administration in medical and allied medical training becomes most clear when we compare these figures with the Nation's manpower needs of about 120,000 persons a year during the 1965–75 decade.

Mr. Chairman, we do not stand alone in this consensus that the Veterans' Administration is becoming increasingly incapable, in terms of financial, professional, and hospital resources, of maintaining the quality of medical care envisioned in the enactment of law which created the Veterans' Administration Department of Medicine and Surgery on January 3, 1946. Expert testimony and unchallengeable facts developed by Senator Alan Cranston, chairman, Subcommittee on Veterans' Affairs, Senate Committee on Labor and Public Welfare; and by Congressman Olin Teague, chairman of the House Committee on Veterans' Affairs, substantiate that millions of dollars of modern life-saving and life-sustaining equipment stand idle in VA hospitals for lack of funds to hire and train personnel to operate it; that VA hospital staff levels are seriously depleted; that eligible veterans are being denied care and treatment; that the VA is unable to fully utilize its facilities for medical education and training; and that needed modernizations of equipment and facilities are being deferred.

Mr. Chairman, in making this plea for increased funding of the Veterans' Administration medical and hospital program, the American Legion is not unmindful of the fact that it was your subcommittee that increased the April 15, 1969, revised VA budget for fiscal year 1970 by $17.6 million for medical care; by about $14 million for construction of hospital and domiciliary facilities; and by $3 million for grants for construction of State nursing homes. Nor are we unmindful of the recent Presidential announcement of authorization given the Veterans' Administration to seek from Congress an additional appropriation of $15 million for the remainder of fiscal year 1970, and of his approval of a $50 million increase in the VA's medical care budget for fiscal year 1971.

Mr. Chairman, notwithstanding your restoration of $17.6 million to the 1970 revised budget, and the authorization given the VA to seek an increase of $15 million in 1970 supplemental appropriations, the VA medical care program remains in distress for the following reasons. In medical care alone—

Public Law 90–206—Pay raises, third step effective July 13, 1969, increased personnel salaries by $73,951,000;

Public Law 83–763—Wage rate increases amounted to $35,000,000;

Public Law 91–93—Agency share of civil service retirement increased from 6½ to 7 percent, and additional terminal payments due to liberalized retirement added $3,035,000;

Public Law 91–101—Eliminated 6-month limitation on nursing home care for veterans with service-connected disabilities, cost $700,000;

Public Law 91–102—Authorized complete medical services for a non-service-connected disability to any war veteran with a toal service-connected disability, cost $4,000,000;

Public Law 91–114—Increase in maximum per diem from $16 to $25, added cost $163,000; and

Pubilc Law 91–178—Increased maximum per diem rate paid to state homes for hospital care, from $3.50 to $7.50, cost $1,400,000.

Thus, although the gross supplemental requirements for the foregoing for fiscal 1970 are $188,249,000, only a net supplemental is authorized of $91,500,000. and the amount to be absorbed by medical care is $26,749,000. The VA budget and medical care program funding problems for fiscal 1970 and 1971 will be further compounded if the 6-percent Federal salary increase being discussed is approved—the $50 million increase authroized for fiscal 1971 will be totally absorbed

In our fiscal year 1970 statement before this subcommittee on the VA budget, we had pointed to the disparity in VA personnel-patient ratios in comparison to those of first-rate community hospitals, an average of less than 1.5 compared to 2.65. This disparity to some degree was a result of personnel reductions imposed by section 201 of the Revenue and Expenditures Control Act of 1968; the denial of increased employee levels in the fiscal year 1969 VA appropriation request; and the executive revision of Federal employment estimates. Although the President in September 1969 granted some relief by raising VA personnel ceilings by 1,500 (1,250 for medical care), and approved in the 1971 budget request 2,100 additional medical care employees, the following tabuation indicates that the VA Department of Medicine and Surgery is still operating at a staffing level below that of June 30, 1966—

June 30, 1966	128,512
June 30, 1967	130,788
June 30, 1968	131,403
June 30, 1969	128,448
Feb. 28, 1970	127,380

While part of the patient care load has been taken over by an increase in the number of part-time doctors, nurses, residents, and interns, we question the wisdom of this practice.

Earlier in this statement we had said that eligible veterans were being denied, because of insufficient funding, needed care and treatment. As you know, Mr. Chairman, since World War II there has been a marked increase in the number of veterans eligible for medical care, in the need for hospital and other type medical care, beds and services, and in personnel needed to provide these services. Yet, in the Veterans' Administration there has been a steady decline in the average number of operating beds, and in average daily patient census. According to the Veterans' Administration budget requests, this reduction in operating beds is consonant with increased patient turnover and reduced bed demand. There is evidence, we believe, that the VA admission policy is geared to the patient needing care for an acute illness—that the patient requiring hospital care for chronic illness, or for intermediate or extended care, is denied admission.

In your consideration of VA needs for construction and modernization of hospital facilities and equipment, we recommend a congressional revitalization of the program that had its origin in fiscal year 1961. At that time, the Congress approved the first increment in a 12-year (later increased to 15-year) program of modernization of hospital and domiciliary facilities to be applied at the rate of $75 million a year. Because of budget economies and rising construction and maintenance costs, this rate of modernization has not progressed as planned. Without realistic infusion of funds into this construction and modernization program, the further deterioration of older facilities will result in costly increased maintenance and inefficient patient care.

And finally, Mr. Chairman, we ask your consideration of increased funds to train larger numbers of medical and associated medical personnel. As you know, VA hospitals are being utilized by medical and other professional schools for training to fill the health manpower gap. According to information from medical schools and from the Veterans' Administration, a limitation has been imposed on the use of VA hospital house staff funds for fiscal year 1970–71. While the primary mission of the Veterans' Administration is veteran patient care, teaching and training are concomitant ingredients of good patient care. In considering the health manpower needs of this coutry, Dr. Roger O. Egeberg, the President's chief health adviser, replying to a question on the Nation's No. 1 health problem and how to solve it, said: "In the first place, we need just sheer numbers of people, 50,000 more physicians than we have now, almost 150,000 more technicians."

With increased funds, the Veterans' Administration can intensify its engagement in education and training in association with medical and dental schools and other academic institutions of physician and other health service personnel.

In conclusion, the American Legion extends its appreciation to you, Mr. Chairman, for the privilege of appearing here to express our views on the Veterans' Administration appropriation for fiscal year 1971.

Mr. GOLEMBIESKI. We appreciate being invited to appear here. We ask that the Veterans' Administration be provided with funds sufficient to administer an effective and efficient program that has been established by the Congress and by the Nation for veterans and their dependents.

I would like to express our organization's thanks for the work you did on the 1970 budget wherein you increased the amount over and above the revised April 15, 1969 budget submitted by the new administration by adding $17.6 million for medical care, $14 million for construction and approximately $3 million in grants to the States for construction of nursing bed facilities. Without these increases I am sure the Veterans' Administration would be in more fiscal distress than they are at the present time.

As you know, the wage board increases, salary increases, and certain laws enacted in the 91st Congress did cause VA to have a deficiency of $118 million and since they have only been authorized to ask for a supplemental of $91.5 million, it leaves them short by about $27 million that they had to take out of their own pockets, so to speak, to meet the added costs of this legislation.

You will note from our statement that the overriding interest of the American Legion is in having sufficient funds provided for the VA medical and hospital care program as well as funds for modernization of facilities and equipment, and new construction.

We feel that the infusion of sufficient funds for construction and modernization would revitalize the VA. They have many old pre-World War II hospitals, cantonment types, and so on, which are highly inefficient. We know there are provisions in the 1971 budget for some of construction and modernization, however, more funds are needed.

We believe more funding is needed for medical care of the VA so it may improve the staff-patient ratios in hospitals; and, so that they could activate needed special facilities. Some have been constructed but not activated and there is a need for additional construction of special facilities.

It would enable them to fully utilize their facilities for education and training and to treat more veterans and to move forward with a meaningful program of modernization of equipment and facilities.

The replacement of equipment has been backlogged considerably because of the shortage of funds and the need for the use of these funds in other areas.

We firmly believe that increased appropriations are needed to assure quality medical care second to none and to maintain the VA as a training agency for colleges and universities in preparing students at the professional level in the medical field and in the so-called associated medical areas.

In looking at the 1971 appropriation estimates that had been prepared by the VA and the estimates that had been submitted by the agency to the Bureau of the Budget, and in comparing it with the final figure submitted by the executive to the Congress, we note that the Office of the Chief Medical Director had recommended a figure that was $126 million higher than what came forward to your com-

mittee for consideration in the budget message. They were also about $66 million higher in construction than came forward to your committee. So, even though the President of the United States has said he approved an increase in the 1971 budget by approximately $50 million, it still leaves VA short $76 million in the medical care area, also, if the administration goes ahead with the six percent Federal salary increase that they plan to request, this increase will absorb the $50 million proposed by the President.

Mr. TALCOTT. We will consider that later, you understand that?

Mr. GOLEMIESKI. Yes, sir; but last year they didn't get the full amount of the shortage. They could only come forward with a request for $91.5 million when they needed $118 million just for medical care alone. The agency had to pick up $27 million in salary costs and so forth. This concludes my statement, Mr. Chairman.

Mr. EVINS. Thank you, Mr. Golembieski. We appreciate your position and we thank you for your testimony.

Mr. TALCOTT. I would like to have an answer supplied for the record to this question: "You have said that millions of dollars of modern life-saving and life-sustaining equipment stand idle in VA hospitals for lack of funds to hire and train personnel to operate it." That is a serious accusation. I would like to have a statement today or tomorrow of instances of that.

Then you said that eligible veterans are being denied care and treatment. I would like to have the names and addresses of two veterans tomorrow.

Mr. GOLEMBIESKI. We would have to go into the field to identify that.

Mr. TALCOTT. This is a very serious accusation to me and I don't want any veteran to be denied medical care.

Mr. GOLEMBIESKI. I can illustrate the situation here, sir.

Mr. TALCOTT. I would like to have the name and address.

Mr. GOLEMBIESKI. I would have to go to the field for that, sir.

Mr. JONAS. Can't you go to the field? You are putting some statements on a permanent record here that will be published and I don't think you ought to make statements that you can't document. All he is asking you to do is to document the statement so we can investigate them. We get contrary advice from what you have given us. We got it yesterday.

Mr. GOLEMBIESKI. I can point to a provision of law which itself bars admission. As an illustration is a man who needs nursing-type care. He cannot receive this type of care unless he goes through the VA hospital. So the law reads now that he has to be admitted to the hospital——

Mr. TALCOTT. Then we ought to be talking to the Legislative Committee.

Mr. GOLIEMBIESKI. That is what we are talking about here.

Mr. TALCOTT. You have mentioned legislative committees and are being critical of an appropriations committee.

Mr. GOLEMBIESKI. I understand Mr. Haley's subcommittee on hospitals will conduct hearings on these matters.

Mr. TALCOTT. I am a member of the American Legion and I care about the veterans getting good hospital care. I think our country has provided the best care for veterans in hospitals of any nation in

the world. We are trying to do a good job and see that the veterans get good care. When you have accusations like this, I think you ought to come up and give us something specific. I think I am entitled to have the names and addresses this afternoon of these people as a Member of Congress.

Either that or you ought to withdraw this from the record.

Mr. GOLEMBIESKI. I don't intend to withdraw it, sir.

Mr. EVINS. Thank you, Mr. Golembieski, for your testimony and thank you, gentlemen.

WEDNESDAY, APRIL 8, 1970.

FEDERAL POWER COMMISSION

WITNESS

ALEX RADIN, GENERAL MANAGER, AMERICAN PUBLIC POWER ASSOCIATION

Mr. EVINS. The committee will call next Mr. Alex Radin.

Annually our friend, Alex Radin, comes before us to give us ideas on the funding for the Federal Power Commission. Alex, we will be pleased to hear you.

Mr. RADIN. Thank you.

I do come here every year to testify in connection with the Federal Power Commission appropriations. The principal reason I do that is that about 1,000 of the municipally owned electric utilities whom we represent purchase power at wholesale from the power companies that are subject to regulation by the Federal Power Commission and we are naturally very interested in the effectiveness of such regulation.

We are also concerned about other things the Federal Power Commission does. For example, they set forth conditions of contracts that we have with power companies and they assist in pooling arrangements and other matters in which we have an interest, but regulation of wholesale rates is our primary concern and we are pleased to note in fiscal year 1969 the Commission accepted rate reductions of $5,300,000 and increases of only $505,000. And for the 10-year period of 1960 through 1969, reductions amounted to a total of $36 million and increases of only about $6 million, so we think this is a good record and are appreciative of the work of the Commission and the funding made possible through your subcommittee and the Congress.

Mr. JONAS. Can you assure the committee these reductions in wholesale rates were transmitted to the ultimate consumer by your members?

Mr. RADIN. I can't assure you that these wholesale rate reductions, that the benefits of those were transmitted to the consumer through rate reductions. The record on that is very good and I believe last year I submitted for the record some statistics showing the extent to which the benefits were passed on in rate reductions and that record is quite impressive.

In some cases the rate reductions are used for additional benefits that the city passes on, or the municipal utility passes on to the city through greater contributions and the people benefit that way too.

Mr. JONAS. I wish you could give the subcommittee some information indicating the extent to which your members used the extra money they received from these wholesale rate reductions in discharging other municipal responsibilities to the community, and are not transmitted to the ultimate consumers in retail rate reductions.

Mr. RADIN. I don't know that we have any figures precisely along those lines, Mr. Jonas. I would be glad to try to assemble some figures as to the extent to which these wholesale rate reductions are passed on to the ultimate consumer through lower retail rates.

In some cases the lower wholesale rates help the utility in maintaining lower retail rates and are an offsetting factor for a higher cost that may have in other ways. For example, labor costs might be going up.

Mr. JONAS. What this means is that the supplier of the municipality's power is subsidizing services to the community other than electric rates. I question whether that is the purpose, or the objective we should be seeking. I thought you were interested in getting lower rates for consumers.

Mr. RADIN. We certainly are and our philosophy is to try to provide rates at the lowest possible charge. At the same time we are also strong believers in local control and local initiative and the local owners of these municipal utilities have the prerogative of using the benefits of the municipal utility in whatever way they see fit and if some of them choose to provide a greater in lieu tax payment, for example, to the city, obviously we can't do anything about that, although we encourage lower rates.

I think in the case of Fayetteville, N.C., for example, Mr. Jonas, they got one of the most substantial wholesale rate reductions and in that case the entire reduction was passed on to the consumer in terms of lower rates. That is one of the most substantial. That was passed on and I believe in most cases it is. It is only in a minority of cases that the lower wholesale rates are used for other purposes.

We have a statement for the record and I would like to urge full appropriation for the Federal Power Commission. My prepared statement goes into other details.

Mr. EVINS. The full statement may be included in the record.

(The statement follows:)

STATEMENT BY ALEX RADIN

My name is Alex Radin. I am General Manager of the American Public Power Association, which represents more than 1,400 local publicly-owned electric utilities in 48 States, Puerto Rico, Guam, and the Virgin Islands. Our offices are located at 2600 Virginia Avenue, NW., Washington, D.C.

More than 2,000 local publicly-owned electric utilities throughout the Nation serve approximately 9 million homes, businesses and industries, or a total of about 30 million people. Most of these systems are small; 61 percent of them serve cities with a population less than 5,000.

Nearly 1,000 local public power systems obtain all or part of their power from private power companies subject to the jurisdiction of the Federal Power Commission. The economic well-being of many municipal electric systems is strongly dependent on their ability to secure agreements for purchase of power at reasonable rates and under equitable arrangements. Power supply costs constitute, on the average, 66.1 percent of electric operation and maintenance expenses.

Most local publicly-owned electric utilities are small. Although size is not a determent of efficiency in distribution, it has become an increasingly important factor in the generation and transmission of electric energy. In order to gain

economies of scale, municipal utilities must be afforded the opportunities to interconnect with larger systems, participate in pooling arrangements, and to participate in large generation and transmission facilities. Certain Federal Power Commission action have assisted in providing these opportunities.

Federal Power Commission action in hydroelectric licensing and relicensing, and in natural gas regulation also have important implications for local publicly-owned electric utilities, which are present or potential owners of hydroelectric facilities, and purchasers of gas for power generation.

CASES INDICATE VALUE OF FPC JURISDICTION

Local publicly-owned electric utilities have found that the Federal Power Commission can be an effective forum for obtaining relief from inequities in wholesale rates or other agreements with private power companies. Sometimes complaints coming to the Commission can be settled informally, with the Commission staff serving as mediator. In other situations, a formal proceeding is required. In either event, the ability of small systems to deal on equal terms with large utilities has been materially enhanced through FPC existence and FPC action, Here are a few examples of what has been accomplished through application of FPC jurisdiction:

1. An FPC investigation of rates of Ohio Power Co. and its affiliate, Indiana and Michigan Electric Co., was concluded in July, 1968, when the Commission accepted an Ohio Power Co. rate filing providing wholesale electric rate reductions amounting to about $107,552 annually to 14 municipal utilities in Ohio. In March, 1968, the FPC accepted an Indiana and Michigan settlement providing wholesale rate reductions of about $377,625 annually to 16 muncipal customers in Indiana and Michigan.

2. A group of Massachusetts municipal electric systems filed a complaint with the Federal Power Commission against New England Power Co. citing inequities in rates and contract provisions. In September 1968, the Commission ordered New England Power Co. to revise contract terms, including elimination of specific service area descriptions; increased flexibility in notice requirements for installation or addition of generation by the customer; and provision for automatic change-over to partial requirements service, upon installation of generation by a full requirements customer. In January 1969, the FPC accepted a rate filing by NEPCO resulting in a $3.3 million rate reduction to municipal wholesale customers, retroactive to September 1, 1968.

3. Gainesville, Fla., filed a complaint with the Federal Power Commission requesting interconnection with Florida Power Corp. on a nondiscriminatory basis. The private power company had argued that interconnection with the isolated municipal system should only take place after a restrictive service area agreement had been determined and the city had paid an excessive charge to the private utility. On November 5, 1968, the Federal Power Commission ordered Florida Power Corp. to interconnect with Gainesville on a basis similar to that enjoyed by the other systems with which Florida Power Corp. was interconnected. The Commission also denied the excessive charge requested by the company and denied the company's contention that a service area dispute must be resolved prior to interconnection.

4. Four municipal systems in Kentucky brought a complaint to the FPC against Kentucky Utilities, charging that the company's wholesale rates were discriminatory as compared with other wholesale customers of the same class during the same period. Under a negotiated settlement, accepted by the FPC in September 1968, Kentucky Utilities refunded to the four cities $89,661 in overcharges.

5. Agreement was reached late last year between Crisp County, Ga., Power Commission and Georgia Power Co., providing that the company will maintain an interconnection with and will wheel Southeastern Power Administration power to Crisp County Power Commission. Earlier last year, the Federal Power Commission had rearffirmed a previous decision requiring the company to establish permanent interconnection with the county.

6. In May 1968, the Federal Power Commission issued a 50-year license to Northeast Utilities, Inc., a combine of three New England private power companies, for construction of the Northfield Mountain pumped storage project, conditioning the license on a requirement that excess capacity from the project be sold and made available "to all who request service on a just, reasonable, and nondiscriminatory basis." Intervention by the Municipal Electric Association of Massachusetts had sought to require the utilities to sell and transmit excess power from the project

to Massachusetts municipals on the same terms and rates as those offered private utilities.

7. Similar principles to those involved in the Northfield Mountain case were involved in consideration of licensing of the Bear Swamp pumped storage hydroelectric project to New England Power Co. Massachusetts municipally owned electric utilities intervened, seeking license conditions necessary to overcome regional anticompetitive practices. This February, the municipal systems withdrew their intervention after NEPCO agreed to a license condition making excess project capacity available to municipals and private companies on an equal basis.

WHOLESALE RATES REDUCED

During fiscal year 1969, the Commission received 2,003 rate filings and completed 2,057. Rate reductions of $5,300,000 were accepted for filing. Rate increases accepted for filing amounted to $505,171. We believe that FPC activity was a principal factor in a substantial portion of the reductions, following studies which indicated that lower rates were warranted. In the 6 fiscal years 1964 through 1969, the Federal Power Commission accepted rate filings totaling $34,483,181 in reductions and only $2,145,425 in rate increases. Rate reductions have increased greatly since the beginning of of the decade, as illustrated by the following table, showing rate filings, reductions, and increases from fiscal year 1960 through fiscal year 1969:

RATE FILING RECEIPTS AND COMPLETIONS

Fiscal year	Filings received	Filing matters completed		
		Number	Increases	Reductions
1960	894	(1)	$534,400	$106,300
1961	469	(1)	996,900	136,500
1962	477	576	2,030,900	127,000
1963	1,882	1,494	278,900	1,204,800
1964	1,295	1,323	395,200	1,448,100
1965	2,576	2,686	1,050,685	8,024,782
1966	2,649	2,796	55,928	6,564,927
1967	2,006	1,963	93,241	4,284,777
1968	2,276	2,241	45,200	8,860,595
1969	2,003	2,057	505,171	5,300,000

[1] Not available.

POWER POOLING IMPORTANT

FPC regulation is of increasing significance with respect to the ability of local public power systems to participate in power pooling plans. As indicated previously, many municipal electric systems are small and are often physically isolated. If they are to take part fully and fairly in the economic benefits of "bigness" expected with large generating units and extra-high voltage transmission lines, then they must rely heavily on FPC action to insure that the private companies equitably share with them economies of scale. Although FPC action has been required in some of the cases I have cited above in order to permit smaller municipal electric utilities to participate in power pools, experience has shown that the large as well as small utilities have derived benefits from such pooling arrangements.

The trend toward giant generation and EHV transmission by interconnected interstate companies which are continually merging into fewer and larger entities complicates the task of regulation and increases the need of the FPC for expert personnel.

HYDROELECTRIC LICENSING DEMANDS

More than 24 million kilowatts of hydroelectric power developed by non-Federal interests are under Federal Power Commission license. Three hundred nineteen projects were licensed at the end of fiscal year 1969; 344 are estimated to be licensed by the end of fiscal year 1970; and 374 are estimated to be licensed by the end of fiscal year 1971.

These Federal hydroelectric licenses, which are issued for a maximum of 50 years, are beginning to expire at a rapid rate, and, under the Federal Power Act, the Commission must review each expiring license and recommend whether the project should be (1) licensed to the present licensee under the same license conditions as originally set; (2) licensed to the present licensee with new terms

and conditions; (3) licensed to a new licensee; (4) converted to nonpower uses; or (5) recaptured by the Federal Government.

Licenses for 72 projects subject to recapture or relicensing will expire in calendar years 1970 through 1975. Each project must be studied not only with respect to power but with respect to other potential water uses affecting essential elements of comprehensive development.

Local publicly owned electric utilities have a definite interest in efficient and complete FPC action in licensing new hydroelectric licenses and in evaluation of expiring licenses. They may wish to seek a license for a new hydroelectric project, seek to be the new licensee in a relicensed project, or participate in a new or relicensed project. In addition, they presently own and operate hydroelectric projects subject to relicensing by the FPC.

It is important that the Commission retain sufficient staff to act efficiently in consideration of new hydroelectric licenses and to analyze thoroughly expiring licenses to determine whether they should be relicensed to the present licensee with or without new terms and conditions, relicensed to a new licensee, converted to nonpower use, or recaptured by the Federal Government.

ENVIRONMENTAL PROTECTION

Last year, the APPA Committee on the Environment called upon the Federal Power Commission to establish an Environmental Advisory Committee to aid the Commission in dealing with environmental problems associated with its responsibilities in the power field. We are pleased that the FPC, on January 28, announced formation of a 10-member task force to assist it in environmental questions arising in connection with the updating of the FPC's National Power Survey.

Environmental issues are becoming an important factor in FPC procedures, as well as the procedures of State regulatory agencies. As FPC Commissioner Carl Bagge stated before the Federal Bar Association this February:

"Today, the dockets of regulatory commissions embrace such subjects as air and water pollution, customer deposit practices, aesthetic standards, undergrounding policies, hiring practices and innumerable other matters foreign to regulatory tribunals even in the recent past. The utilities have been challenged to breathe new life into their established practices. And regulators are coming to know that blind adherence to precedent is incapable of resolving unprecedented issues."

At the end of January 1970 the FPC proposed to amend its rules to require electric utilities to submit information designed to provide a basis for development of an effective environmental quality program. It is essential that FPC maintain sufficient staff to analyze environmental factors involved in FPC-regulated activities.

GAS REGULATION CITED

Electric power generation is the largest industrial category of natural gas use in the United States, accounting for almost 3.5 trillion cubic feet in 1969. In 1969, 28 percent of electricity generated by thermal powerplants was generated by natural gas. Many local publicly owned electric utilities use natural gas for power generation and are concerned with adequate regulation.

With growing problems of air pollution, local publicly owned electric utilities may turn to increased use of natural gas and are vitally concerned with the present and future cost of this fuel.

Gas producers have been claiming a shortage of natural gas and requesting increased rates because of the alleged shortage. Interstate gas pipeline companies requesting rate increases before the FPC have also used the argument that they warrant a higher rate of return because of the alleged gas shortage.

In January of this year, the APPA Legislative and Resolutions Committee adopted the following resolution regarding the alleged gas shortage:

Whereas producers of natural gas are seeking higher rates for the purported purpose of stimulating exploration to overcome an alleged shortage of this fuel, and

Whereas approximately one-third of all energy used in the United States is supplied by gas, including use of this fuel to generate electricity, and

Whereas claims of a shortage are based on producers' data which is unavailable for public examination and independent evaluation, and

Whereas similar reports of shortages preceding efforts by producers to escape from regulation by the Federal Power Commission in 1956 proved unfounded, and

Whereas price increases sought by producers could boost the cost of gas to consumers by about $1 billion annually: Now, therefore, be it

Resolved, That the American Public Power Association urges: (a) that the Federal Power Commission require gas producers to make a full public disclosure of information on gas reserves; and (b) that the FPC conduct an independent analysis of the reserve situation prior to any consideration of price increases for producers, including publication of cost data so that the public may know what it actually costs to produce reserves of gas under given circumstances.

In order to fully evaluate requests for gas rate increases, APPA supports an independent study of gas reserves, and feels that this can be accomplished in conjunction with the proposed National Gas Survey. We urge appropriation of the requested $340,000 for initiation of the National Gas Survey.

RELIABILITY PROBLEMS OUTLINED

The Federal Power Commission has requested $2,215,000 for electric power industry systems evaluation, an increase of $200,000 over the 1970 estimate.

Included in this classification is work on the National Power Survey, expected to be issued late this year, and Commission efforts to prevent power failures.

In 1967 and 1968, electric utilities reported 145 power interruptions. A total of 89 power interruptions were reported to the Commission in 1969.

The Federal Power Act requires the Commission to promote and encourage voluntary interconnection and coordination of the Nation's power systems in order to assure an abundant supply of economical electric energy while providing for proper utilization and conservation of natural resources.

Consistent with this requirement, the Commission issued a statement of policy June 25, 1969, which was revised with request for comments on January 13, 1970, looking toward strengthening existing regional coordinating groups in an effort to increase reliability of service.

FPC requested participation in regional coordinating groups, including: (1) participation on a nonvoting basis by the Commission staff in coordination group activities; and (2) reporting to the Commission certain data from the coordinating groups, including estimation of peak loads, itemization of existing and new capacity resources in a region, estimation of capacity margins for reserves at the time of future peak loads, plans for air and water pollution control for large generating plants, and a plan for present and future bulk power transmission facilities of the region.

APPA has requested that the Commission revise its proposed regulation to insure opportunity for all electric utilities in a region—regardless of size or ownership—to participate in the activities of regional or national reliability councils or coordinating organizations through direct or indirect voting representation.

The importance of increased activities in promoting reliability of service and the extent of activities already undertaken by the Commission in this regard indicate the necessity of increased FPC funding and staff to promote reliability. APPA supports the requested appropriation in this field.

APPROPRIATION REQUEST SUPPORTED

Federal Power Commission activities in regulating wholesale rates of electricity, assisting in reaching equitable contracts among electric utilities, and regulating rates of natural gas sold to electric utilities has been of great value to the local publicly owned electric utilities represented by APPA and the consumers served by these systems. We therefore support appropriation of the $18,450,000 requested in the President's budget, particularly the $6,814,000 requested for work on hydroelectric power regulation, electric power industry systems evaluation, and electric power utilities regulation, and the $340,000 requested for initiation of the National Gas Survey.

Mr. EVINS. Did you see a statement in the Evening Star where some representatives of the Pentagon stated that the electric power companies were overcharging the Government at the Pentagon alone by more than $20 million?

Mr. RADIN. I didn't see that.

Mr. EVINS. I commend the employee of the Pentagon. I think he should have a citation for discovering that the power companies are

overcharging the Government. The budget for utility services is increasing every year and I hope your Commission can help hold the rates down.

This man who is trying to expose these increasing costs to the taxpayers should be commended.

Mr. RADIN. Thank you very much, sir. I am very glad to hear that statement.

WEDNESDAY, APRIL 8, 1970.

NATIONAL SCIENCE FOUNDATION

WITNESS

ROY E. HEATH, DIRECTOR, OFFICE OF RESEARCH AND DEVELOPMENT, BOARD OF REGENTS OF STATE UNIVERSITIES, WISCONSIN

Mr. EVINS. We have with us Dr. Roy E. Heath, Director of Research and Development, Wisconsin State University. Dr. Heath, you appear here in connection with the institutional program of the National Science Foundation funding. Your statement will be included in the record. You may proceed as you wish.

(The statement follows:)

STATEMENT OF DR. ROY E. HEATH

WISCONSIN STATE UNIVERSITIES—BACKGROUND

The Wisconsin State Universities System is composed of nine university campuses, four 2-year campuses and two field stations. The system has had a remarkable growth of full-time students from 7,400 in 1951 to 30,000 in 1964 and 61,890 in 1969. It is the fifth largest system in the United States, exceeded only by the four in New York and California. Historically the Wisconsin State universities began as State normal schools in 1866, became State teachers colleges in 1927, State colleges with liberal arts programs in 1951, State universities with graduate programs in 1964. The Wisconsin State universities system is separate from the University of Wisconsin with its four campuses and centers.

The principal source of elementary and secondary teachers in Wisconsin is the Wisconsin State universities system. During 1969–70, 43.2 percent of the physics teachers in the public schools received their highest degree from one of the Wisconsin State universities. For other fields the percentages are as follows: chemistry, 40.2; geograghy, 42.5; biology, 40.6; and mathematics, 43.2. The percentages would be higher if the B.A. and B.S. degrees were considered.

Graduate enrollment, oriented heavily to teacher training, has increased considerably since 1964, and 3,049 full-time students were enrolled in September 1969. Summer 1969 enrollment was 4,680.

INSTITUTES

The Wisconsin State universities system believes in institutes and workshops. The 233 special institutes and workshops held during the summer of 1969 enrolled 7,359 students. Of this number of students, 280 were supported by the National Science Foundation, 138 by the U.S. Office of Education, and 54 by NASA. (See attached "1969 Summer Institute and Workshops WSU System Report.") In 1966 we held 177 compared to the 233 of 1969. These programs, many of which have paralleled many NSF and U.S. OE programs, are highly productive. They improve teacher capability. They are a proper mechanism to introduce new methods and concepts into the elementary and secondary schools. They are in line with the principal mission of our institutions of serving education.

The best argument I can present to support institutes is that we are supporting them with Wisconsin dollars. You can well understand our concern over the drop of $16.4 million in the budget as authorized and based on the recommendation of the Bureau of the Budget.

Since the public schools employ the greatest number of WSU graduates, I have asked Kenneth Dowling, science supervisor, Wisconsin Department of Public Instruction, who recently studied the impact of NSF institutes in Wisconsin schools, as to whether or not the NSF institutes have been successful. I am quoting in part from his letter: "Wisconsin has not been saturated by teachers who have been upgraded beyond minimum certification requirements by NSF institutes. It is apparent that the need for such programs is still very great and probably will always be. Also, the greatest need appears in the small rural districts where even teachers with long tenure have not had NSF aid—a fact that should influence selection and even recruitment of participants * * *

"Subjectively, the NSF institute program has profoundly influenced science education. Its potential is obvious, and it should be continued indefinitely."

Dr. Thomas Fontaine, deputy Assistant Director for Education of the National Science Foundation, in his supplemental statements before the House Subcommittee on Science, Research, and Development, Committee on Science and Astronautics, in February stated: "The institutes have generally been very successful in two ways. First, they have materially raised the competence of teachers and, more important, have increased the effectiveness of the teachers in their own classrooms. Second, they have shown conclusively the relationship between subject matter competence on the part of the teacher and his effectiveness and have thus convinced educational authorities and teachers alike of the importance of good teacher training and of the desirability and feasibility of continuing education for teachers."

He states further: "Inasmuch as the instructional personnel program has been operated for more than 10 years on, as compared with other NSF science education programs, a large scale, and inasmuch as significant results have already been achieved, especially at the high school teacher level, the program is being reduced in fiscal year 1971. The funding levels, fiscal years 1969, 1970, and 1971, respectively, are: $38,629,728, $44,795,000, and $28,900,000. All of the reduction is at the high school teacher level."

Apparently the decision to cut institutes was based on an assumption: "In view of the fact that an estimated 40 percent of our current secondary school science and mathematics teachers have participated in the institutes program, a reduced level of support has been requested for fiscal year 1971, but there are still a number of things that need doing for which this activity is most suitable. Therefore, the activity is being retained but at a reduced level."

The one reference I have found giving the 40-percent figure is in the book, "Investment in Knowledge," by Krieghbaum and Rawson, published in 1969. On pages 315 and 316 it states: "Because of the large number of teachers who have attended more than one summer institute, NSF does not know exactly how many individuals have received institute training. All it knows is the total number of 'training opportunities' that it has provided—about 150,000 for high school teachers in summer institutes from 1954 through 1965. Best estimate of the NSF staff is that these 150,000 training opportunities have been used by approximately 90,000 individuals or about 40 percent of the 226,000 science and mathematics teachers in the Nation's secondary schools during 1964–65. Because of losses of individuals who drop out of secondary school teaching after receiving NSF training, the actual percentage of the current teaching force with summer institute experience is somewhat lower—probably about 35 percent."

ELIGIBLE PARTICIPANTS 1969

According to my calculations there are 406,000, not 264,000, eligible participants in the secondary schools. These include science (including social science), mathematics, principals, and supervisors of instruction. (See appendix.) Using the more realistic figure, the number of teachers having institute experience is closer to 26 percent than to 40 percent. (See appendix A.)

EQUIVALENCY OF INSTITUTES

The significant thing is not the total number of opportunities available but the nature and extent of the opportunities. For example, for 1969 NSF supported the following institutes:

1969	Number of participants	AYE
Academic year institutes	1,367	1,367
Summer institutes	17,405	4,351
In-service institutes	12,977	2,595
Total	31,749	8,313

This shows a total of 31,749 opportunities, but it includes summer institutes of 4 to 8 weeks, inservice institutes varying in credit and relatively standard academic years. A participant could get 30 to 32 credits in one opportunity, 6 to 8 in another, and as few as 3 in another. When all of these are equated to an academic year equivalent of 30 to 32 semester hours, then the opportunities drop from 31,749 to 8,313 academic year equivalents.

(Note: 4 summer institutes=1 year; 5 inservice institutes=1 year.)

A NSF study summarized in Krieghbaum and Rawson's "An Investment in Knowledge", on page 250 and quoting Dr. Neville Bennington, former head of the institute programs, concludes that the fundamental updating or upgrading needed by secondary teachers is the equal of one academic year. This report led to the establishment of the highly successful sequential summer institute programs.

TRAINING IS FALLING BEHIND NEED

The level of NSF support for institutes is not keeping even with the need for training. According to the NSF's own annual report of 1969, Page 81, "School systems continue to employ not fully qualified teachers because the regular teacher training programs of colleges and universities can supply only 15,000 certified teachers annually to fill 28,000 vacancies covering expansion of science offerings and replacements of those leaving teaching." According to the National Education Association, 8 percent of the classroom teachers resign each year, either from retirement or other reasons. This percentage of the 389,000 classroom teachers (app. B) gives 30,500 leaving the profession. Compare this figure to the 32,297 opportunities in 1969 or more correctly to the 8,313 academic year equivalents, add the new teachers entering the field and it is obvious that we need more, not less, support for institutes.

Serious consideration should be given environmental problems. Through the NSF programs, the nature of instruction in earth science, physics, chemistry, biology, and mathematics has changed nationally in our schools. These programs were developed with so called research grants and then implemented with the institutes.

The shock of the environmental problems did not come as sudden as Sputnik—but we now realize the problem. I question if research dollars will best be spent through basic research grants to large Ph.D. mills and private industry, as compared to following the program development—institute route, which has proved so successful. We already know many of the basic scientific facts involving pollution. The problem of correction will be providing tax dollars to apply present knowledge.

Let us encourage interdisciplinary institutes involving the sciences, economics, engineering, and political science. Let us improve instruction in this area so that future voters will be willing to provide the necessary funds to preserve our environment. Such a program can be part of the ongoing institute operation.

The cooperative college-school science program should certainly have continued support but I hasten to mention that the universities producing the teachers are not concentrated in urban areas and this program is not a satisfactory substitute for regular institutes. Similar limitations will apply to preservice programs.

We ask for continued support of the instructional scientific equipment program and college science improvement program. These are two of the seriously needed programs for the Wisconsin State universities.

Thank you for the opportunity to present our views on this important matter. Attached you will find some supplementary materials which may prove useful to you in your deliberations. It is indeed unfortunate that the recommended cuts seem to have zeroed in on colleges and universities, especially concerned with education of teachers and some of the best programs. We recommend increased funding for the institutes, COSIP, and ISEP programs of the National Science Foundation.

APPENDIX A

ESTIMATE OF ELIGIBLE NSF PARTICIPANTS

Total, secondary classroom teachers, spring 1969, as estimated by NEA	864,000
Total, secondary classroom [1] teachers, private schools, fall 1968	87,000
Total	951,000
Percentage of secondary teachers in fields, 1965–66, supported by NSF:	
Public	
Mathematics	13.9
Science	10.8
Social science	15.3
Agriculture	1.6
Total	41.6
Private	
Mathematics	11.4
Science	8.5
Social science	14.3
Total	34.2
864,000 by 41.6 percent	359,000
87,000 by 34.2 percent	29,700
Total	389,000

Principals, assistant principals, supervisors of instruction, State science supervisors: 40,000 by 41.6 percent, 17,000.
Total eligible: 389,000 plus 17,000, 406,000.

NSF OPPORTUNITIES 1954 THROUGH 1969 AND ACADEMIC YEAR EQUIVALENTS

	Opportunities	AYE
Summer institute	226,634	[1] 55,656
Academic year programs	18,971	[2] 18,971
In-service institutes	141,616	[3] 28,323
Total		102,950

[1] 226,634 divided by 4.
[2] 18,971 divided by 1.
[3] 141,616 divided by 5.

Note: 102,950 AYE, over 406,000 eligible equals 0.26 or 26 percent assuming no retirements from teaching or supervision.

Source: Digest of Educational Statistics, p. 40 and 41.

Dr. HEATH. Our primary concern is that the budget is presented through the Bureau of the Budget and the National Science Foundation and zeroed in on the type of schools that are producing as many as 57 percent of the teachers who are appearing in the public schools as teachers. The institute program is a very important program. As far as we are concerned, it has been one of the most successful programs because we have been able to upgrade education; we have been able to change our education institutions as a result.

Our concern is that we hope you will continue the institute level at at least the same level as last year.

Mr. JONAS. How can we do that when Dr. McElroy says he wants to change it? It wasn't a decision initiated by the Bureau of the Budget but a decision of the National Science Foundation. What did he tell you is the reason he wants to phase this program out?

Dr. HEATH. I think the influence came before Dr. McElroy came to the National Science Foundation.

Mr. JONAS. He defended it here.

Dr. HEATH. He defended it on a false figure. He defended it on the basis that 40 percent of the teachers in the secondary schools have had institute experience.

Now, in my estimation, this is a false figure.

In the first place, we are offering institutes in economics, institutes in social science, and they never include them in their figures. They merely include science, mathematics, the sciences and mathematics in their statistics. According to the charts that were worked out in your testimony last year, there were then 264,000 teachers in the public and private schools. According to my estimates—and this appears in my appendix A, based on the statistics available, which shows that we figure there are 406,000 eligible teachers.

Now, another thing that I think Mr. McElroy has not really taken into consideration is the number of opportunities that you present to teachers, since they vary so much in length, it doesn't have any relationship to the amount of quality you are going to turn out, and according to NSF's own statement, it is necessary to have three summer institutes, or approximately 30 hours—and this is based on this book that NSF paid to publish, just published in 1969. There is a statement in there where they state it was desirable to have 3 years. On this basis, the level of NSF support is not keeping even with the need for training. If you refer to the NSF's own annual report, and if you go to page 18 of that report, it says school systems continue to employ not fully qualified teachers because the regular teacher training programs of colleges and universities can supply only 15,000 certified teachers annually to fill 28,000 vacancies. I'm quoting from their annual report.

According to the National Education Association, 8 percent of the teachers retire. Now, NSF may argue with you that the male teachers stay longer than the female teachers and that, therefore, the statistics are not an average figure.

I called Ed Pfau director of certification for the State of Michigan the other day and I ask about the difference in age brackets. He said the average age for the teachers of science and mathematics in the Michigan schools is 33 for male and the overall average is 36. So they must be leaving the profession rather fast too because believe me, we are turning out a number of them.

Mr. TALCOTT. They just go to administrator, principal, or vice-principal or something like that.

Dr. HEATH. The fact remains we still need training for the replacements. My point is, we need to continue this program.

Mr. JONAS. Do you think this summer institute program for high school teachers is essential?

Dr. HEATH. I think it is essential.

Mr. JONAS. You think it is worthwhile?

Dr. HEATH. I think it is one of the most worthwhile things the Federal Government has ever come up with.

Mr. JONAS. I would say on the record that I have always felt the place to start to improve the scientific knowledge that we need is at the high school level and if you have inefficient or incompetent high school

teachers of science, you are not going to get well-prepared students when they leave high school. That is my theory.

Dr. HEATH. I checked the State of Wisconsin figures. There are 80 mathematics teachers in the State of Wisconsin that had to be on special permit in order to teach because they did not have the adequate background to teach the courses they were offering in mathematics in the system.

When you add this up—and use NSF's own figures, and you see the number they say aren't qualified, and they quote 15,000 in the country, their job isn't done.

Mr. JONAS. They argue that there is a better way to do it than to have these summer institutes.

Dr. HEATH. Here again is a lack of realization as to where the teachers are. Take, for example, the State of Wisconsin. Platteville, Wis., is in the western section of Wisconsin. We have between 6,000 and 7,000 students with probably 50 to 60 percent taking teacher education in that town with a population of less than 3,000. What I am saying to you is, that is typical of our system; it is typical of many of the schools. The net result is then the college-cooperative-school science program, that is proposed as a substitute by NSF, is not a substitute. The universities in teacher education are not where the urban students are. So I plead with you to continue the summer institute program.

I have a remark in my statement to the effect that serious consideration should be given to the environmental problems. Through the NSF programs, the nature of instruction in earth science, physics, chemistry, biology, and mathematics has changed nationally in our schools. These programs were developed with so-called research grants and then implemented with institutes. The shock of the environmental problems did not come as suddenly as Sputnik, but we now realize the problem. I question if research dollars will be best spent through basic research grants to large Ph. D. mills and private industry, as compared to the program development and institute programs.

We already know many of the basic scientific facts involving pollution. The problems of correction will be providing tax dollars.

Let us encourage the interdisciplinary-type institutes using the sciences, economics, engineering, and political science and let us improve instruction in this area so future voters will be willing to provide the necessary funds to preserve our environment. Such a program can be part of the present ongoing institute program.

The cooperative college-school science program should certainly have continued support, but I hasten to mention the universities producing teachers are not concentrated in urban areas and this program is not a satisfactory substitute for regular institutes. Similar limitations will apply to the preservice program.

Thank you for this opportunity to present my views. Attached is a whole series of supplementary material that may be useful to you in your deliberations.

Mr. EVINS. Dr. Heath, I want to ask you one question: We have had testimony this year before this subcommittee to the effect that in the summer institute program which this committee has sponsored—and we have insisted on earmarking funds for each year—that it is the same teachers who get the benefits; that they are repeaters;

that it is not reaching a broad section of the teachers of this Nation who could upgrade the students in the teaching of science. They say only a few are particitpating and that they are repeaters.

We have testimony to this effect. What is your comment?

Dr. HEATH. My comment is a person should be permitted three such institutes if they are summer institutes. He should be permitted five institutes if they are service institutes in order to bring him up to the equivalency factor within a period number of years, so you get maximum mileage out of the money you are spending.

My answer to your question regarding this: Have we saturated the market? May I quote from our Department of Public Instruction in Wisconsin: "Wisconsin is not saturated by teachers who have been upgraded beyond minimum certification requirements by NSF institutes. It is apparent that the need for such programs is very great and probably always will be. Also, the greatest need appears in the small rural districts where even teachers with long tenure have not had NSF aid."

Mr. EVINS. Wisconsin is one of the leading States in the field of education. They are not saturated and I would guess then that other States are not saturated either.

Mr. TALCOTT. But there are some teachers who want to go to the institutes, but can't go because they are crowded out by teachers or by people who have been back three or four times who are just institute-goers.

Dr. HEATH. My feeling is, once a person has three institutes—I have run institutes and I have never accepted anybody with more than three.

Mr. TALCOTT. Why not let everybody go before one teacher goes the second time?

Dr. HEATH. You will find a statement in this book showing that the first institute was effective. The second institute was more effective and the third institute lets you give the person the breadth of courses that you felt he needed in order to do the best job.

Mr. JONAS. How many weeks in an institute?

Dr. HEATH. Six generally.

Mr. EVINS. You indicate there are some 406,000 teachers who are eligible for summer institutes. How many teachers have participated? How many have been repeaters? Do you have any information on that?

Dr. HEATH. Nobody has reliable figures. This particular book here is the only study that I have seen on this and it estimates at the time they had 150,000 they figuresd that 90,000 had been repeaters.

Mr. EVINS. 150,000 have participated. It is estimated 90,000 have been repeaters but 406,000 are eligible.

Dr. HEATH. That is right.

Mr. EVINS. So there is a large number of teachers who haven't had the benefit of the summer institutes training program.

Dr. HEATH. Yes, sir. And all you have to do is go to this document to document it and I have it on appendix A.

Mr. EVINS. And the teachers want to go, or they wouldn't have applied.

How many have been denied, how many have been turned down who have requested participation?

Dr. HEATH. Those are the figures the NSF has. I don't have them.

Mr. TALCOTT. I think it is the other way around. They have to scout around to get the teachers to go.

Dr. HEATH. No, that is not true.

Sir, I ran institutes for 5 years at Northern Michigan University and always the institutes we ran in the general science area were three to one for the number of positions we had; a minimum of three to one.

Mr. TALCOTT. Then you were getting outside of their scope?

Dr. HEATH. No, we were in the field of general science. I don't know if you gentlemen realize how bad this situation is.

Mr. TALCOTT. I think it is terrible. I think the schools are in for the greatest come-up they have ever had. The teachers are not happy with the faculty; they are not happy with the caliber of students they are turning out or anything.

Dr. HEATH. At the college level.

Mr. TALCOTT. All levels. From Headstart to graduate school. If you people don't see this, I think you are missing something. This is coming on us very dramatically.

Dr. HEATH. Our situation in the Wisconsin University system is entirely different from the Big Ten operation. One of the rules and regulations of our Board of Regents is that only a full-time staff member, not a graduate assistant, and only those people can teach in our institutions.

We are in the teacher education business and we are able to maintain this and we still have 62,000 students in our system. We are having a very significant growth in our system. After all, we have gone from 30,000 in 1964 to 62,000 in 1969.

Mr. TALCOTT. That would be 20 percent too many. When the war is over, we will drop down quite a bit, won't we?

Dr. HEATH. No; we will continue. The birth factor comes down a little bit but we estimate 68,000 to 70,000 next year in our system. We are budgeted for this number.

Probably the best proof I can give you on this is to say, gentlemen, we support this type of program with Wisconsin dollars and we believe in it. We ran 233 special programs last summer, of which I think 280 students were financed by the National Science Foundation. You have done something good for education. The institute programs are productive. I just wish that you would look at the back part of this documentation here to see what the students say has happened as a result of one program at Washburn College.

Mr. EVINS. You may leave those documents with us. Thank you for leaving this book with us. One chapter is on an overview. This is also something on the summer program and how the National Science Foundation moves into the high schools. Chapter 11 is entitled "Could you use $10 million?"

I see you quote extensively from the hearings of this subcommittee headed by my predecessor, Albert Thomas.

My own question on page 192 asks:

> Mr. Director, could you use $10 million instead of three in the high school training program?
>
> Dr. WATERMAN. We could.
>
> Mr. EVINS. In fiscal year 1957?
>
> Dr. WATERMAN. Yes, I believe so.

Mr. EVINS. In other words, the Foundation is staffed and ready to move if the funds will go forward?

Dr. WATERMAN. Yes.

I am flattered that one of the chapters is entitled by a question which I asked.

Now, I find the budget for this program was not $10 million, but has reached $36 million and it is proposed to cut back to $20 million. Your testimony is very helpful to the committee. We appreciate your appearance.

Dr. HEATH. May I say that Neville Bennington, a man you have had before this committee for many times, was a director of the National Science Foundation Institute. This is a man very much in favor of institutes and he believes in them. May I also say I don't think the testimony of the NSF is in line with the statements they made in their 1969 annual report.

Mr. EVINS. Thank you very much, Dr. Heath.

WEDNESDAY, APRIL 8, 1970.

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

WITNESSES

JEH V. JOHNSON, CHAIRMAN, HOUSING COMMITTEE, THE AMERICAN INSTITUTE OF ARCHITECTS
THOMAS WRIGHT, AIA
JACKSON WRIGHT, DIRECTOR, HOUSING PROGRAMS, AIA

Mr. EVINS. We have with us Mr. Jeh V. Johnson, chairman of the Housing Committee, the American Institute of Architects; Mr. Thomas Wright, with the American Institute of Architects; and Mr. Jackson Wright, Sr., housing programs, AIA.

The committee will be pleased to hear you.

Mr. JOHNSON. Thank you, Mr. Chairman.

Mr. Chairman, my name is Jeh V. Johnson. I am a practicing architect from Poughkeepsie, N.Y., and the chairman of the American Institute of Architects' (AIA) Committee on Housing. For the record, I should note that the AIA is a professional society representing slightly more than 24,000 licensed architects. Accompanying me is Thomas W. Wright, a practicing architect and an immediate past president of the Washington metropolitan chapter of AIA, Inc.

THE NEED FOR FULL FUNDING

I am here today to represent the profession's serious concern for the meager quantity of housing this Nation is producing for low- and moderate-income families, and to urge full funding of the housing programs authorized by the Housing and Urban Development Act of 1968 and 1969.

There is virtually no new housing for rent being created that meets the needs of working families of average income. It is a well-known fact that the country has been deficient in low-cost housing for decades, but there is an expanding void that includes thousands of fam-

ilies who have heretofore been able to solve their housing problems on their own. This includes the civil servant, the industrial worker, the young white-collar worker, and the rapidly expanding group of newly formed families in the technical and professional fields.

A rent survey in the town of Poughkeepsie, N.Y., indicates that an income of over $13,000 per year is necessary to provide rental housing for a family of four at the average rent now being charged. Further, rental units are increasing in cost at a rate of 15 percent per year. This is in an area of relatively moderate and construction costs, and this condition is aggravated considerably in high-cost areas.

Single family homes for sale are now beyond the reach of about 81 percent of the families in my region. This means that "housing subsidy" affects the bulk of the so-called middle class, as well as the so-called disadvantaged groups.

The consequences of inadequate funding of housing programs

Every architect I know who is involved in housing has in his office several hundred, and in some cases, several thousand units of housing ready and waiting for allocation. These units are feasible; the difficult local problems of site selection, zoning changes and community acceptance have been met and solved and in a majority of cases the sites are cleared and waiting. If funding is not forthcoming for these and thousands of similar cases, the construction costs will continue to climb creating even greater need for subsidy, and the sponsors and public agencies will ultimately be unable to carry the burden of empty sites that are unproductive of either social usefulness or taxes. These sites will be lost to other forms of development.

The social consequences of this delay (for funding) are many, most significantly the continual and even accelerated frustration of those in need in the communities, with a consequent disenchantment with the abilities of the Government and responsible community leadership to produce solutions to basic community problems (or to satisfy housing needs.)

Inadequate funding will perpetuate the fragmentation and the inefficiencies of the building industry by making impossible the aggregation of large enough markets to encourage new techniques in industrialized building, new materials development, or the bringing of new workers into the building industry. In every "slow" construction year, thousands of workers leave the industry for other jobs, and don't come back—so these become an automatic scarcity when there are good years (and money is available).

It is essential that housing starts be increased immediately and kept at a high level to offset the dramatic increase in family formation (the so-called war babies), along with an alarming increase in the number of deteriorating and abandoned housing units. Maximum funding of existing Federal programs will be a major stimulus in all of these areas. Further the side effects of maximum Government involvement creates benefits beyond the mere production of housing units. First of all the housing created under sections 221–D–3, 202, 235, and 236, becomes a strong part of the fabric of often weak communities. Put differently, it becomes the nucleus for the community improvement, and the catalyst for aggressive private development. Second, these programs create jobs and income in communities where there is now a scarcity of both.

Third, they are extremely effective tools against continued inflation by bringing local housing markets back into balance—and by eliminating the artificial and unnecessary scarcities of good housing alternatives that lead to steady rental increases on the local level.

Full funding of existing programs will at best help the Nation keep pace with its housing needs—short funding causes us to fall further and further behind in a calamitous downward spiral.

NEW DIVISION IN NATION APPEARING

The Nation seems divided in many issues, many subjects, and many matters. I am observing a new division that is simple to describe, but tragic to observe, between those who have a good place to live and those who do not. Those Americans who have a good place to live bought in a favorable market, built under balanced construction costs, and with 4-, 5-, or 6-percent money are fortunate, but increasingly they are becoming not only indifferent to the needs of those without, but today they are actually in the way. One sees increasingly the device of local zoning used to exclude multifamily housing and mobile homes and in the process those families who have no other choice. Further, the notion that an honest, hard-working man can, by sheer will and determination, provide a good home for his family without any outside help is no longer true. It is a myth, but one that is held firmly by many who are well housed—this myth has made its way into public policy on the local and national level, and is further impeding our efforts to raise and maintain our annual housing starts.

We will not stand in the way of the young, the recently transferred, the migrant white-collar worker, the low-income worker, the black or the female household head in their efforts to find good housing. We can start with maximum commitment from the Federal Government to bridge this widening gap between the housing haves and the have nots; substitute fact for myth and meet the needs of a growing majority of our people.

FULL FUNDING OF ONGOING PROGRAMS NEEDED

Therefore, we strongly urge that funds be provided for—

221–D–3 program for rental and cooperative housing

One of the proven and successful efforts thus far made by this country to provide housing for the low- and moderate-income families provides financing at a 3-percent below-market interest rate (BMIR) for rental and cooperative housing. AIA urges that the program be continued because of the necessity to serve those of moderate income who will not be eligible under the interest assistance program, but who need help to obtain decent housing.

202 program for the elderly

According to a survey presented to the Special Committee on Aging, U.S. Senate, 90th Congress, first session, December 5 and 6, 1967.

Exhibit A. Identification of market potentials among elderly households for federally subsidized rental housing 1970 and 1975. This paper presents forecast estimates of the number of elderly households who will qualify by income for admission to housing produced un-

der the following federally subsidized housing programs: Low Rent Public Housing, Rent Supplement Housing, and Section 202 Senior Citizen Housing. The first two programs serve the same income levels and they are characterized by their deep subsidy. In the case of rent supplement housing, the subsidy consists of an annual supplement payment made to the private owner of the project. In the case of public housing; the subsidy consists of an annual contribution payment made by the Federal Government to the local Housing Authority (a public owner), tax forebearance by the local community (under payment in lieu of taxes agreement) and indirect subsidy 202 program consists essentialy of BMIR financing (3 percent) interest. (These programs can best be serviced by those organizations who have control and interest therein).

For the purpose of this forecast, elderly households are defined as consisting of primary families in which the head is 65 and older. Bureau of the Census family projections were used as the basis to estimate the total number of elderly households for each of the forecast periods.

The market potential for section 202 housing is considered to consist of these elderly households whose income exceeds low-rent housing admission limits, but which incomes fall below the admission limits established for the section 202 program. Employing the same forecast techniques utilized with regard to the potential market for low-rent public housing and rent supplement housing, the following income range was used for purposes of determining income eligibility in each of the two forecast periods:

Year	
1970	$3,400 to $5,000
1975	3,900 to 5,700

The primary market potential consists of elderly renters whose incomes fall within the above-described income levels. The number of elderly renter households whose incomes fall in this range is estimated as follows:

Year	
1970	520,000
1975	469,000

Limited occupancy experience in section 202 Housing Projects, so far, indicates that between 25 percent and 30 percent of the tenants had moved from homes they owned into section 202 housing. This "secondary market potential" from among homeowners is taken into consideration by adjusting upward the estimated market potential, based on elderly renter households with qualifying income. Such an adjustment factor, it is believed, would amount to about 25 percent (i.e. the estimated primary potential market is multiplied by 1.25). This would be reflected in the following combined potential market estimate:

Potential market for 202 housing

Year	
1970	650,000
1975	586,000

The number of elderly households increases by 25 percent if the definition of elderly is rendered from 65 years and over, to 60 years

and over. Reduction of retirement age would probably increase the demand for section 202 housing units correspondingly.

However, we are not producing the required housing anywhere near the amount needed to fulfill these potentials described above.

The 202 program for the elderly—as has the 221–D–3 program—has done much to add to the quality and quantity of good housing for the elderly residents of the country.

PHASING OUT OF 202 SLOWS DOWN HOUSING PROCESS

HUD's actions to phase out 202 into 236 is unworkable, at present, for the following reasons:

That FHA is not administratively organized to phase 202 into 236 in the field offices at this time, thus causing confusion and indecision in the processing.

There is no tax abatement, due to flexible rents allowable by 236.

Confusion over the cost of efficiency units versus one-bedroom units are proportionally out of line, due to the FHA thinking and encouragement of larger units in low-cost housing, but this thinking is not applicable to the elderly housing program.

The 236 program has built-in regulations that are not required in the 202 program.

Two illustrations: The 236 program does not permit dining rooms, if individual kitchen units are built in the units.

The 236 program restricts carpeting which is not true in the 202 program.

The 202 program as administered by the regional offices, gives the practicing professionals an opportunity to use their expertise to find ways to fit the special needs which speeds up the work and keeps the per unit cost down. These cost savings as reflected throughout the country, when compared to public housing, averages out to be between $2,500 to $3,000 per unit.

AIA strongly urges that HUD discontinue its efforts to force sponsors to forgo use of 221–D–3 BMIR and 202 funds. Particularly, in view of the fact that GNMA has approximately $2 billion in special assistance funds which were provided by Congress for this program. We urge the department to review its policies and make additional mortgage funds available for the BMIR program.

235 program for homeownership

AIA recommends that the appropriation actions include the full amount of the additional and unused interest assistance contract authority under section 235 which is contained in the 1968 act, as increased in the 1969 act. Therefore, a supplemental appropriation should be made of the $40 million consisting of the $35 million which is authorized, but not yet appropriated for fiscal year 1970 and the $5 million authorized, but not appropriated for fiscal year 1969. We urge the President to request Congress to make this supplemental appropriation of $40 million instead of the $25 million which is being recommended by HUD.

236 program for rental and cooperative

AIA urges that appropriation act's include the full amount of the additional and unused interest assistance contact authority under 236 which is contained in the 1968 act, as increased by the 1969 act.

Therefore, a supplemental appropriation should be made of $45 million—consisting of the $40 million which is authorized, but not appropriated for fiscal year 1970. And the $5 million authorized, but not appropriated for fiscal year 1969. We urge the President to request Congress to make this supplemental appropriation.

RESEARCH AND TECHNOLOGY

The AIA recognizes that one way to provide more and better housing is to produce it for less money. American industry has demonstrated its capacity to respond quickly in other research areas, and if given the necessary impetus through private/public coordination and funding, can also respond to advancing housing technology—and in a very short period of time.

Housing technology refers to a broad definition of research including demonstrations and experiments in new approaches to the living environment. This should encompass experiments in new towns, new towns-in-town and advanced planning techniques for existing cities involving all of its components; the central city, its suburbia and its rural surrounds. New approaches and systems must be developed concurrently with Government-owned and operated housing.

The AIA strongly supports HUD's request that funds for research and technology be increased from the present $23 million to $55 million in fiscal year 1971. Also, that an additional $2 million is available this year for low-income housing demonstration program, which is administered by the research and technology office.

LOW RENT PUBLIC HOUSING

In view of the lack of housing for the thousands of the low-income group who cannot be adequately housed without Federal subsidy aid, causes these families to live in rat-infested slums, which has led to sickness and death and has caused severe crises in our cities. Request for housing units of 140,000 per year are going unfulfilled.

AIA strongly urges the appropriations for the fiscal year 1970 of the $30 million authorized for grants to local housing authorities to assist in financing tenant services in public housing. We also, recommend authorization of the amount required for special subsidies on housing for the elderly and displaced persons. There should be advance appropriations for all grants for fiscal year 1971, since such an advance appropriation will allow necessary leadtime for the initiation and planning of such programs. The full amount of the $75 million of annual contribution contract authority should be made available and the Bureau of the Budget should repeal its limitation that only $33 million can be used this year.

EQUAL OPPORTUNITY FOR HOUSING

The AIA affirms that housing for all people is one of its central concerns therefore, we urge that full and adequate appropriations for the administration of the fair-housing program under title IV of the Civil Rights Act of 1968. Of the $8 million requested by the President for fiscal year 1969, Congress only appropriated $2 million for such expenses as administration; $6 million has been appropriated for fair

housing and equal opportunity for fiscal year 1970. We strongly urge that sufficient funds be provided for staffing to guarantee that the objectives of a good home and living environment is made available to all. We strongly urge that HUD's request for $11.3 million be the minimum funding appropriated.

CONCLUSION

It has been a privilege to present the views of the American Institute of Architects. If there are any questions, I shall do my best to answer them.

I would like to summarize and lay particular stress on one or two points we have made in our testimony. As a former member of the Douglas Commission, I can say we did spend a considerable amount of time on the subject of housing needs in the country. What we would have to do to keep up with existing deterioration of housing and to match our growing number of families and family creations.

We arrived at a number that suggested we should be building between two and a quarter and probably—about two and a quarter million housing units a year. Of these, about 500,000 units we felt should be low- and moderate-income units, and these should be given priority.

The Housing Act of 1968 set a somewhat higher goal to shoot for—about 2,600,000 units a year.

As you know, our present rate of housing production is well below that. It is almost half. It is at about 1,300,000 units a year, roughly.

One of the things we would like to lay great stress on here is the need for full appropriations, up to the limit of the authorizations for certain of the housing bills under which we hope to build the majority of these units for low- and moderate-income families.

We point out above in our testimony that the unassisted housing cannot provide the needs of the average working family. This is not even the poor family. This is the family of average income. At the present time the gap between what can be provided in the unassisted market and what people can pay for under average circumstances is so wide that more families than ever are out of the reach of housing.

I have cited numbers from my own township to indicate that upward—an income of upward of $13,000 a year is necessary to provide for the needs of the family that has only two children, in unassisted housing.

Now, as you know, $13,000 a year is not an average salary in this country by any means. That is a salary well above the average for most of our working people.

Further, the usual resources of housing for people of low income—that is to say, old housing—is in rapidly diminishing supply, partly because it is wearing out and partly because the land on which it is situated is being used for higher and better uses or for public improvement. So we have had a fantastic decrease in the reservoir of housing, of good, used housing which is, in my view, the best form of low-income housing—a good old house in a good old neighborhood probably is the best all-around bargain for a person who can only afford $100 a month, let us say, in rent, but those are disappearing.

I would like for Mr. Wright, who is a practicing architect in Washington, Mr. Thomas Wright, to comment on his view of the housing needs as they are seen right here in Washington, D.C.

Mr. THOMAS WRIGHT. Gentlemen, I think the situation in housing in this country is in a state of crisis. Housing just is not being built. The reason is clear. The money is not available. The interest rates, the fight against inflation and so forth, leave housing the victim.

Mr. TALCOTT. In Mr. Wright's statement he mentioned interest rates and you mention interest rates, but isn't it architect's fees and building construction workers' fees that also contribute to this horrible situation? Aren't you people just as responsible for the inflation as anybody else?

Mr. JOHNSON. Could I just comment on that? If you look at the breakdown of the actual monthly rent that individuals pay in rental housing, you will find about 47 percent—this is in a selected example of which we have some knowledge—47 percent goes for payment on the mortgage, out of the total 100 percent rent package and of that about half of it is interest and half of it is in principal.

Mr. TALCOTT. So they are trying to buy 40-year mortgages instead of 15-year mortgages?

Mr. JOHNSON. These are relatively short-term mortgages because they are speculative, unassisted projects.

Now, construction costs have gone up very rapidly but percentagewise I don't believe they have gone up as rapidly as the other components in the housing costs. The architect's fee is the same old thing as it always was—percentagewise—but we find that land costs and construction costs are going up and our scatter shot approach to housing tends to make housing scarcer and, therefore, more expensive and every year you have a decline in housing; you have people who leave the housing business and don't come back.

Mr. TALCOTT. Don't you think it would be a lot better to get away from conventional homes and get into some new modular construction, factory-built homes, so the low-income people can afford the homes?

Mr. JOHNSON. Yes, I agree.

Mr. TALCOTT. No person can afford a $12 an hour plumber. Until we get into some other means of construction, I don't think we can even think about getting homes for low-income people.

Mr. JOHNSON. We can't even get to that until we get markets of sufficient size to justify tooling up for it.

Mr. JONAS. We have 900,000 public housing units under contribution now that have been constructed and built since 1936. The thing that worries this committee is the fact that many of the public housing authorities in the country are on the verge of bankruptcy. HUD had to bail out the National Capital Housing Authority to the extent of $900,000 this year. They have recently had a bad situation in St. Louis, and the same thing exists in other big cities. The public housing authorities are in real trouble because they have used up their reserves, or are rapidly depleting their reserves because of the high cost of maintenance and upkeep.

Now, what suggestion can you offer us that we can pass on that will make the occupants of these houses that we provide them—and they only pay 25 percent of their income— that is the maximum now—in rent, that will make them start taking care of these houses that they

are provided through subsidy. The windows that are broken out and the misuse and abuse of these public housing units has become scandalous. What assurance can you give us that we won't run into that same situation with rent supplement houses and 236 houses and all of the others? When you give somebody something that he doesn't work for, I am afraid he just doesn't feel any responsibility.

Mr. THOMAS WRIGHT. I think both of you Congressmen have made a very appropriate comment.

To go back to history just for half a second, and the reason for the high maintenance and so forth, like the units in St. Louis that you refer to, when our country first began building public housing, up until fairly recently, until some of the new housing acts—1966, 1968, 1969, and so forth—public housing was more or less isolated.

The answer, I believe, sir, to give pride, is to use some of the programs that are available now in the 1969 Housing Act, such as homeownership. It is not hard to do. We are doing it. I think that is the answer, and try to get a mixture of income groups.

Let me cite as an example, if I may, a community that we have under construction right now. There are 606 units. Three hundred and twenty of them are public housing. Ninety-two are townhouses for large families. That is Turnkey 3, and that will be homeownership. Two hundred twenty-nine families of older people. Nobody objects to older people and most of them don't have a very high income anyway, so there is no disgrace for older people in public housing. But then we have 286 units of moderate income families so there are three times as many moderate income families as low income families. Also we have a shopping center, a school, day care and professional offices.

The community has been behind this. We have had nine public hearings. Not one person has made a statement in any public hearing against this.

Mr. SHIPLEY. Where is this?

Mr. THOMAS WRIGHT. It is Capitol View Plaza on East Capitol Street, just inside the District Line; Southern Avenue.

Mr. JONAS. A mixture of subsidized and nonsubsidized housing in the same complex?

Mr. THOMAS WRIGHT. Yes. In this case it is all subsidized, but it is public housing income levels and moderate income levels. FHA 236 in this case.

Mr. JONAS. You don't recommend then that the limited number of houses we can build—and we can't build enough for everybody overnight—you don't advocate taking care of the lowest income group first?

Mr. THOMAS WRIGHT. That is correct. I do not. I believe in creating balanced communities.

You will remember in Fort Lincoln there were a lot of community leaders, spokesmen, who talked in favor of having all of Fort Lincoln in public housing. That would have been a terrible ghetto. No, I agree with you. I think there have to be balanced communities.

Mr. TALCOTT. Where do we get the money? The taxpayers have to pay the bill.

Mr. JOHNSON. Your question is one we have tried to struggle with for some time. I think the question of where you start depends on the particular local situation with which you are dealing. There are many

communities in which there is an enormous gap. Many of the needs of the very poor are taken care of through public housing, but the housing stock in the bracket just above the 236 range which is 35-percent higher than the public housing limit, is vast. In some cases properties that they leave can be occupied by other families who have a need that can be satisfied with lower income. What I am saying is each community has its own particular hierarchy of problems.

Mr. JONAS. I wish we had some experience in this because there is some disagreement as to whether, when you do what has been suggested, the end result is not going to pull down the middle group to the lower level, or whether the end result is not going to make it all a ghetto-type operation, or whether a mixture will elevate the lower group.

Mr. JOHNSON. We are trying to tackle that in the project we have in Newberg where the housing authority will be leasing many of the units in this middle- and moderate-income project. We have worked out the physical design so that you never have too great a concentration of large families in any one part of the project with the result that the overall density in the project will be far lower than it would be had it been entirely a family project. In that way you have reduced a lot of your maintenance problem.

We also, by request of all the communities where we have worked, have tried to stick to low-rise for families. We find that high-rise works very well for senior citizens—in fact, they like it quite a bit. One comment on senior citizens. We have found that the so-called trickle down theory where you leave a house and somebody else moves in, does work where you talk about senior citizens, especially in smaller, older towns. If a family had been holding a house since 1920 with many bedrooms, finds it can no longer keep up with the taxes and doesn't want to bother and can move into a senior citizen project, and then a large family can then buy this low cost, relatively low-cost housing resource and use it more completely.

We have seen that actually work. The so-called trickle theory doesn't always work but we have seen that work.

That is why we are supporting in our testimony the furtherance of section 202 housing specifically for the elderly.

There is another reason for that. We find it is much easier to obtain sites for elderly persons than it is for family projects.

Mr. EVINS. Does the other gentleman have a statement for the committee?

Mr. JACKSON WRIGHT. I would like to. In answer to the Congressman's statement of a few moments ago about how we can improve upon the situation in the public housing, of course, I believe all emphasis has been placed on building the building but the problems only begin when the families move in. I think we should devote a lot more money to the training of managers for these particular buildings. I say this because I was a former manager of public housing and we did work very effectively with cutting down the various instances of vandalism and whatnot by helping the people to take a personal interest in the particular project where they lived.

Mr. EVINS. What public housing project?

Mr. JACKSON WRIGHT. Allegheny County Housing Authority in Pennsylvania.

Mr. EVINS. How large was it?

Mr. JACKSON WRIGHT. The units that I was responsible for was about 1,500 families, of various types of construction, highrise, low-rise, three-story walkups and of all ethnic groups and races.

Mr. EVINS. Was the counseling all for low-income public housing?

Mr. JACKSON WRIGHT. Yes; all low-income public housing.

Mr. EVINS. What type counseling did you have there? How effective were you?

Mr. JACKSON WRIGHT. In most instances I was the only paid counseling staff available. In most public housing the manager was the only man who was a paid man on the staff, with the exception of a bookkeeper in many instances. So I had to marshall the forces of the various social agencies in the area to come in and meet with me once a month because there were no other funds available for that purpose.

Mr. EVINS. Church groups, labor groups, fraternal groups, civic groups?

Mr. JACKSON WRIGHT. That is right. Public Welfare, Red Cross, Family and Children Service, Lankin Christian Center, Homestead Hospital, Braddock Hospital, and other social agencies active in this area.

Mr. EVINS. Did they voluntarily come in and help you with counseling?

Mr. JACKSON WRIGHT. They did, which made it possible to aid these families who were desperately in need of assistance and guidance. They served as a resource for us. If there was a basic problem, I could easily refer them to these areas like the Red Cross and so forth, for help.

Mr. EVINS. How effective were the results of this type counseling?

Mr. JACKSON WRIGHT. It was quite effective, but we still had no on-site accommodations where they could meet. We had to meet off the premises. We did not have funds to handle the tenant counseling services. That is why we support the funding of the tenant services because I think these funds could be used effectively for these purposes in many instances to take care of problems on site for them and allow paid qualified staff to take care of some of the tenant needs as they surface. It could improve their lot.

Mr. JONAS. What percentage of reduction occurred in your maintenance rate after you instituted this counseling and had it in effect?

Mr. JACKSON WRIGHT. There was quite a drop in our vandalism. I couldn't give you a percentage, but there was quite a drop, and because we were able to organize the various families on the various floors in the high-rise buildings to take a responsibility for their floor. In time they would take care of that and would supervise the running of that particular floor because they had a personal interest in this area where they lived. It worked out very well in many instances.

There are various other services which we could have easily assisted the families in performing if we had had funds to take care of those particular needs. I say better trained managers and better tenants services will improve the lot of the low-income families and cut down much of the problems that exist there.

Mr. EVINS. Gentlemen, you are all very nice to come in and give us your advice and counsel and your testimony is appreciated.

WEDNESDAY, APRIL 8, 1970.

CIVIL DEFENSE

WITNESSES

GILBERT J. LEONARD, PRESIDENT, CIVIL DEFENSE COUNCIL
ALLAN R. ZENOWITZ, PRESIDENT, THE NATIONAL ASSOCIATION OF STATE CIVIL DEFENSE DIRECTORS
COL. ROBERT L. FOX, DIRECTOR OF CIVIL DEFENSE—TENNESSEE; PRESIDENT-ELECT, NATIONAL ASSOCIATION OF STATE CIVIL DEFENSE DIRECTORS

Mr. EVINS. We have with us Mr. Gilbert J. Leonard, president, Civil Defense Council; Mr. Allan R. Zenowitz, president of the National Association of State Civil Defense Directors, and Col. Robert L. Fox, director, Office of Civil Defense for Tennessee.

Gentlemen, you all appear in connection with the appropriations for civil defense. The committee will be pleased to hear you. You may proceed.

Mr. LEONARD. Mr. Chairman and members of the committee, it is a pleasure to be with you today to present the views of the Civil Defense Council on the nationwide civil defense program, and, more specifically, on President Nixon's fiscal 1971 budget request for the Office of Civil Defense.

I am the civil defense director of Vigo County and Terre Haute, Ind., a position I have held since 1962. I speak to you today, however, as president of the U.S. Civil Defense Council, a national organization of 2,000 city and county civil defense agencies in jurisdictions representing more than 85 percent of the Nation's population. Or to put it another way, our national council is directly concerned with more than 170 million Americans.

I ask you to share our concern because our needs as local directors are not ours alone. They are shared by you as U.S. congressmen. They are shared by the President and his administration. They are shared by any official who has any responsibility for acting to save and sustain human life in a time of major disaster.

The time to act is now. And this is why I appreciate the opportunity to testify before you today.

The job of a local civil defense director is not well understood by many people. Perhaps this is because a local director is concerned with defense, yet he wears no uniform, issues no directives, commands no troops. The job of the local civil defense director is to serve his local chief executive in disaster-control preparations.

He must pull together all of the key elements in and immediately available to his local government in this task.

He must see to it that emergency operational procedures are laid out and well understood by those directly involved.

He must make sure that people are trained and ready for effective emergency action.

He must assure that decisionmakers have communication systems readily available to them so that they can work in unison as a team when life-or-death decisions may, in the last analysis, depend upon the left hand knowing what the right hand is doing—or even worrying about.

He must develop and manage a system to help protect the people of his community, and make sure they know what they are to do in a time of emergency.

He must do all of this largely by persuading other people to help, and he must do it while the skies are clear. It's too late to start after the rains come.

Gentlemen, this local civil defense director has the toughest job in the entire civil defense program. He needs all the help he can get.

The key mission of the Office of Civil Defense in the Department of Defense is to help that local civil defense director because the entire civil defense program is as effective as that local director back in the hometown—back in thousands of hometowns across our Nation. It all depends upon him, because that's where the people are—back home.

Those people back home may face many types of emergencies—floods, tornadoes, hurricanes, a nuclear attack. No matter what type of emergency, it is the job of the local director to help his Government help the people.

I can report to you that, largely due to the assistance and guidance provided by the Office of Civil Defense, local directors are becoming more effective in carrying out their responsibilities. But in all honesty I must also state to you that they are becoming concerned that the Federal Government is showing signs of looking away from its responsibilities in this field, of leaving those local directors to face their problems—your problems—more and more on their own.

Just one example. Several years ago the Federal Government, convinced that greater professionalism would be developed in civil defense staffs if Federal matching funds were used to pay certain personnel and administrative expenses, started a program to do just that.The Office of Civil Defense calls it the "P. & A." program. In recent years this program has not been allowed to grow. It has not even kept pace with the normal growth in cost-of-living expenses.

The net result is that, even though the Office of Civil Defense P. & A. budget request for fiscal 1971 is $20.4 million, or one million higher than last year, it is less than a maintenance budget. OCD estimates that 360 local jurisdictions, which want to enter the program, cannot make use of this professional development program because there simply is not enough money budgeted. An additional $2 million would be required to help these 360 local jurisdictions.

The U.S. Civil Defense Council of local directors urges Congress to add $2 million, making the request for the OCD personnel and administrative expense program a total of $22.4 million.

We wish to make clear that, although the total budget for the Office of Civil Defense of $73.8 million has been presented as a "minimum" budget, we consider it less than minimum, and urge that the total be raised to $75.8 million.

Local directors everywhere need this assurance of financial support. Even more important, they need this specific example that their Federal Government intends to provide leadership in the nationwide civil defense program.

Gentlemen, this concludes my statement.

Mr. Evins. Thank you, Mr. Leonard, for a very excellent statement.

This committee is aware of the fine work that Civil Defense does throughout the Nation in tornadoes, hurricanes, fires, and all types of emergencies. Colonel Fox is a very distinguished director of civil defense from my State of Tennessee.

Colonel Fox, do you have a statement for the committee?

Colonel Fox. No; I came along with Mr. Zenowitz as president-elect of our association and to sit in on the committee hearings.

Mr. EVINS. Mr. Zenowitz, the committee will be glad to hear you.

Mr. ZENOWITZ. Mr. Fox will be leaving us as of July 1.

Mr. EVINS. We hadn't heard of this new honor to come to our friend and we congratulate him.

Mr. ZENOWITZ. We are quite privileged to have him.

Mr. Chairman, it is a privilege and an honor to have the opportunity to appear before you today and to present this statement on behalf of the National Association of State Civil Defense Directors.

The association, of which I am president, is composed of the directors of civil defense of all the 50 States, the District of Columbia, the Commonwealth of Puerto Rico, Guam, American Samoa, the Virgin Islands, and the Panama Canal Zone. The aims of the association are to further the development of civil defense in the national interest, and to support the emergency preparations programs of the respective States and Territories. I am particularly pleased to represent the State civil defense directors and to introduce their views into the proceedings of this committee.

Your asking for these views is testimony to the fact that civil defense is indeed the product of the joint efforts of the Federal, State and local governments. It is certainly fitting and is, in my opinion, necessary that the concerns and attitudes of State and local governments be considered in your review of the national civil defense budget. Your action on this appropriations request will be watched by State and local legislative bodies for indications of the importance which the Congress attaches to the national civil defense efforts. The degree to which State and local governments support this joint effort is directly influenced by the concern, or lack of concern, exhibited by the Federal Government.

In assessing the impact of the national civil defense program, I believe it is important to look closely at its collateral benefits. By collateral benefits I mean those things which are in addition to the primary purpose of civil defense—preparation to meet the effects of enemy attack. It should be noted that this narrow definition of civil defense is made only by the Federal Government. State and local governments, both by law and tradition, define civil defense to mean the response of government to any unusual emergency. We do not make any differentiation between enemy attack and natural disaster in our basic preparedness measures, except as it is necessary to do so in order to comply with Federal rules and regulations.

However, since the Federal definition of civil defense is limited to the effects of enemy attack, these other aspects of State and local emergency readiness are, for the purposes of this discussion, collateral benefits. And these benefits are not only substantial; there is tangible proof of their value almost every day. The most dramatic recent proof, of course, is the response to disaster caused by Hurricane Camille.

There was no way to keep that terrible force from destroying the cities that stood in its path, no way to keep the buildings from being flattened or the trees from being uprooted. But planned evacuation, based on civil defense guidance, kept the death toll to an amazing few, and recovery actions, under the management of State and local civil defense professionals, were positive. One need only look at the record of lives lost in less powerful hurricanes—Galveston, Cammeron—to appreciate the job done by civil defense in Hurricane Camille. There remains much to be done along the gulf coast in terms of long-range recovery and reestablishment of the shattered economic base, but the civil defense job of immediate survival is one of which we can all be proud.

However, Hurricane Camille is only one example of the collateral benefits of effective civil defense planning. Aircraft accidents, floods, tornadoes, explosions, and incidents involving nuclear sources all involve these people who are identified with civil defense and whose training and preparations make them invaluable additions to the Government emergency teams. But the most important thing is that governments are learning to approach emergencies on a team basis, and this is almost entirely the result of the planning, organizing, and training performed in preparation for enemy attack.

This is an expanding capability—there are better civil defense plans in more places every year. The speed and extent of this expansion is, in largest measure, influenced by the amount of direct Federal assistance available to support it. This is not limited to the financial assistance programs, although these programs are essential. The assistance given to training, to shelter survey, to shelter marking and stocking, to community plans for use of shelters, and to maintenance of a viable radiation detection capability are equally important. But all of these things depend on people, not just on plans and equipment. People who are competent in and dedicated to the development of a better national civil defense posture.

We have the hard core of these people now in civil defense agencies of State and local governments and in the national and regional offices of the Office of Civil Defense. It is this resource that we need to protect, and to guard jealously against the increasing demands for the support of other programs. I do not pretend that civil defense has the answer to crime in the streets, or civil disturbance, or to pollution of the air or the water, or to the increasing cost of governmental services. But I do sincerely and honestly believe that the civil defense professional—man or woman who is seeking to build in his or her community a better capacity to meet the effects of disaster—can and will contribute significantly to the solution of these other problems.

We know from experience that civil defense readiness can contribute to the management of civil disturbance—we have some evidence that we may be able to contribute to environmental control—we have seen the emergency telephone number, 911, centered on civil defense emergency operating centers—and these same civil defense emergency operating centers serve as the nerve center for natural-disaster operations. We know that planning for emergency use of communications can and does produce real savings in the cost of day-to-day Government communications services.

I certainly am not trying to imply that I believe preparation for enemy attack is a secondary effort. This is our first and most important job. But I am saying that the money which you appropriate for civil defense does more than build a capability to meet the effects of enemy attack. It helps build throughout the Nation a basic capability in Government to react quickly, wisely, and effectively to any emergency which threatens the peace and well-being of its citizens.

While I realize the severe limitations which a budget of this total amount imposes on each one of the separate program elements, to add any amount to one program demands that some other program be equally reduced during the course of the year. However, certain goals and objectives may not be capable of accomplishment, making available some funds for use in other programs. We would like to see some of these funds channeled into the personnel and administrative contributions program. This is not possible with the ceiling limitation placed on this program each year by Congress, therefore, the most immediately helpful thing this committee can do is to remove the annual fiscal year maximum on funds which can be expended for State and local personnel and administrative expenses. The statutory $25 million limitation would, of course, not be changed.

In quick summary, sir, I think Mr. Leonard has hit the highlights. The highlights are this: On the State and local level the Federal Government has encouraged a massive funds program called a P. & A. program for the development of civil defense and other emergency services. During the last year we have had anywhere from 10 to 16 percent salary increments, increases in salaries at the State level, plus an additional cost of doing business. We have not been able to meet the needs of the salaries of our personnel. We respectfully request that this be considered in your deliberations. The most important thing that civil defense has to offer for the protection of our country is skilled and trained people and we must continue them on the payrolls.

Mr. JONAS. You don't think the local community should care for or take care of that part of this responsibility?

Mr. ZENOWITZ. Sir, I believe this, that this is a joint effort, Federal, State and local, and it was structured on that basis. The Federal Government has taken the lead in the program and therefore we would like to keep it this way.

The local communities have made, sir, a greater contribution than the States and the Federal Government has. There are many people not in this P. & A. program. They are going into loans. They have other personnel and a need for volunteers.

As the organization develops, you must have money. The State and the local governments are making a much greater contribution. In my State we are making a contribution of 30 to 40 percent more than the Federal Government even though we are in matching-funds program. New York State is making as much as 50 percent greater contribution.

Mr. EVINS. This is a program where we need to work together and we want to continue to maintain this concept.

Mr. ZENOWITZ. In summary, one additional thing. With the changing times we live in today, civil defense is becoming more and more

vital. On the State level it is civil disturbances, emergency communication, emergency resources. However, we receive our money from the Federal level based upon just meeting a Federal criteria, but we are doing much more on the State level and I feel that this must be recognized.

Mr. Evins. When we have these riots and disturbances we call out the Guard. What does civil defnese do in these instances?

Mr. Zenowitz. May I ask the distinguished Colonel from the State of Tennessee to mention what is happening in your State which is very similar to the entire Union?

Colonel Fox. As you know, the Governor called Claude Armour in from Memphis and made him a special assistant in connection with civil disturbances. As a result, not the past legislature, but the one before, amended our act to put us in civil disturbances primarily to furnish things like communication and other equipment that might be valuable.

The local people get out with their auxiliary police. They don't confront the people involved in the civil disturbance, but they form a back-up to the local police so the police can then be moved on in. Things like that.

Mr. Evins. Thank you, gentlemen, for appearing.

Wednesday, April 8, 1970.

Housing Programs

WITNESSES

HON. JEFFERY COHELAN, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF CALIFORNIA
HON. JOSEPH L. ALIOTO, MAYOR, SAN FRANCISCO, CALIF.
RONALD PELOSI, SUPERVISOR, SAN FRANCISCO
TERRY FRANCOIS, SUPERVISOR, SAN FRANCISCO
HADLEY ROTH, MAYOR'S ASSISTANT
HON. J. N. SHOPTAW, MAYOR, TEXARKANA, ARK.
HON. LAWRENCE F. KRAMER, MAYOR, PATERSON, N.J.

Mr. Evins. Gentlemen, the committee will come to order.

We have with us the mayor of San Francisco, Mr. Joseph L. Alioto. We also have our distinguished colleague, Jeff Cohelan, Member of the Appropriations Committee, who wants to be heard.

Mr. Cohelan. Mr. Chairman and distinguished members of the committee, it is my great privilege today to introduce an old friend, the mayor of San Francisco, Mayor Alioto, and his colleagues who are coming here from the National League of Cities.

The Mayor is one of the most eloquent spokesmen for the cities in my judgment in the United States. He is going to be expressing a view this morning on some very, very real needs that we have not only in the great Bay area of California, but throughout the entire Nation.

I have only had a chance to scan his presentation to you and he will be referring to illustrations that relate to the great city and county of San Francisco, but as one who represents the great county of Alameda, across the Bay, I can testify that we share those experiences and those feelings.

It is with great pleasure I present to you Mayor Alioto.

Mayor ALIOTO. Mr. Chairman and distinguished members of the committee, I want first of all to thank Congressman Cohelan. The problems of the San Francisco Bay area, as a matter of fact, are quite similar between San Francisco and the other areas around San Francisco. The problems of our cities throughout California are quite similar.

I talk here today first as mayor of San Francisco and secondly as a representative of the U.S. Conference of Mayors nad the National League of Cities.

We have formed special committees to address ourselves to some of the problems which have arisen recently. They are administrative problems as well as legislative problems but in the final analysis they all come down to money. This is why we are pleased to have the opportunity to talk to you.

Rather than simply read formally the talk I have prepared, I will ask that that be filed in the record, Mr. Chairman, and I want to talk to you directly.

STATEMENT OF MAYOR J. L. ALIOTO

Mr. EVINS. Your entire statement will be included and you may summarize your remarks, Mr. Mayor.

(The statement follows:)

Mr. Chairman and members of the subcommittee: I am here in two capacities—first, as mayor of San Francisco, and, secondly, as a representative of the U.S. Conference of Mayors and the National League of Cities.

First, let me speak of my parochial priorities as mayor, for they underscore, quite urgently, my larger concerns and my most imperative pleading for American cities generally.

Gentlemen, San Francisco needs your help.

And it needs it badly.

The fate of two enormous and vital sections of our city is truly in your hands.

Please let me explain:

In too many minds, I'm afraid, redevelopment is still looked upon as basically injurious to the poor—and to the black poor in particular.

In many areas of our country, redevelopment has in the past been synonymous with Negro removal.

But that is not true today in San Francisco. In fact, it is exactly the opposite.

Redevelopment is absolutely essential to the transformation of San Francisco's two principal ghettos—and to the hopes of thousands of Americans for, at least, a decent way of life.

As things stand right now, San Francisco's two ghetto developments—Hunters Point and the Western Addition—are in mortal danger.

Hunters Point has often been described as the most ambitious attempt at true social planning in the Nation.

The development encompasses new housing to replace dilapidated war-time barracks. It provides jobs, training programs, new schools, parks, churches, playgrounds, child-care centers, and amenities of living.

This complete new environment, for and by its present residents, has been a long time in the planning. The first bulldozers are now on Hunters Point ridge.

But now, once again, this completely noncontroversial development is threatened—threatened by hazardous delays, slowdowns, and staff cuts, all of which have dispirited a community that has been patient for so long.

Hunters Point needs $4.1 million to go ahead on schedule this year. So far, it has been promised only $2.6 million.

The Western Addition funding crisis is even more acute.

The Western Addition is another model urban renewal development—for and by the community.

It, too, is at the point of a dream come true—of a shining new community in the heart of San Francisco.

But that delivery is also jeopardized, almost in toto—again by a lack of funding.

The Western Addition needs $15 million to proceed on schedule this year. So far, it has received only $10 million.

And to complete it as planned, it will need approximately another $44 million in amendatories over the next 5 years.

Gentlemen, as you may know, I am leading a drive of metropolitan mayors throughout the country in an effort to get supplemental appropriations for urban renewal.

I've chosen to be parochial about San Francisco's particular crisis for the reason that it is comparable to so many other cities.

There are those, I know, who feel that every spare dime we can afford should be put instead into other priorities.

As a large-city mayor, I am not one of them.

The environment, the basic health of our cities is too precious.

There are some, too, who feel that while urban renewal may have some attractive accomplishments and some progress to its credit, it is still too slow or too little.

Again, as a large-city mayor, I am not one of them.

To me, renewal is positively essential to the life of San Francisco—and to almost every large city I know.

I just hope we're not too late as it is.

Surely, I hope it is not too late to overcome the starvation in redevelopment funds before it actually constricts planned construction and deflates the expectations of those who long for decency in housing and for justice in their lives.

Summer is close at hand, and, as I needn't overemphasize, its blazing sun reduces false promise to a slender and insubstantial shadow and kindles the despair and hostility that are the volcanic hazards of our modern American society.

Already, discontent and skepticism are beginning to seethe in our ghettos, and there is a morose doubt that somehow the United States is going to foreclose on the promises before it extends into our deplorable ghettos and to every American.

The United States, after all, is the "land of promise," and it would be tragic and a desecration of our democracy if the aspirations of millions of our fellow Americans were denied.

The aspirations are fundamental—a decent home, a wholesome neighborhood, and a reasonable opportunity for employment, happiness and tranquility.

So it is with this grave urgency that I address you now in my second capacity as spokesman for the U.S. Conference of Mayors and the National League of Cities.

I call upon you to avoid a crisis in scuttling the benefits or urban renewal at this time when they are finally a growing reality of modern housing for low and moderate-income families, burgeoning jobs for ghetto residents, parks and playgrounds, schools.

The crisis can become even more menacing because the renewal program has been asked to take on increasing responsibilities at a time of rising costs and insufficient funding.

The new and progressive programs such as relation, code enforcement and rehabilitation grants and housing subsidies added by Congress throughout the relatively short legislative history of urban renewal have provided needed benefits and commitments to residents of renewal areas but have also increased costs. Costs and commitments—I regret to say—that are not now being met by current funding.

There are other reasons for high costs of urban renewal, among them:

1. A Bureau of the Budget system which requires grant reservations—a time when only "guesstimates" are possible—"guesstimates" that are torn between understatements and overstatements.

2. A Bureau of the Budget system which arbitrarily restricts the use of monies authorized by the Congress and causes overhead and inflationary costs to mount as projects are restricted in their capacity to stay on schedule.

3. The expectation that the renewal process may blueprint a static form of urban life rather than reflect essential dynamic changes within the best planned renewal process. Cities do not and will not stand still. Their needs change. Im-

provements bring their own evolutionary requirements. These needs are reflected in changes to renewal plans and some of the changes unavoidably require additional funding.

4. Court awards on real estate condemnations sometimes generously increase costs, yet these awards must be respected.

5. Inflation has ballooned projects costs an estimated 25 percent.

6. Federal delays in appropriately timed delivery of support programs cause renewal to operate with static budgets against the costs which mount with delays. Erratic delivery of FHA funding of critical housing programs, rehabilitation aids, rent supplements, neighborhood facilities, and HAA leasing make renewal projects unschedulable and therefore their costs of overhead mount with the delays from this on-again-off-again process. For instance, real estate values increased $13 million because of prolonged delays in funding for San Francisco's Western Addition.

7. Citizen participation and the "PAC" (project area committees funded by the renewal system) deliver essential benefits and enlarge horizons, but, understandably, they are costly. As indispensable as citizen participation is—and San Francisco has encouraged it fully to an exciting and creative reciprocity between the city and her citizens—it does stretch out decision making. But the resulting higher costs are worth every dollar, for they return a sense of involvement and interest, which are the indefatigable sparks to any city's future.

8. Added social services, compensatory employment, higher cost funding of contracts, minority employment or training, working program submissions, and other vital programs add further to overhead.

9. Land price write-downs to reduce the cost of housing for low and moderate-priced housing are new costs which could not be anticipated in early project budgets because sorely needed legislation did not permit such write-downs.

10. Finally, there's inflating interest—always higher. In Western Addition alone, interest exceeds estimates by a staggering $3 million. Despite the added benefits derived from legislation and the increase in costs, there are, among others, three major programs—renewal and new and rehabilitated housing—which are seriously underfunded and which I shall address myself to today.

In the area of urban renewal, HUD Secretary George Romney has reported to the Chairman of the Senate Appropriations Committee that most of the available renewal funds will be totally committed by the end of this month. Mindful of this prediction, I urge you to enact a supplemental appropriation of $600 million as proposed by the U.S. Conference of Mayors.

Further, Secretary Romney has indicated that the backlog of applications on hand for both neighborhood development programs and conventional renewal projects totals approximately $2.7 billion and is expected to increase to $3 billion by the end of this fiscal year. The Administration's request now before you for only $1 billion for 1970–71, while recognizing the backlog of $3 billion, is difficult to understand. For the next fiscal year we need $3 billion funding.

At this reporting, the renewal funding situation has become so serious that HUD has seen fit to depart from the practices—indeed, moral commitments—of two decades and announce to the cities that if the cost of renewal projects should increase, they'll have to go it alone. HUD's "Dear John" letters to the cities—San Francisco got hers in January—made clear the Federal Government will fund on the traditional sharing basis only one supplement or "amendatory"—and no more! This drastic action makes no pretense of covering the amount reasonably required even if one supplement were to be regarded as the last measure of support.

Beyond that, renewal projects, caught midway in the delivery of the benefits for which the cities have so long labored, are now told that they are on their own. All remaining funding of the promises the cities have been led to make to their people are left for delivery to the cities themselves, regardless of their desperate financing condition.

The situation is no better for those cities which have gone to year-to-year financing (called Neighborhood Development Programs or NDP's). They too are severely hit by underfunding—in many cases with very severe restrictions.

San Francisco's Hunters Point and Western addition, where hope has blazed with encouraging intensity, are about to be plunged to a crashing halt by insufficient funding.

To repeat the explosive economics:

Hunters Point—a project under the Neighborhood Development Program—needs $4.1 million to go ahead on schedule this year, but so far has only been

promised $2.6 million and no promise of availability of the $16.4 million needed to complete the project in the future.

The Western Addition project funding crisis even more acute. The project has only received $10 million of the $15 million needed for this year alone, and further, has been advised that no more amendatories will be considered. To complete the project as planned, it will take approximately $44 milion in additional amendatories over the next five years.

This country's efforts tq produce housing for low and moderate income families is seriously threatened by lack of funds for FHA's section 236 rental subsidy program.

In the fiscal year 1969–70 Congress appropriated $85 million in interest subsidy funds for section 236 housing and approximately two months after such appropriation the funds were exhausted. The most recent request by the administration for a supplementary appropriation of only $25 million for section 236 for the balance of this fiscal year is again seriously deficient.

The administration has also recently asked for $145 milion for the section 236 program for the fiscal year 1970–71. This amount, based on last year's experience, will be exhausted in less than four months.

We have been advised by the regional FHA insuring office in San Francisco that currently that office has Section 236 projects in process that will require $5 million interest subsidy. Within our San Francisco urban renewal projects alone, there are approximately 1,200 units programmed for the fiscal year 1970–71 that will require over $1.5 million in interest subsidy plus another $2.3 million estimated to be required for approximately 1,600 units in 1971–72.

The progress of property rehabilitation programs across the nation was severely curtailed for much of the past year owing to the depletion of Section 312 loan funds early in April, 1969 and the subsequent lack of a supplemental appropriation to serve the program needs for the balance of that year.

For fiscal 1969–70, $35 million has been appropriated for Section 312 rehabilitation loans. This amount is significantly less than the $84 million estimated to be needed nationwide.

Locally, the San Francisco Regonal HUD Office has been allocated $5.5 million for 312 loans for residential rehabilitation. Of this amount, some $1.4 million is already earmarked for backlogged applications, leaving $4.1 million available for new rehabilitation applications through the current fiscal year.

Over the next nine months, approximately $6 million will be requested in San Francisco alone in rehabilitation loan funds. These requests are expected to be equally demanded by approved urban renewal projects and by approved federally assisted code enforcement programs (FACE).

Special mention must be given to the Model Cities program begun in 1966. Congress recognized at the start that additional funds would be needed for the urban renewal component of Model Cities demonstrations, and it authorized $250 million the first year and $350 million the second, in addition to the $725 to $750 million for other renewal projects. This add-on for Model Cities has been discontinued. Now renewal projects in Model Cities neighborhoods must be funded from the total available for other projects. This is really a new and fresh demand on urban rennewal appropriations. At the proposed level of $1 billion a year, this may account for 25 percent of the total. Really, there is no room under the $1 billion ceiling.

You are also scheduled, I understand, to hear from Mr. Eneas Kane, Executive Director of the San Francisco Housing Authority, today who will be testifying in his capacity as President of the National Association of Housing and Redevelopment Officials. I support Mr. Kane's position that the current and proposed funding of public housing operations and maintenance is grossly insufficient.

As you may know, I am chairing a drive of mayors throughout the country in an effort by the U.S. Conference of Mayors to get adequate appropriations for urban renewal.

Gentlemen, a crisis in confidence in government is now being generated, but the crisis that is really generated is the underfunding of an ongoing system of delivery of needed urban benefits and the torturing of the residual financing into a desperate, irreconcilable conflict.

It is not pleasant to contemplate the valid protests our reasonable citizens will make once the message of insufficient funds is the current answer to their years of effort. I hope your recognition of the extremely serious funding situation and your subsequent action to alleviate the crisis by providing for funding beyond the Administration's requests will be forthcoming soon to reassure our citizens that their current fears are short lived.

Mayor ALIOTO. There are other witnesses here, the distinguished Mayors of Paterson and Texarkana. I have with me from San Francisco, who I would like to introduce, supervisors Terry Francois, who is sitting here behind me, and Ronald Pelosi, who is sitting here, and we also have the distinguished director of our public housing agency, the general manager of our public housing agency who, in addition to that, happens to be at the moment the national president of NAHRO and is therefore very much concerned with the same kind of problems we are dealing with.

If I can speak of my parochial priorities as mayor of San Francisco, I will actually be speaking about the entire problem, Mr. Chairman. There are no differences in the problems we face. For example, in January of this year 50 mayors received a similar letter from Secretary Romney. We characterize this letter as a "Dear John" letter.

"Dear John: We aren't going with you any more;" those letters said. They said HUD was going to give us one more amount on the amendatory and from there on we were on our own.

The effect of that letter, if carried out, would mean most of the urban renewal projects in the United States would be brought to a standstill unless the cities themselves were prepared to pick up the slack. In our case, it would be a slack of something like $40 million. As it is right now, as I am sure the Chairman is readily aware, the property taxpayers in our big cities today are kind of forgotten men. They carry a disproportionate load of the tax burden. They are probably the most unrepresented people in our entire democratic system, and the notion that we should thrust suddenly $40 million on them to complete just one renewal project when it was basically a federally related program is, of course, not admissible even if we had the money to handle it and we simply don't.

In California we are not privileged to have a significant housing policy at the State level, such as the States of Massachusetts, Connecticut, and New York. We don't get any assistance at the State level on housing, so when the Federal Government walks away from us on projects that were federally sponsored to begin with, you can see we are talking about simply grinding to a halt, just bringing them to a halt, and with the kind of things that exist in the cities today it is just impossible for us to do that.

Let me talk specifically about two of our projects. The two projects I am talking about are typical of what is going on in the entire Nation. The two I would like to talk about are Hunters Point and Western Addition. To begin with, in many areas redevelopment is looked upon by substantial members of the black community—and with justification—as simply a device to move black people away from the center part of the town or even the central city. With the widespread citizen participation we have been able to achieve at both places, this simply isn't the case any more. This is not the case, as a matter of fact, in most of the projects which have developed throughout the United States at the present time.

Our redevelopment is absoltuely essential, Mr. Chairman. Urban renewal is absolutely essential to the restoration of our cities. There are those you know who somehow think that the problems of the cities as they relate to housing and urban renewal are not their problems; that they can get behind little artificial barriers that they call the suburbs and somehow insulate themselves from what is happening in

the cities. It simply cannot be. These things are encroaching upon not only the big cities, but the suburbs as well.

As things stand right now, San Francisco's two ghetto developments, Hunters Point and Western Addition, are really in mortal danger. This has been described as one of the most imaginative programs in the United States where we are creating an entire community. That community involves not only housing but jobs, where nearby an industrial park is being developed simultaneously under urban renewal in the whole neighborhood concept. The low-cost and moderate-cost houses that are being built are absolutely indispensable and these things are going to go by the board unless we get more Federal funds.

Again, to just bring it into some kind of balance, let's take our Western Addition situation where we are attempting to build 2,000 moderate- to low-cost units. Now, the 2,000 moderate- to low-cost units aren't low cost in terms of construction because there is no such thing as low cost in terms of construction. They have to be subsidized in one form or another. San Francisco happens to be one of the few cities in the United States that has actually made an appropriation—not very much by your standards, but significant by ours—of close to $500,000 to assist, for example, in subsidizing that last element that isn't subsidized by the Federal Government, and we get nothing at all, of course, from our State in that respect.

But in this particular thing we are building 2,000 units. We already have 200 of these built. The 200 that we have built are in rather esthetic designs as far as housing is concerned and not simply project areas. There is tremendous community participation in connection with these two. By reason of our necessity to demand amendatories, by reason of that necessity, we are approximately $40 million short in that particular project. Forty million dollars short.

Now, let me tell you how that $40 million is made up because I think it is very significant: In 1964, the Federal Government approved a project with estimates of about $40 million. It is now actually more, but let's say $40 million added to it. By reason of the increased costs and the inflation we have had, $8 million of that is in interest. Just $8 million of that alone is in interest that we are talking about. Twelve million dollars of that is in the increased costs of land. Twelve million dollars in increased costs of land. Approximately $20 million of that is the necessity to write down the cost of the land so as to make the project financially feasible. Twenty million dollars of that is in that area.

Now, there is another area that I think ought to be mentioned. There has been, as you know, in accordance with congressional mandate and some elaboration at the administrative level, the insistence that everything we do, we do with community groups; that there be maximum feasible involvement; maximum feasible participation. No one is arguing about that. Some of the groups we deal with we think are rather obstructionist, but they are given these opportunities to be obstructionists for other motives, even political motives. Sometimes we run into the situation where we have to remind those in HUD that when people have made certain elections at a local level that HUD ought not to try to sneak those who lost the election in the back door by in fact insisting that everything we do has to be given some kind of a veto in these various community groups.

Nevertheless, the involvement of the community—and most of it has been commendable—some has been obstructionist, but most has been commendable—also means you stretch out your decisions, and stretching out a decision in an inflationary period simply means you pay more money. This is the other thing we are troubled with.

Now, with respect to amendatories, as I say, just in January we received from Secretary Romney a letter which says "We are all through with you on amendatories." Because of a lack of money, they are in effect saying that "what we have started we aren't going to finish and we might make some new starts and those on a limited basis."

I don't know how you can check that administrative discretion, but it gets back to a question of money.

Basically what we are asking for, Mr. Chairman—and I get right down to the substance of it—we desperately need a supplemental appropriation of $600 million. This is an amount previously requested——

Mr. EVINS. In the urban renewal area?

Mayor ALIOTO. Yes. We desperately need it. I can't possibly convey to you the measure of that desperation.

In a city like San Francisco, which is regarded as one of the cooler cities in the country in terms of the volcanic social tension——

Mr. EVINS. This committee has funded urban renewal on an advance basis for 2 years and for budgetary reasons this year the Bureau of the Budget cut it back to 1 year.

Mayor ALIOTO. We understand that, but so far as this year is concerned, we really desperately need to cover these amendatories and the other projects. We desperately need $600 million.

There had been an authorization, as you know, for $1.7 billion for fiscal year 1971. The administration has seen fit to request only $1 billion for 1971. In the light of the problems I have talked about and the desperate necessity to complete those things which we started—you see, the problem about starting these things, Mr. Chairman, is that you raise certain hopes in people. We have had our problems in the cities. The principal problems come about when those hopes get dashed, and that is exactly what is happening at the present time.

For the first time literally since I have been mayor beginning in 1968, for the first time we have had three articles recently in our major newspapers and on television that there is a certain tension and intensity of tension developing in some of our ghetto areas. There are two reasons for it. Dashing the hopes with respect to housing and the very serious unemployment situation which has developed in our commendable fight against inflation—nobody is arguing about that element of it, but to have chosen the route of directly generating new unemployment creates a problem for those of us in the big cities who live with ghetto conditions. So we desperately need this $600 million I have spoken of. We desperately need the appropriation of $1.7 billion that is authorized. We think we need $3 billion for 1971, and this is a specific request we are making for urban renewal in 1971, $3 billion which, as I say is desperately needed. Certainly the authorization up to $1.7 billion.

That is a summary of my remarks.

Mr. EVINS. We thank you for your fine statement.

Are there questions?

Mr. BOLAND. I want to commend the Mayor of San Francisco for his fine statement. He has had problems out there and I think he has dealt with them very effectively.

You do point to a problem with respect to amendatories. I believe we generally support urban renewal on this committee. I know I do and the majority of the members of this committee do.

I have some problem with the amendatories. When you file an application for a planning and survey grant, there is an immediate reservation made of x number of dollars. When you get to phase 1 and actually put in the boundaries, usually the boundaries are larger and the amount required for the reservation escalates a bit. The amendatories come in which amend the original boundaries or the original application and this has been a real problem around the United States.

Yours would call for about $44 million in amendatories over the next few years in San Francisco alone, I think, just for one project.

Mayor ALIOTO. That is correct.

Mr. BOLAND. In the city of Boston it runs around $66 million. I think there has to be a more careful screening by local officials with respect to amendatories.

It is fine to say that we ought to have this particular area in the urba nrenewal area itself, but I think there has to be a little bit more careful screening by local authorities with respect to amendatories.

Mayor ALIOTO. I would think that is correct. There must always be a very careful screening of things, but let me point out with respect to the amendatories you are talking about, $20 million of it comes from just two sources. Increased interest—I don't suppose anybody wants to blame us for that—and $12 million of it is increased land costs by reason of jury verdicts over which we have no control.

In each of the cases, at least in terms of the amendatories we are talking about in our Western Addition, those amendatories come in as a result of plans which are approved by HUD, by the Federal authority. It isn't that we are simply adding something to what we originally came in with.

Another substantial part of the amendatories is the increased cost of site clearance; $2 million for that. Just increased cost of site clearance.

Our administration cost, because of the necessity to deal with community groups which stretches out these decisions, our administration costs alone are running something like $4 million a year to keep this up, the cost of doing business, the running of the thing, the personnel and everything else in dealing with that.

Now, if you have to make the choice, Congressman, of finishing the project you have authorized, or going on to new projects, it seems to me the choice ought to be made to finish what has been started.

Now, the amendatories should be screened carefully, but once they are valid it seems to me there should be no question about supplying them.

Mr. TALCOTT. I am delighted to hear the Mayor of San Francisco and a neighbor of mine. I am an advocate of his position. I understand he caused the people on the Water Quality Control Board to cry.

Mayor ALIOTO. They gave us $34 million yesterday for construction after a 5-hour fight.

Mr. TALCOTT. I would like to reiterate what Mr. Boland has said about the amendatories. We have to consider all of the other cities and counties participating in the urban renewal programs. What has happened here is that many cities have intentionally estimated low in order to get their foot in the door, then after getting their foot in the door their costs increase. There are increases in costs for delays and everything else that happened, but I think they knew about it in the beginning but just wanted to get a program going and on the books. This deprived other cities who needed things maybe even more than San Francisco, or maybe even more than Texarkana, because they weren't able to get their programs into being. We have some obligations to these other cities too that we have to be more careful about, more frugal about, more strict about, I think. Some have amended five or six times and added new things that are not land clearance and are not interest. Even though they knew that interest was going up, they knew that land costs were going up, they knew that the jury results were going to be greatly in excess of what they estimated, so you have this problem.

Mayor ALIOTO. I would agree with you on the proposition that if any amendatories bear the stamp of having been developed on the theory that you first get your head in the tent and then you get your shoulders in the tent and then you get the rest of your body in the tent, if they are developed on that theory, there can be no question about it, Mr. Congressman, and perhaps the thing to do, instead of simply sending letters to 50 big cities and saying, "We are not going to go along with you on amendatories," is to examine the amendatories and where there is evidence—and you can't disguise this kind of evidence of planning——

Mr. TALCOTT. We need your help to make sure that some of the other cities and other municipalities in your leagues and associations do not do this kind of thing because it jeopardizes the whole Federal program and jeopardizes other cities we are really trying to help.

Mayor ALIOTO. And I would think HUD would make a distinction between amendatories. Those that bear this stamp ought to be knocked out. Those that are legitimate should be granted.

Mr. TALCOTT. HUD was trying to accommodate people, trying to be easy, trying to help people along and I think this was a bad judgment by HUD, to permit some of these things to happen.

Mayor ALIOTO. I think that is true, Congressman.

Mr. EVINS. Are there further questions?

Thank you, Mayor. Thank you very much for your excellent statement.

We will recognize our very esteemed and able colleague and valuable member of this committee, David Pryor.

Mr. PRYOR. I would like to present to the members of the committee one of the very eloquent mayors of the South, mayor J. N. Shoptaw of Texarkana, Ark., who has been mayor for 2 years. He has been very aggressive, has a splendid administration; he is a man of great vision. As the committee knows, the city of Texarkana was funded 2 years ago as a model city. We have done many good things with this program.

I would like to present to the committee Mayor J. N. Shoptaw.

STATEMENT OF MAYOR J. N. SHOPTAW

Mayor SHOPTAW. Mr. Chairman and members of the committee, I have already been introduced as mayor of Texarkana, Ark. I greatly appreciate the privilege of appearing before you today to present some of my thoughts and concern on the need to finance urban renewal activities for all the cities throughout the United States.

I was well impressed with the mayor of San Francisco, Mayor Alioto. He was quite a speaker. He was introduced very well. I want to say here that, due to the Arkansas law, we mayors in Arkansas don't receive salaries, so we are not expected to be such great speakers, I guess.

Texarkana, in 1968, was designated as one of the 150 areas to receive additional Federal aid and assistance through the model cities program. Both because of the need and in appreciation for this additional assistance, Texarkana, Ark., through its local government body has attempted to make as widespread use of available Federal funds as it is possible to assist our community in meeting its pressing urban needs.

For example, we have been able through the assistance of the Department of Housing and Urban Development to upgrade water and sewer facilities, expand and improve upon our park system, provide additional public housing, commence cooperative housing activities, commence rent supplement housing activities, and, through the use of our supplemental funds, proceed to underwrite the cost of many varied social and educational programs having a significant impact upon the model neighborhoods.

Our model neighborhoods are divided into four phases. We have the Sand Flats neighborhood, the South Texarkana neighborhood, and the Ozark-Ingraham neighborhood, and Mountain neighborhood. Three of these are predominantly black. One is predominantly white and we have done a great job in this work.

We have been advised that because of our aggressive development of the model cities program, Texarkana has been able to create and fund more projects than other cities of comparable size both in our region and nationally. We have a separate detailed statement of programs which we have developed. Some of them have been completed, and some are just underway. I hope that you will take time to look them over. It is under a listing of programs funded by the Department of Housing and Urban Development in Texarkana, Ark.

(The document follows:)

PROGRAMS FUNDED BY THE DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT IN TEXARKANA, ARK.

In developing a comprehensive model cities plan for the city of Texarkana, Ark., the physical redevelopment and renewal of the model neighborhood areas was quickly identified as our most pressing priority. While numerous types of physical redevelopment grants can be used to assist in specific areas, it was readily apparent that some type of renewal was the only approach permitting the broad based kind of redevelopment necessary to solve Texarkana's problems on a permanent and lasting basis, Texarkana has developed a number of projects designed to complement the overall impact of renewal. Some of these have been funded, but the status of renewal remains uncertain.

OTHER PHYSICAL DEVELOPMENT RESOURCES UTILIZED IN TEXARKANA

1. *Metropolitan development urban beautification funds*

During the initial planning grant stages the Texarkana, Ark., model cities agency utilized a mini-grant park to creat six pocket parks scattered throughout the model cities neighborhoods. This grant involved federal funds in the amount of $10,000.

2. *Metropolitan development urban beautification funds*

The city applied for $57,842 of urban beautification funds to finance approximately 50 percent of the cost of redeveloping existing park properties (two) and developing additional park facilities in the model neighborhood. The grant was approved in February and construction of the improvements will begin upon completion of specifications and working drawings in May.

3. *Water systems improvements*

Metropolitan grant in the amount of $608,475 was awarded to the city of Texarkana, Ark., for water system improvements.

4. *Rent supplement housing*

A 21(d)(3) rent supplement housing project broke ground for 128 units on March 28, 1970.

5. *Cooperative housing*

A 236 cooperative housing project has been approved for Texarkana for the construction of 200 units.

6. *Public housing*

Texarkana Housing Authority is finalizing plans for construction of 100 units of public housing.

7. *Housing Development Corp.*

A private nonprofit corporation designed to provide a permanent source for housing rehabilitation and development is operative.

8. *Home improvement technical assistance*

A project designed to assist persons to secure home improvement loans if funded; implementation is awaiting renewal funding.

9. *Relocation*

A central relocation agency has been funded with model cities supplemental funds and is soon to be operational.

WHAT RENEWAL MEANS TO TEXARKANA

Renewal assistance provides the only vehicle for comprehensive redevelopment necessary to meet the goals promised in the model cities comprehensive demonstration plan.

Pertinent housing and redevelopment statistics are as follows:

In the model neighborhood—

Fifty percent of the 4,000 dwelling units are substandard; with 1,350 being substandard-repairable and 650 being substandard-nonrepairable.

Sixty-five percent of the streets in the model neighborhood are classified as temporary, made of seal-coat construction and without curbs and gutters.

Ninety percent of the model neighborhood is without a standard storm drainage system; ten percent (400 units) of the housing in model neighborhood flooded under heavy rains in 1968.

Some 1,000 septic tanks and 200 to 300 pit privies exist in the city because the sanitary sewer system is not accessible to some areas and some individuals lack financial resources to untilize the system where it is accessible.

Mayor SHOPTAW. As we commenced the comprehensive planning process in 1968 there were two needs of Texarkana that stood out above all others and these needs were housing and storm-drainage improve-

ment. Assistance in solving these two problems was to come through urban renewal activities, which would have involved the creation of an urban renewal agency for Texarkana; and activities to be undertaken by the United States Corps of Engineers.

We did start this program, although we funded it with city funds. In 1966 we had such floods down there that it came up in the Howard Johnson motel and in many of the houses.

In spite of the fact that many components of our planning of lesser priority have received attention, to date we are still faced with a critical need to meet our storm-drainage needs and our housing and urban redevelopment needs.

I would like to indicate that the reason Texarkana has found difficulty in meeting these needs has been the shortage of funds available to provide us with the financial assistance to undertake these programs. We are well aware that there are nonmodel cities designee communities whose urban redevelopment problems are the same as ours and who, like ourselves, are in need of help and assistance. We are convinced of the good will and intentions of both our regional and national renewal assistance people, who we believe have given our problems and our application fair attention. But despite the efforts of these good people and despite our own local efforts through the model cities program and through other programs it is not possible for Texarkana to meet these two high-priority needs until or unless adequate funding can be made available to us. Our best information indicates that this shortage of funds is a national problem and if lending our support in behalf of all the smaller cities of the United States will assist in meeting these needs, we are not only happy but delighted to do so. It would be easy for me to recapitulate all of the program areas and activities in which Texarkana, Ark., has engaged to provide short term benefits; however, we find that we must always return to urban renewal and redevelopment—specifically the neighborhood development program—as the fastest means by which we can proceed towards solving pressing needs of our community.

It has been a pleasure for me to appear here with Mayor Alioto and Mayor Kramer.

Mr. Evins. Mr. Mayor, we thank you for your statement. You appear here in support of full appropriations for the model cities program in the Department of Housing and Urban Development?

Mayor Shoptaw. Yes, sir.

Mr. Evins. How is your model city working out? They say some are succeeding and some are not.

Mayor Shoptaw. Ours is working fine.

Mr. Evins. Working well, making progress?

Mayor Shoptaw. Believe it or not, we are ahead of Texarkana, Tex.

Mr. Evins. You have to have two mayors, do you, one for Arkansas and one for Texas?

Mayor Shoptaw. Yes, sir.

Mr. Evins. Are there questions? Thank you very much.

The committee is pleased now to hear the distinguished mayor of Paterson, N.J., Mr. Lawrence F. Kramer.

STATEMENT OF MAYOR LAWRENCE F. KRAMER

Mr. KRAMER. Thank you, Mr. Chairman, and members of the committee.

Gentlemen, I think my presentation this afternoon can and shall take all awards for brevity. The facts have been stated so accurately by the mayors who have preceded me.

What I could add, however, would be the size factor that comes into play. What I mean by that is that we have heard from two distinguished mayors from two very different size communities. Paterson, N.J., represents what, I think, so many many cities in the United States represent in terms of our population and the problems that develop from density within that population. What I am saying is that the Paterson voice is here to say, "Aye," to what has been said. Paterson, with 150,0000 people, feels that the tool with which we can do the most in these trying times is urban renewal, a word that has perhaps been abused because of the mechanical operations of it, or the ability of the local community to use it effectively.

But, when and if employed properly, it can be the tool that can resolve many of our problems.

We believe that such programs as Operation Breakthrough and, most particularly, the NDP, will enable the communities to finally and once and for all begin to be effective. But, like any tool, it is as good as the craftsmen who pick it up. We think that once the professional talent has been put abroad, the programs that you in your wisdom have supplied can be harnessed to be effective. But at the bottom of all of that, of course, is the funding. If that is there, all of these things can then become a reality. If it is not there, we will again be frustrated by what we have seen so many times in the past. Excellent programs and good administration ready to go forward and no money to do it.

I promised brevity and brevity it shall be, but not so brief that we don't add our voice loud and clear for cities of our size to what has been said.

If there are any questions, I will be glad to attempt to answer them.

Mr. EVINS. Mr. Mayor, you address your remarks to the urban renewal phase of HUD's budget?

Mayor KRAMER. That is correct, sir.

Mr. EVINS. $1 billion is budgeted for next year.

Mayor KRAMER. It is not enough.

Mr. EVINS. Without objection, your prepared statement will appear in the record at this point.

(The statement follows:)

Mr. Chairman and members of the committee, I am Lawrence F. Kramer, mayor of Paterson, N.J. The social and economic forces creating our slums appear to move more rapidly than the governmental forces that would eliminate them.

The scale of housing problems in Paterson, N.J. is such that the rental vacancy rate has dropped from 3.3 percent in 1960 to 2.2 percent in 1967 to 1.8 percent in 1969. It is reported that Paterson is second only to New York City as the most densely populated city in the Nation. These facts paint a picture of an old housing inventory where vacancies are few, depreciation rapid and most important of all, replacement extremely slow.

In Paterson, as well as other major urban centers the housing supply is eroding amid the construction standstill. Economic pressures are steadily eroding the

quality of Paterson's housing supply and shrinking the quantity at such a pace that it is having devastating affects on the surrounding occupied properties. Only through urban renewal particularly under the NDP program can this pattern be arrested. For only today with this revised tool can a city reach into areas where the need is greatest and offer the inducements of eminent domain and land write-down costs to stimulate private investment.

And if this approach is to function properly, more money from Congress must become available for experimentation, low-cost mortgages and redesigned buildings. The homebuilding industry is at a standstill brought about by many factors, such as high interest rates and inadequate supply of mortgage funds. Homebuilding is also being impeded by rising land costs and wage increases for construction workers. As you know, there is a heavy demand on the construction industry for commercial and industrial as well as public construction. The home-building segment of the industry continues to be stifled in its need to provide housing facilities especially for the middle-income and low-income people of our urban cities. We cannot solve our urban problems unless we find it possible to stimulate this industry by developing new methods for mortgage financing, generating a rapid increase in the supply of trained manpower and making full use of modern technology in the construction industry.

As mayor of the City of Paterson, I have so often been disillusioned and frustrated by the lack of the sense of urgency on the Federal level in dealing with urban problems. A case in point is the recent cut-back in the commitments to the Neighborhood Development Program. This is the most realistic approach to renewal formulated to date for it gives the municipalities the flexibility to move into critical areas as demand arises without tieing up millions of dollars in massive single projects that may take a decade or more to complete. In Paterson a conservative 1-year NDP program submitted by the city proposed an acquisition of only 173 properties. The program is now authorized to purchase 26 properties severely limiting our redevelopment planning. The NDP approach was intended to save time, save dollars and bring renewal effort to those areas where it was most critically needed. The city submitted its preliminary application in November 1968, but ultimately did not even receive even this reduced project until April 1970. The credibility of our efforts at the local level to deal with the urban problem has suffered greatly due to delays and even more so due to the inadequate funding of existing housing and community development programs, programs which community participants themselves helped to design. In another area HUD recently announced that if cities with renewal projects face increase costs, the Federal Government will fund on the traditional sharing basis only one amendatory, but for Paterson and other cities this policy is devastating for it leaves the completion of the projects to the city which are already in desperate financial condition. Our efforts to date call for a new sense of realism in urban affairs. Secretary Romney's operation "Breakthrough" has recognized this need in the area of solving the homebuilding requirements in our cities. However, we cannot afford another frustration. This program must be developed to meet the immediate needs of our central urban areas. This fresh approach demands major congressional support and dollars, and we must determine whether even the most efficient mass production methods can bring housing costs into a realistic range without additional subsidization. Perhaps an outright payment by the Federal Government of say, 25 percent of the construction cost instead of the present program of interest in tax subsidies may be required to provide the stimulation as needed.

We cannot afford to ignore the problems of the urban fabric of our society. We must not only work to correct the problems we face today, but also strive to prepare for the future when we will be even more urbanized. Urban renewal is the only real tool we have at our command to combat those forces of physical decay which so rapidly lead to social chaos.

As our Nation emerges from the stultification of our chaotic urban renewal approaches and as optimism rises with the creation of new approaches, such as NDP and Operation Breakthrough, we must recognize the deeprooted responsibility to support hope with reality. To fund and to fund fully and realistically those programs which tell our city dwellers that hope does exist and that abandonment of the urban core can give way to those very programs that offer the only real hope to those of us who have refused to abandon the city for the tempting lure of suburbia. And let us not forget that what happens in the central cities of our Nation affects not only the inhabitants of those cities but also the people who live in suburban and rural areas.

The President's budget requests for supplemental appropriations for the current fiscal year and for fiscal year 1971 are bare minimums when compared with the actual needs of our cities. Nevertheless, we support these budget requests, with one important exception. That exception is the request for urban renewal. We must have more funds for renewal than have been requested by the President. In fact, we desperately need a supplemental appropriation for fiscal year 1970 of the $587.5 million which is authorized. And we need at least the full $1.7 billion authorized for fiscal year 1971. Our needs are much greater than these amounts, but the immediate appropriation of these funds would prevent dire consequences which might otherwise occur in renewal programs around the country.

Mr. EVINS. I wanted to read this to the mayors of your organization. This budget document in one paragraph says:

Of all the federal programs that have an important bearing on urban development, including direct federal construction and the various loans acts and insurance programs, no attempt has been made to add up all of the various funds. However, the Department of Housing and Urban Development estimates that the total federal financing commitment for urban social and community development for 1971 is about $44 billion compared to $21 billion in 1964. The Department figures indicate a magnitude of federal financial involvement in communities of 2500 population and over will exceed $44 billion.

This committee has seen the mounting increases in all programs and not just housing, but I wish the mayors could get the idea that there are large commitments of the Federal Government going into all city programs.

Mayor KRAMER. Mr. Chairman, I don't think there is any question but what there has been a very dramatic response in regard to some of these problems that have finally been recognized but, frankly, taking cumulative figures like this, I would urge that we take the cumulative guidelines that come with them. You will find that some cities in fact can in no way qualify for many of those dollars.

What we are saying here this afternoon is that under the direct NDP program, under the direct urban renewal umbrella, per se, we do qualify, and that is where the dollars ought to be applied and we could then be effective at the local level.

Mr. EVINS. Are there questions?

Thank you, Mr. Mayor, for your testimony.

HOUSING PROGRAMS, SECTIONS 235 AND 236

WITNESS

JOHN C. WILLIAMSON, NATIONAL ASSOCIATION OF REAL ESTATE BOARDS

Mr. EVINS. Mr. John C. Williamson. We will hear Mr. John C. Williamson, a representative of the National Association of Real Estate Boards. He is appearing specifically with regard to funds for 235 and 236.

Mr. WILLIAMSON. Yes, sir. I would like to introduce my assistant who works on this, Louis Nevins, a member of the District of Columbia Bar.

I have just a three-page statement that will be filed and I will summarize.

(The statement follows:)

I appreciate this opportunity to present the views of the National Association of Real Estate Boards with respect to appropriations for the FHA section 235 and 236 interest subsidy programs administered by the Department of Housing and Urban Development.

In view of the short time since these programs were first implemented, firm conclusions about the ultimate success or failure of these programs should not be drawn. However, on the basis of the evidence available to us, both programs are fulfilling their purpose, and there is every indication that they will exceed the expectations of their proponents. The only factor preventing either program from making more of a dent in our Nation's housing problems has been the lack of sufficient contractual authority to keep up with demand and need for this type of assistance. We believe both programs warrant full funding at the levels authorized by the Congress.

There is available for appropriation for the balance of this fiscal year authorization of $40 million for section 235 and $45 million for the section 236 program. The administration has requested $25 million for supplemental appropriations for each program during the present fiscal year, but would apparently apply the authorization surplus to its request for fiscal year 1971. In view of the lengthy backlog of applications which Secretary Romney has described in several public appearances, we believe there is ample justification for making all funds currently authorized available immediately in the supplemental bill. We understand that virtually every FHA office in the country is presently out of funds, and we fear that $25 million for each program will not meet the needs of acceptable applications already on file in many of these offices much less the applications which are being sought every day by eligible low-income families.

Clearly, both the section 235 and section 236 programs are providing housing to many lower income families. Our association is not unmindful of powerful budgetary considerations—particularly the recurring threat of inflation which is fed to a substantial degree by Federal spending—but we believe our national commitment to better housing for lower income families is so critical that we cannot afford not to fund these programs at full levels.

One thing which causes us great concern at this time is that applications for commitments to insure housing under section 236 exceed the total authorization for the program through fiscal year 1971. In other words, even if the program were fully funded by the Congress, assuming all present applications were acceptable to FHA, no developer who submits an application in the next 15 months can hope to receive even a reservation of funds. We realize that not all applications will be found acceptable, but when one considers the fact that substantial section 236 funds have been assured to State-assisted programs, and that even more funds will be allocated to model cities projects, it is not difficult to reach the conclusion that these funds will be spread thin. That is why we believe it is imperative that the program be fully funded by the Congress.

Turning to the section 235 program, it is our opinion that the primary purpose of this program is to enable lower income families to become home owners. In some places in the country it is also possible to achieve a secondary goal of increasing the Nation's housing supply of moderately priced housing, but this is not possible everywhere.

In many small communities where speculative volume building is always at minimum levels the best chance of a low income family achieving home ownership is through the purchase of an existing home. Certainly a low income family should not be denied the benefits of home ownership through this program because he hasn't found a new home that qualifies. Also, there is something inherently wrong in any program which says in effect that low income families whose shelter costs are borne in part by the taxpayers need to be housed only in new housing.

The subcommittee is aware that up to 30 percent of the funds made available for contractual authority under section 235 may be allocated for existing housing units. This increased allocation was inserted into the Housing Act of 1969 because it was apparent that there were many areas where, because of the extremely high cost of new construction, existing housing would have to be utilized. Our association has discussed this problem with the FHA Commissioner and has been advised that he intends to make the full allocation to existing housing on an administrative basis.

In closing I would like to urge the subcommittee to add a word of caution in its report that these subsidies are intended for families of low income who clearly and unmistakably are unable to purchase a home either new or existing without subsidy.

The Housing Act of 1968 requires that the Secretary shall report annually to the respective Committees on Banking and Currency of the Senate and House of Representatives with respect to the income levels of families on behalf of which assistance payments have been made under this section. A comparable requirement is included in section 236.

As of December 31, 1969, there were 23,196 units occupied by homeowners receiving subsidies under section 235; and 43,440 units occupied and subsidized under section 236. However, the Secretary as of this date has not submitted the annual report of income levels being served, as required by the 1968 act. Nothing could discredit these programs more than evidence that subsidies are being paid on behalf of individuals who are able to find adequate shelter without subsidy. It is because we believe the programs are meritorius that we sound this note of caution.

We commend these views to your sympathetic consideration.

Mr. WILLIAMSON. We support the section 235 and 236 programs. For many years we have been working with the agencies and with members of Congress to try to develop some effective mechanisms for housing low-income families. We worked on public housing for many years and then we worked on the rent supplement program. Now we have the rent certificate program and also the section 235 and 236 programs and we think that the latter programs are very effective mechanisms for housing lower income families. That is why we are here, to make this plea that they be fully funded for fiscal year 1971.

We would like to see the subcommittee approve complete funding for the supplemental appropriations bill because applications are not being accepted now. There is a big demand throughout the country. We understand the administration as recommended $25 million for the supplemental but that the balance of the authorization not being used would be added to fiscal year 1971.

Of course, we realize that in that respect it would be fully funded although we think that it would be better to grant contract authority for $40 million for 235 and $45 million for 236 in the supplemental even if it involves less for fiscal year 1971.

Mr. JONAS. There is $25 million in each 235 and 236?

Mr. WILLIAMSON. That is right We would like to see the full authority which would be $40 million for 235 and $45 million for 236, even if that means less for fiscal year 1971. The administration has requested less than it would have and added that to the fiscal 1971.

Mr. JONAS. They are asking $140 million for 235 and $145 million for 236 in 1971.

Mr. WILLIAMSON. That is right. Also in our testimony we add one note of caution. Many people in our industry have viewed sections 235 and 236 as a means of reviving homebuilding. We don't think that that is their primary purpose. There are other things that are involved in our low level of homebuilding starts, but section 235 and section 236 were never intended to be mechanisms for reviving the homebuilding industry. They were intended to provide a mechanism to house lower-income families, and we just add a note of caution that while we think these are meritorious programs, they could be discredited if they involved the granting of subsidies for families whose incomes are sufficient to permit them to provide their own housing without subsidy.

Mr. JONAS. Did I understand you correctly to say that even if it became necessary to take the $15 million and $20 million out of these two programs in the regular 1971 bill, if that became necessary you would rather see that done and have them added to the supplemental?

Mr. WILLIAMSON. I would rather see more in the supplemental because of the big backlog of applications that have accumulated.

Mr. JONAS. We are aware of this backlog. I have talked to the Department. They are anxious to get additional contract authority. However, I have been talking with the Chairman of the committee and he doesn't see any possibility of getting this supplemental on the House floor until early May. Then it has to go through the Senate. Then it has to go through conference and the fiscal year is going to be nearly up before this money is going to become available, even if we put it in.

Mr. WILLIAMSON. The longer it takes, the duller is the thrust of our argument. I agree with you.

Mr. JONAS. Your idea is that even if it didn't become available until the near end of the fiscal year, they could go ahead waiting on the 1971 bill to clear?

Mr. WILLIAMSON. They could go ahead and, of course, the 1971 appropriation bill probably won't be enacted until after July and the monthly rate at which they would execute contracts would be based on the monthly rate for the previous year.

Mr. JONAS. We are hoping to get it through the House before the end of July. I don't know why we can't get our bill through the House in May. We hope to get the 1971 bill through conference before the end of the fiscal year.

Mr. WILLIAMSON. I want to add this other point: There seems to be a trend in the administration and even in the industry to keep pushing toward higher income limits, for the families to be benefited. We think this is unfortunate, that this could discredit the programs.

I have just taken the liberty of suggesting some language that the committee might want to use. A word of cautions to expressing the views of the committee that they should make sure that these subsidies are going to families of lower income.

The Secretary of Housing and Urban Development is required by the Housing Act of 1968 to submit an annual report on the income levels of the families benefiting from these subsidies and even though there are over 40,000 section 235 units already being occupied and some section 236 units actually under management, the Secretary has not submitted that report so we don't know the income levels that are served.

In my years of experience in housing legislation, I notice always a trend and a push toward taking care of higher income people because higher income people don't bring problems into projects. But the primary purpose of this program is to house people that can't afford housing.

Mr. JONAS. That is interesting. We heard testimony this morning from the other point of view, that you need a mix to make these projects succeed.

Mr. WILLIAMSON. That would be very desirable if a mix were maintained, but our experience has been that people just like to build for higher income people, particularly the developers. We think that one of the strong points of the 235 program is the fact that 30 percent of the contract authority is made available for existing houses. In many of the smaller towns where you don't have much speculative, volume building, the only chance a low-income family might have for a house

is through the existing-house market. The same thing is true in some of our higher building cost cities. The primary objective of the 235 program would be better served if existing housing were utilized rather than increase the mortgage limits. The higher mortgage limits simply drive lower income families out of the program.

Mr. JONAS. Of course, you run into this problem: You get a lot of citizen resistance where a guy is working hard and not asking for any Government help or subsidies, and he is just above the maximum income limit. He sees his neighbor, who doesn't work as hard, he thinks, as he does, and doesn't try as hard, getting all these subsidies and he has to struggle along, pay for his children's education, maintain his own home, try to buy it, and pay a lot of taxes too.

Mr. WILLIAMSON. You will always have that and it is too bad. That is the reason why Congress, in 1949, when they enacted the Public Housing bill, had a 20-percent gap, to make sure that the people who were going to be assisted could not get housing in the private market. That 20-percent gap was knocked out several years ago.

I think it is important, just to make sure that the people who get these subsidies can't afford the private market. What is going to happen in this 235 housing and 236, I am afraid, is that in years to come the mortgagees and the people responsible for checking these incomes every other year, are not going to be as zealous in that regard as the department downtown and if they are lax, you are going to find middle income people being subsidized to the tune of $1,000 a year that clearly are making enough money to support an economic shelter cost.

That $1,000 a year is not only a gift from the United States, but I understand by ruling of the Internal Revenue Service that that $1,000 is deductible, as interest paid by the beneficiary of the subsidy even though it is really paid by the Government. That is why it is very important that we keep these programs from going to people who can afford to pay full economic costs.

Mr. EVINS. Are there further questions?

Mr. Williamson, your testimony has been helpful. Thank you for appearing.

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

WITNESS

LOUIS R. BARBA, PRESIDENT, NATIONAL ASSOCIATION OF HOMEBUILDERS

Mr. EVINS. Mr. Barba, you represent the National Association of Homebuilders. You are its President, I believe?

Mr. BARBA. Yes, sir.

Mr. EVINS. The committee will be pleased to hear you.

Mr. BARBA. First, let me introduce on my left hand side, Joe McGrath, our staff vice president, and to the rear of me are Carl Coan and Burton Wood. They are our legislative staff over at NHB Headquarters.

Mr. EVINS. You didn't introduce the lady. She is the most important one of all.

Mr. BARBA. That is Mrs. Louis Barba. She is the mother of our five kids and we are proud of them.

My name is Louis R. Barba and I am a builder from Chatham, N.J. I appear before you today as president of the National Association of Homebuilders.

The membership of our association totals some 51,000. These members belong to 481 affiliated local and State associations throughout the 50 States, Puerto Rico, and the Virgin Islands. Of all the homes and apartments built in this country by professional builders, we estimate that our members construct two-thirds of them.

We appreciate the opportunity to appear before this committee. Our primary concern is with the production of housing. Because of this we are also vitally concerned with the success of the housing programs of the Federal Government and production under these programs is, of course, dependent upon adequate funding.

Last week, in making his first housing goals report, President Nixon reaffirmed this Nation's 10-year housing production goal of 26 million units, established by Congress in the Housing and Urban Development Act of 1968. "If the goals are in fact to be achieved, however," the President said, "housing must receive a higher priority in the allocation of national resources."

We believe one of the necessary and important steps in this national effort, as emphasized by the President, is the full funding in fiscal 1971 of three relatively new programs aimed at housing lower income families. These are the section 235 homeownership program, the section 236 rental housing assistance program, and the rent supplement program. In addition, we urge the appropriation of the $25 million supplemental amounts for section 235 and 236 for fiscal 1970 as authorized in the 1969 Housing Act.

As this committee knows, out of the amounts authorized for the first 2 years of the 235 and 236 program, there are unappropriated funds remaining of $15 million for section 235 and $20 million for section 236. We understand that HUD has not requested these balances to be appropriated this year, but instead has added them to the fiscal 1971 budget request. We think this is a mistake. We think these funds are nedeed now and, if available, would be quickly used in this year's building season. Therefore, we urge the committee to appropriate in the pending supplemental both the $25 million for each of these programs, as requested by the administration, and the unappropriated $15 million for section 235 and $20 million for section 236. This would provide $40 million for section 235 and $45 million for section 236 in this fiscal year. There is no doubt in our mind that all this money is needed now, and can be used before July 1.

Our information is that all but $29 million of contract authority for the 235 program had been reserved or obligated as of the 21st of March and that there are about $66 million of applications on hand and under review. Of the $155 million, which Congress has appropriated for the 236 program, $140 million has been reserved or obligated and there are proposals and requests on hand amounting to $183 million.

Thus the 235 funds will shortly be exhausted and the backlog of 236 proposals and requests far exceeds the remaining balance of contract authority. It is vital to continued housing production under programs, therefore, that authorized funds be made available as soon as possible.

In addition, we support the administration's request for the full funding in fiscal 1971 of the rent supplement program. According to HUD, of the $122 million Congress has appropriated to date for this program, $102 million have been reserved or obligated. Against the remaining $20 million of contract authority, there are approximately $40 million of proposals and requests on hand.

The housing industry cannot operate efficiently on a stop-and-go basis and this leads me to bring to your attention another matter of real importance to all builders. That is the problem of lead time essential in a building operation concerned with land acquisition, planning, materials supply, and financing.

In order to maintain the momentum and continuity of these essential HUD programs, we very earnestly urge your approval of the administration's request for advanced authorization of contract authority for the fiscal year 1972. These requested authorizations are $140 million for section 235, $145 million for section 236 and $75 million for the rent supplement program. We believe your approval for this advance authorization will lead to a much more efficient and economical use of the programs.

Housing production is now at a shockingly low rate. For the committee's information we have attached as exhibits two NAHB publications which provide extensive details on the present serious conditions in the housing market. These are the March edition of NAHB's Economic News Notes and our March 17, 1970 Housing Starts Bulletin.

Unquestionably, the Federal programs which I have discussed here constitute one of the few bright spots in an otherwise dismal building situation. Furthermore, these HUD programs represent the most complete utilization of private financing, building, ownership, and management of housing yet devised under the Government's housing programs for lower income families. They represent a real challenge to industry and they provide a realistic means of meeting our national housing goals for lower income families. We urge early and favorable action on the pending budget requests.

I should like to express our appreciation for the opportunity to appear before you to present our association's views.

(The attached documents follow:)

NATIONAL ASSOCIATION OF HOME BUILDERS / 1625 L STREET, N.W., WASHINGTON, D.C. 20036

DIFFICULT SPRING AHEAD FOR HOUSING

Data currently available shows a further weakening in the U. S. economy as well as a decline in the money rates. There are also more definite indications of a further softening in employment. There is little evidence yet to show that the sharp rise in prices has been arrested, although, a case could be made for some slowing in the rate of increase.

One can only conclude from the available evidence that in the first quarter of 1970, real Gross National Product will show a further decline. The extent of this decline could well be more substantial than expected earlier and very likely it would extend into the second quarter of 1970. All evidence points to a slow, inch by inch, easing of monetary policies in response to the slowdown in economic growth, and the increase in unemployment rates.

This is the way the economy seems to be shaping up for the rest of the year:

- We will have a decline in GNP in real terms in the first and second quarters.
- Any recovery that does occur in the second half is probably going to be mild.
- Unemployment will increase to over 5%.
- The increase in expenditures for plant and equipment (as projected by some) will not be realized.
- Monetary policies will gradually ease.
- There will be a slow but persistent increase in flow of savings.
- Housing will decline further to about a 1 million starts rate in the spring and stay at low levels through summer, possibly fall. Starts should pick up slightly and continue to increase in the latter part of the year.
- Total housing starts for 1970 are difficult to predict. Secretary Romney indicated in recent testimony that the HUD estimate is 1.4 million housing starts. His forecast is conditioned on full funding of Federal programs as well as a changing credit picture. NAHB's forecast is for 1,260,000 housing starts, about 15% below the 1969 levels.
- There will be a moderation in price increases.

MONEY MARKETS

It is still too early to conclude that the Federal Reserve Board has eased its tight monetary policies, although, as indicated in the February *News Notes*, there was some evidence that the process may be starting.

This is what the data shows:

- The FED member banks net borrowed reserves increased in the first week of February and then declined for two consecutive weeks, but then increased in the last

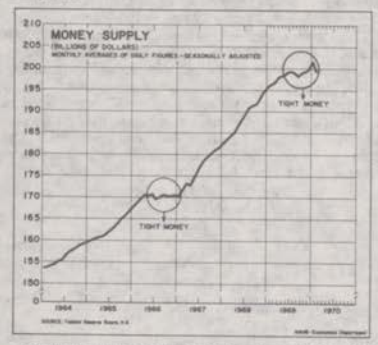


week of February again to $991 million from the $888 million level of the previous week. This is still substantially below the levels of last year when the net borrowed reserves stood way above the $1 billion mark.

• Money supply (the currency and demand deposits) behaved quite peculiarly over the last two months. There was an increase in the last week in December, when supply jumped from $197.8 billion to $202.9 billion. It declined for 6 consecutive weeks and it then increased slightly in the third week of February.

• Member bank borrowing from FED showed somewhat of an ease in the last week of February when such borrowings averaged $1.06 billion, down from $1.11 billion the previous week.

• Interest rates kept declining in February. Short term rates were down from the December 29, 1969 peak by 111 basis points, while long term government yields dropped 87 basis points.



• Several small banks lowered the prime rate from 8½% to 8%.

• FNMA prices continued to increase from their lows reached in the second week in January. The price at which FNMA will buy loans during a committed period of 90 days increased since mid-January from $93.78 to $95.19, or $1.41; price on 180 day commitments increased by $1.82, and on one year commitments, increased by $1.35.

• Flow of funds in January was a minus $2.725 billion. February will likely show a slight improvement, a plus $2.225 billion for the four financial institutions. Total year 1969 shows a net inflow for the year of $5.802 billion, down 86.7% from 1968. Savings and loans and mutual savings banks taken together for the year 1969 show a net inflow of $6,627 million, down 43% from the 1968 inflow of $11,636 million.

• Savings and loans in January showed a net outflow of $1,405 million; much worse than the industry's expectation of a minus $1,000 million. February will be a low for S & Ls as well—plus $125 million—compared to a plus $605 million for February of last year. Indications are that the S & Ls will not see relief in the near future. It is easy to see the effects of the interest rate hike on the impact of the raising the minimum purchase amount of Treasury Bills and FNMA debentures.

• Mutual savings banks experienced an outflow of $100 million in January, compared to a net inflow of $240 million in January, 1969. The February net flow is

FLOW OF FUNDS INTO
SELECTED SAVINGS INSTITUTIONS
(In Millions of Dollars)

Month	Life Insurance*	Savings and Loans	Commercial Banks	Mutual Savings Banks	Total	Total S&Ls & Mutuals
Total Year						
1969	$ 9,535	$ 4,816	$-10,360	$2,591	$ 5,802	$ 6,627
1968	11,274	7,442	20,557	4,194	43,467	11,636
1967	10,339	10,678	23,675	5,116	49,817	15,794
1966	8,138	3,615	12,135	2,589	26,477	6,204
1965	9,414	8,513	19,986	3,594	41,507	12,107
% Change						
1968-69	-15.4%	-46.4%	**	-38.2%	-86.7%	-43.0%
1967-69	- 7.8	-62.2	**	-29.4	-88.4	-58.0
1966-69	17.2	11.6	**	0.1	-78.1	6.8
1965-68	1.3	-52.6	**	-27.9	-86.0	-46.3
1969						
January	1,277	-90	-1,600	240	-175	148
February	952	605	400	339	2,296	944
March	993	1,369	200	672	3,144	2,041
April	535	-516	-600	-183	-764	-699
May	765	642	300	313	2,020	955
June	184	1,359	-2,000	355	-102	1,714
July	730	-1,100	-3,500	-152	-4,022	-1,252
August	987	-8	-1,500	102	-419	94
September	775	879	-900	303	1,057	1,182
October	1,125	-406	-900	-138	-319	-544
November	729	237	-1,000	257	223	494
December	569r	1,067r	740r	483r	2,859	1,550
1970						
January	1,000e	-1,405r	-2,220	-100p	-2,725	-1,505
February	900e	125e	1,000e	200e	2,225	325
Total 2 Months						
1970	1,900	-1,280	-1,220	100	-500	-1,180
1969	2,229	-513	-1,200	579	1,095	66
% Change	-14.8%	**	**	-82.7%	**	**

r - revised, e - estimate, p - preliminary
* - Assets net gain
** More than 100% decline

Source: Federal Home Loan Bank Board, Federal Reserve Board, Life Insurance Institute, National Association of Mutual Savings Banks, Estimates by NAHB Economics Department.

expected to be $200 million, and this figure could be optimistic. This compares to $339 million inflow in February, 1969.

• Commercial banks showed a net inflow in December, 1970 of $740 million, the first net inflow since May, 1969. January dropped off to a minus $2,220 million, but February will probably be positive by $1,000 million. Indications are that the run off might be over in the time deposit sector, and commercials might be improving their time deposit situation.

The Gross National Product in real terms declined slightly in the last quarter of 1969, after robust increases in the previous four quarters. Data for the first two months of 1970 indicate a further erosion of growth with little prospects of any improvement in the second half.

The Federal Government may end up with a small deficit rather than a $1.3 billion surplus. But this will not be of such scale as to put an undue pressure on the money markets such as we have seen in the past years.

This is what the major indicators available in February show:

Composite of key leading indicators fell in January to 149.3% of the 1963 average from an upward revised 152.1% in December. This represents ten months of consecutive decline (with one minor exception).

Industrial production fell in January to 169.9% of the 1957-59 average, from an upward revised figure of 171.1%. This is the sixth consecutive decline in the industrial output, already equaling the decline of 1967.

Durable goods orders received by manufacturers fell in January to a seasonally adjusted annual rate of $28.6 billion from an upward revised $30.3 billion in December. This is the fourth consecutive month of decline.

NATION'S MAJOR HOMEBUILDERS

A private study conducted by a group of marketing research departments of buildings materials supplies shows some interesting statistics concerning major builders. According to this study . . . .

- California is still the stronghold of the large homebuilder. . . . but major builders now operate in most other large housing markets in the country.
- The major builders are involved in the merger trend . . . . but the number of mergers compared to the number of all builders is still quite insignificant.
- The largest builders have changed with the changing market. They have been increasingly involved in multifamily construction as well as government programs.
- The top 80 builders have been in the business for a long time and their size has not changed significantly one way or the other in the past few years.
- The group showing some increase has been concentrated among the builders found in the lowest third group: building between 200 and 599 units–BUT, the change in the size of these builders has been due to their entry into multifamily housing.
- Large builders will continue to raise funds outside the traditional mortgage market.

1969 Production Estimates
425 Major Home Builders

No. of Units	*No. of Builders*	*1969 Estimated Production* *Single Family*	*Multi-Family*	*Total*
Over 1,000	80	55,000	110,000	165,000
600 to 999	60	19,000	27,000	46,000
200 to 599	285	44,000	48,000	92,000
	425	118,000	185,000	303,000
U. S. Housing Starts		810,000	687,000	1,497,000
Major Builders Share of Total Market		14.6%	27.0%	20.2%

SURVEY INCLUDES BUILDERS OF 200 OR MORE UNITS

For the purpose of this study, a "major" builder was defined as "an established business" which has operated for several years. The firm should have started at least 200 residential units on the site in 1968, 1969, and projected as many or more for 1970.

Apartments accounted for 62% of the units produced by the major builder group in 1969–several years ago, it was much lower. Previous studies by the same group show the steady increase in apartment construction.

Year	*Multiple*
1965	30%
1966	38
1967	42
1968	46
1969	62
1970	64

THE MAJOR BUILDERS HAVE CHANGED WITH THE CHANGING HOUSING MARKETS

At least 20% of the large builders experience some type of change each year. The changes range widely, from a few actually going out of business, to merely changing the firm's name and address. In many cases, the managing principals change or there are shifts in the ratio of the amount of income generated from actual homebuilding as compared to income from other business activities. The most recent changes involve the shift into apartment construction and a trend toward merger, acquisition, or the public sale of stock. Incidentally, a large number of the surveyed group indicated that they were involved in developing plans for modular units or were investigating industrialized housing.

CALIFORNIA: STILL THE STRONGHOLD OF THE MAJOR BUILDERS

In the mid 60's, the West, and California in particular, was the "home" for nearly one third of the nation's "major" builders. In 1963 housing starts reached 400,000 units in the West. Most of these homes were built in California where the large builders could operate successfully. The rate of starts dipped to 150,000 units in 1966 and many of the large builders were equally affected. Currently, the rate of starts is about 300,000 units and, although it is declining now as a result of the money situation, the activity is well above the 1966 low.

The headquarters of each company involved in this study, the major builders in the West, reportedly accounted for over 30% of that region's new homes and apartments in 1969. It is significant that the Northeast and North Central regions, not previously noted for large builder operations, now have more and more major firms than before producing over 20% of the area's residential construction. The South, a very large area with fewer major population centers, is influenced the least by major homebuilders.

Major Builders - Geographical Analysis (Headquarters Location)

Region	*No. of Builders*	*Estimated 1969 Starts by Major Builders*	*Total Starts in Region*	*Percent of Region Market*
Northeast	70	45,000	211,000	21.3%
North Central	115	82,000	352,000	23.3%
South	105	76,000	615,000	12.4%
West	135	100,000	319,000	31.3%
	425	303,000	1,497,000	20.2%

THE MAJOR BUILDERS ARE INVOLVED IN THE MERGER TREND

The recent merger and acquisition trend which is involving all of the nation's industries is evidenced in the big builder group. Among the major homebuilders surveyed, 30 have already merged or been acquired. Another 20 have been mentioned publically as "merger" minded.

Compared to the industry, as a whole, either the number of mergers or the number of units these companies are producing is still relatively small and their impact on the industry only marginal.

The recently completed mergers are considered by many as financial experiments. In the future, the homebuilding industry must compete with many other industries as an investment alternative. Invariably, the basic motivation is return on investment. The financial aspects, short term as well as long term, of any merger must be adequate. These situations are not easily found. Several major corporations have already tried and failed in attempts to enter the homebuilding industry. The size of the new operations will not make success come easier.

1970 HOUSING FORECAST: CONTINUED DECLINE

Housing starts are still declining. As the chart at the bottom of this page shows, the twelve month total of starts reached a peak of 1.6 million units in June, 1969. In the seven succeeding months, the total moved down 8.8% to 1.46 million starts. This decline averaged 1.3% per month. In 1966, on a comparative basis, starts hit a peak of 1.57 million units in March and declined steadily for 16 months to 1.1 million units. This was a total decline of nearly 30% and an average monthly decline of 1.8%. The 1966 decline started in the spring (versus the summer for the current decline) and was much more rapid even in the first few months. Nevertheless, the current decline is sharp and continuing. There has been no direct indication that the decline is slowing.

The building permit data, sometimes a slight leading indicator, is declining at an even faster rate than starts. In January, the seasonally adjusted annual rate of building permits was at 952,000 units, 23.4% below the December rate of 1,239,000 units. Singles were down 28.5%; from 639,000 units in December to 457,000 units in January. Multiples were down 17.5%; from 600,000 units to 495,000 units. All four regions registered declines: Northeast down 15.9%, North Central down 49.1%, South down 10.5%, and West down 17.0%. January building permits are at the lowest level in three years and second lowest in the 11 years for which monthly data is available. The January decline was the sharpest monthly decline in recent history.

The next few months look bleak. Assuming that starts would follow the 1966 pattern of a decline of 16 months at a rate similar to the recent seven months, starts would bottom out in October with a 12 month total of about 1,280,000 units, and then turn slightly upward by the end of the year. At this time, this appears to be the best that can be expected from a market that is going down as fast as it is.

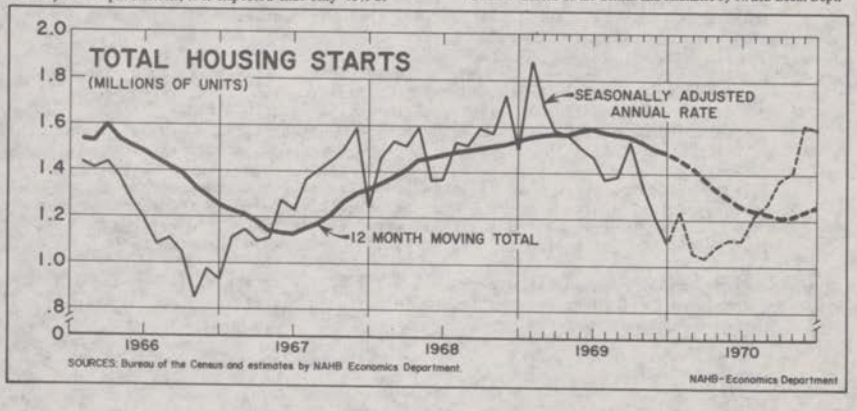
Another aspect of the current trend is that the decline is coming at a time of year which will slow a turnaround. Normally, about 50% of the year's housing production is started between March and August. Because the projected easing of the money markets will require several months to actually effect production, it is expected that only 45% or less of the total 1970 production will be started between March and August. The normal inability of the industry to make up for lost time in the latter months of the year will affect the result.

The NAHB Economics Department forecast for 1970 still is for 1,260,000 housing starts. There has been no evidence to indicate an increase in this figure is in order as yet. The table shows the calculation month by month for the year. However, it is clear that the situation is changing. As more production figures are reported and as additional information is available such as the next *JOURNAL of Homebuilding* Metropolitan Housing Starts Forecast, the outlook could possibly change.

NAHB 1970 HOUSING START FORECAST
(Thousands of Units)

MONTH	TOTAL PUBLIC AND PRIVATE — ACTUAL STARTS		TOTAL PRIVATE — SEASONALLY ADJUSTED ANNUAL RATE	
	1969	Forecast 1970	1969	Forecast 1970
Jan.	106	68	1,878	1,161
Feb.	95	59	1,686	1,052
March	136	88	1,584	1,036
April	160	111	1,563	1,085
May	158	117	1,509	1,122
June	151	115	1,469	1,117
July	127	112	1,371	1,215
Aug.	128	117	1,384	1,270
Sept.	133	118	1,542	1,374
Oct.	126	127	1,392	1,408
Nov.	97	121	1,295	1,610
Dec.	82	105	1,252	1,593

Source: Bureau of the Census and estimates by NAHB Econ. Dept.



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NATIONAL ASSOCIATION OF HOME BUILDERS / 1625 L STREET, N.W., WASHINGTON, D.C. 20036

MICHAEL SUMICHRAST, Chief Economist / DONALD SPEAR, Assistant Director / SARA FRANKEL, Research Analyst

ANNUAL RATE IN FEBRUARY UP 10.4% . . . The seasonally adjusted annual rate of housing starts in February increased 10.4% from 1,197,000 units in January. The February rate of 1,321,000 units, however, was 21.7% below the February 1969 rate of 1,686,000 units. Both singles and multiples showed increases, singles up 15.8% from 692,000 units in January to 801,000 units in February, and multiples up 3.0% from 505,000 units to 520,000 units. Regionally, gains were registered in all but one region. The Northeast was up 49.7% from 171,000 to 256,000, the South was up 11.3% from 470,000 units to 524,000 and the West increased 32.4% from 216,000 units to 286,000 units. The North Central declined 25.0% from 340,000 units to 255,000 units.

ACTUAL STARTS FOR THE FIRST TWO MONTHS DOWN 27.5% . . . Despite the jump in the annual rate, the actual number of units, started during the first two months of 1970, were down 27.5% from 200,600 to 145,500 units. Singles were down 25.2% from 99,200 to 74,200 units and multiples were down 27.1% from 101,400 units to 71,300 units.

PERMITS INCREASE 13.2% IN FEBRUARY . . . The February seasonally adjusted annual rate of building permits was at 1,147,000 units, 13.2% above the revised January rate of 1,013,000 units. Singles were up 17.0% from 469,000 units in January to 549,000 units in February. Multiples were 9.9% from 544,000 units to 598,000 units. Regionally all four regions registered increases: Northeast up 32.9%, North Central up 24.8%, South up 8.1% and the West up 1.0%. Even through the February permit level was higher than January, it was still the lowest level (other than January) since January 1968 when the rate was 1,148,000 units.

SUMMARY . . . The unexpected jump in housing starts reflects to some extent, the erratic movement of monthly data. The concentration of the increase in the single family sector is likely due to an increase in activity among the assisted Government programs. The actual housing starts at 76,500 units in February are still low in comparison to the past. It should also be remembered that a slight increase in actual starts makes a substantial difference in the seasonally adjusted annual rate. For instance, this February actual starts were 13,600 units below last February figure of 90,100 units, but translated in annual rate, the February 1970 rate was down by 365,000 units from the February, 1969 seasonally adjusted rate.

Unfortunately housing starts will still be low in the coming months because the basic underlying problems in mortgage markets have not, as yet, improved.

NEW HOUSING ACTIVITY
(In Thousands of Units)

Year	Priv. & Public Starts	Total Private Starts	Private One Family	Private Multi-Family	Total Private Starts	Starts Gov't Programs FHA[1]	VA	Bldg[2] Permits	FHA Applications	VA Appr'l Requests
1960	1296.0	1252.1	994.7	257.4	1252.1	261.0	74.6	998.0	318.3	142.9
1961	1365.0	1313.0	974.4	338.6	1313.0	244.3	83.3	1064.2	328.3	117.8
1962	1492.4	1462.7	991.3	471.4	1462.7	259.5	77.8	1186.6	284.9	171.2
1963	1642.0	1610.3	1020.7	589.6	1610.3	221.0	71.0	1334.7	270.6	139.3
1964	1561.6	1529.3	971.5	558.0	1529.3	204.6	59.2	1285.8	249.8	113.6
1965	1509.6	1472.9	963.8	509.0	1472.9	196.6	49.4	1239.8	237.9	102.1
1966	1196.2	1165.0	778.5	386.4	1165.0	158.4	36.8	971.9	197.0	99.2
1967	1321.9	1291.6	843.9	447.7	1291.6	179.7	52.5	1141.0	239.2	124.3
1968	1547.7	1507.7	889.5	608.2	1507.7	227.1	56.1	1341.4	245.5	131.7
1969	1497.0	1462.7	810.1	653.6	1462.7	240.5P	51.2	1296.2P	283.2P	138.2

p = preliminary

	Actual Starts				Seasonally Adjusted Annual Rate					
1968										
Jan.	82.7	80.5	45.2	35.3	1456	157	52	1148	163	122
Feb.	87.2	84.6	55.4	29.2	1537	164	63	1394	152	141
Mar.	128.6	126.6	79.3	47.2	1511	149	63	1416	160	127
Apr.	165.2	162.0	98.0	64.0	1591	147	59	1340	144	126
May	145.1	140.9	86.8	54.1	1364	133	57	1280	161	110
June	142.9	137.9	81.4	56.4	1365	137	54	1281	157	120
July	142.5	139.8	86.4	53.5	1531	134	49	1289	146	135
August	141.0	136.6	82.5	54.0	1518	144	51	1290	167	127
Sept.	139.8	134.3	80.2	54.0	1592	145	54	1393	169	125
Oct.	143.3	140.8	85.6	56.3	1570	153	55	1378	199	147
Nov.	129.5	127.1	64.8	62.2	1733	158	53	1425	212	172
Dec.	99.8	96.4	53.8	42.5	1507	158	65	1463	187	136
1969										
Jan.	105.8	101.5	51.3	50.2	1878	137	59	1403	178	148
Feb.	94.8	90.1	47.9	42.1	1686	138	52	1477	168	132
Mar.	135.6	131.9	71.9	59.9	1584	157	53	1421	160	136
Apr.	159.9	159.0	85.0	74.0	1563	166	48	1502	165	124
May	157.7	155.5	91.3	64.3	1509	134	47	1323	167	122
June	150.8	147.3	82.7	64.6	1469	147	48	1340	174	126
July	126.5	125.2	73.5	51.7	1371	137	46	1228	174	145
Aug.	127.6	124.9	69.5	55.4	1384	143	47	1245	169	151
Sept.	132.9	129.3	71.5	57.9	1542	152	54	1201	192	127
Oct.	125.8	123.4	68.0	55.3	1392	163	52	1183	230	130
Nov.	97.4	94.6	55.1	39.5	1295	178	53	1191	230	184
Dec.	85.3	84.1	42.8	41.3	1299	191	59	1239	210	147
1970										
Jan.	69.0P	66.2P	33.3 P	32.9P	1197	170	54	1013	251	141
Feb.	76.5P	73.8P	40.9 P	32.9P	1321	182	58	1147	250	142

1. FHA annual totals including all units; monthly rate includes 1-4 family.

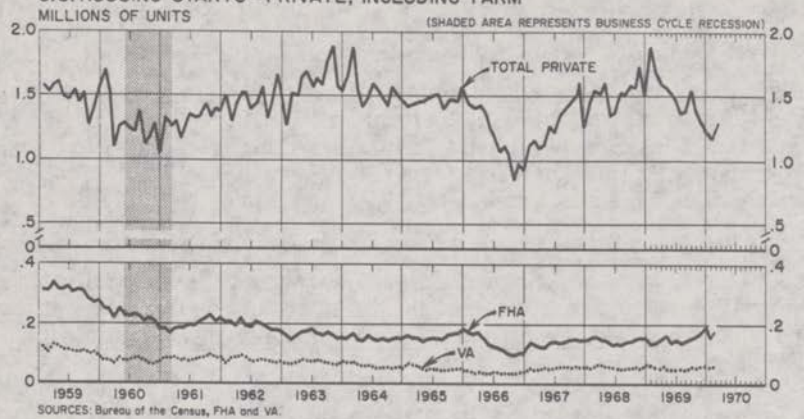
2. Based on 12,000 reporting places 1962-1966 for permits, and 1962 - March, 1968 for starts. Based on 13,000 reporting places from May, 1967 for permits and from April, 1968 for starts.

Source: Department of Commerce, FHA, VA.

March 1970

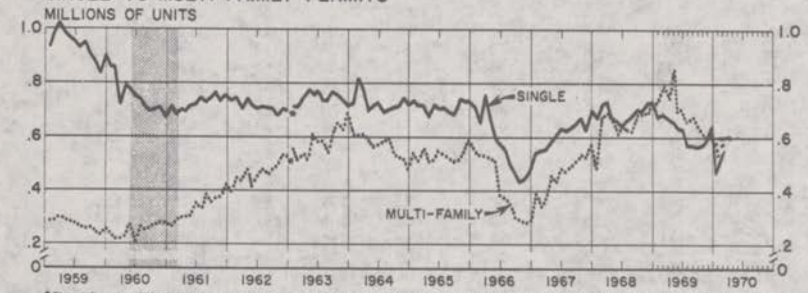
HOUSING TRENDS SEASONALLY ADJUSTED ANNUAL RATES

U.S. HOUSING STARTS - PRIVATE, INCLUDING FARM



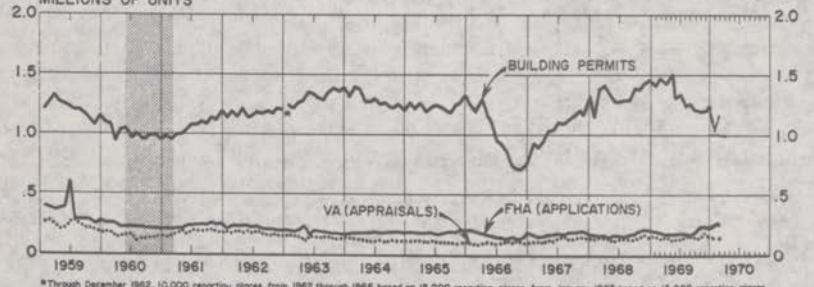
SOURCES: Bureau of the Census, FHA and VA.

SINGLE VS MULTI-FAMILY PERMITS



*Through December 1962, 10,000 reporting places, from 1962 through 1966 based on 12,000 reporting places, from January 1967 based on 13,000 reporting places.
SOURCE: Bureau of the Census.

PROPOSED UNITS



*Through December 1962, 10,000 reporting places, from 1962 through 1966 based on 12,000 reporting places, from January 1967 based on 13,000 reporting places.
SOURCES: Bureau of the Census, FHA and VA.

NAHB - Economics Department

Mr. EVINS. Thank you, Mr. Barba, for your helpful statement. We can appropriate money for housing here and we have done this generously but you know labor costs are up, interest costs are up, materials costs are up, land costs are increasing and homes cost more. What can we do to check this inflationary spiral? What can your association do to help reduce these high costs?

We had testimony here earlier that the big cost increase is in interest.

Mr. BARBA. We have said repeatedly, sir, for the past year, that credit restraints should be used to attack the inflationary cycle. We have said that wage and price controls might be necessary if these restraints fail. We don't feel that the Federal Reserve at any point has aided in reducing interest rates. Their policies have increased interest rates more than any other factor. Fiscal and monetary controls have not been the best devices in which to assist the housing field.

Mr. EVINS. We haven't checked the spiral of inflation and interest rates. What would you recommend? You are opposed to these things but what would you recommend by way of a device to bring it down? What mechanism can be used?

Mr. BARBA. One of the most realistic solutions we see at the moment is for a subsidy applied to the interest rates—that is, a Government subsidy. There are several bills pending now before the Congress relating to those matters and some relaxing of monetary and fiscal restraints by the administration.

Mr. JONAS. You don't solve any long-range problem by piling on another subsidy. That is not a real solution. Can't you give us a better idea than that as to how to get costs down?

Mr. BARBA. Are you talking about interest costs?

Mr. JONAS. I am talking about all costs.

Interest is only one of the problems. Another problem is high labor costs and materials costs.

Mr. BARBA. There is no way, sir, this industry can resolve those labor costs. Unions, in order to keep up with inflation, will come in at the expiration of a contract for a 45 percent increase over a 2 or 3-year period. Their explanation is they are only trying to keep up with the inflationary spiral. There is no way in industries such as ours where we can negotiate on an equal basis, on an equal footing with a union, that can simply withhold all the men from the job and refuse to negotiate or refuse to work.

Now, even though our industry is made up mostly—at least 60 percent—of nonunion labor, those union contract settlements apply whether a fellow is a member of the union or not. He gets the same wage rates.

Mr. JONAS. I have read in recent months of some fantastic settlements the building industry has made with the building trades.

Mr. BARBA. Forty-five percent, sir. They are averaging 45 percent over a 3-year base. I have been hit by it. I started a project last June and before the project actually got underway, their rates contracts came up for renewal in New Jersey and those settlements which were reached by about the middle of July or the end of June sometime called for a 38-percent increase.

Mr. SHIPLEY. What trades?

Mr. BARBA. This applies to the carpenters, mason, plumbers. All the essential building trades. Those contracts are settled on a county-by-

county basis. I must tell you, there is no way that a guy like myself, or an organized industry, can bargain with these fellows. It is a process by which an industry like ours is on an uneven basis.

Mr. EVINS. If you could somehow bring down the cost of building and the cost of homes, you would have more buildings. I think the check and restraint is because of the high cost today in all factors and we haven't found the answer.

Mr. BARBA. Beyond your land cost, beyond your labor costs, you have your material costs. Material costs are rising and have been for the past 2 months. They have started to rise again. The Chicago area has shown a 10-percent increase in material costs in the past 3 weeks. We know lumber costs are going to rise by at least 50 percent before the year is over. Lumber is going to be in short supply. There is a lack of willingness to look into that whole timber supply situation as it applies to the national forests, and the cutting of the timber and the auctioning of the timber—the whole process. Because of lack of attention to that, there is no question the cost of lumber may rise as high as 50 percent. That will mean, in a small house, at least a $600 to $700 increase in this one single item, lumber.

Mr. JONAS. Have you talked to these conservationists and tried to explain to them that bills we have up for consideration would not, as charged, have gutted the national forests?

Mr. BARBA. It would have planted trees in the forests.

Mr. JONAS. We couldn't even get the rule adopted on the House floor because of the powerful lobbying of these conservationist groups who saw red.

Mr. BARBA. It is a part of our legislative program. We understand it will come up later this year.

Mr. JONAS. I wish you could have a committee to meet with these groups and try to resolve some of their objections.

Mr. BARBA. The forest products industry, as well as the homebuilders, have been meeting with them.

Mr. JONAS. Mr. Barba, how do you account for the increase in the adjusted annual rate of starts for February?

Mr. BARBA. We think that is an erratic jump and probably a distortion.

We had our convention in January and at that time the Department of Housing sent down some of its key FHA staff. We had 55,000 people, builders and other people interested in housing, in attendance at that convention. It is the largest convention in the country.

We had 5 days of meetings devoted to housing production and so on. HUD participated, I would say, in about six major areas of those meetings, and that resulted in an increased involvement of the builder in FHA programs. They zeroed in on the 235 and the rent supplement and 236. As a result, when those builders got back home, immediately after the convention, they went to their FHA offices and picked up commitments and started immediately on those programs, and we think this is reflected in that 10-percent increase in housing starts.

Mr. JONAS. Could they get a start underway in that period of time?

Mr. BARBA. Yes.

Mr. JONAS. What do you consider a start?

Mr. BARBA. A start is an actual digging of the hole in the ground. There is quite a difference between a permit and a start. In areas like

North Carolina—well, North Carolina had a bad winter this year, but you take the Southern areas and the Far West—Florida, for instance—builders have gotten into 235 in a big way. I have just made a trip around the country, to Utah, Nevada, Colorado, Indiana, Florida, and I am leaving right from here to go down to New Orleans and from there out to California and I must tell you that these builders have exhausted all their 235's, all their 236's, and they are just sitting idly by. I have received letters, I have had phone calls, I can show you the letters over in my office. This is the only program that is keeping them alive, 235.

Mr. EVINS. Mr. Barba, you tell them the committee said you are a good advocate.

Mr. BARBA. The States are interested in this, also. I have met with the Governors in three of those States. As a matter of fact, the Governors introduced me at the platform and they hope this committee will provide 235 funds.

Mr. EVINS. Thank you very much for appearing.

HOUSING PROGRAMS

WITNESSES

ENEAS J. KANE, PRESIDENT, NATIONAL ASSOCIATION OF HOUSING AND REDEVELOPMENT OFFICIALS
MELVIN J. ADAMS, VICE PRESIDENT FOR RENEWAL, NAHRO
MISS MARY K. NENNO
JOHN D. LANGE

Mr. EVINS. We will call the representatives of the National Association of Housing and Redevelopment Officials, Messrs. Kane, Adams, and Lange, and Miss Nenno.

Mr. Giaimo of Connecticut, a very valued member of this committee, had a prior commitment and wanted us to extend you a warm welcome, Mr. Kane.

Mr. KANE. Chairman Evins and members of the subcommittee, I am Eneas J. Kane, president of the National Association of Housing and Redevelopment Officials and executive director of the housing authority of the city and county of San Francisco. Accompanying me is Melvin J. Adams, vice president for renewal of NAHRO and development administrator of the city of New Haven.

It is a privilege to present this statement on behalf of the members of NAHRO who are the administrators of local housing, renewal, and codes agencies throughout the country. Currently, our membership includes over 1,800 local agencies and 7,000 individuals.

Mr. Chairman, I understand that the subcommittee is hearing testimoney today covering both the supplemental requests of the Department of Housing and Urban Development for fiscal 1970, as well as the appropriations requests for fiscal 1971. We would like to address our statement to both of these requests, with particular emphasis on those programs where our membership has direct responsibility of administration at the local level.

SUPPLEMENTAL REQUEST FOR FISCAL 1970

In terms of the supplemental requests of the administration for fiscal 1970, NAHRO strongly supports the need for additional immediate funding of $25 million each for the section 235 and section 236 housing assistance programs for lower income families; we understand that the available funds for the section 235 program are already gone and those for section 236 are being rapidly exhausted. It is essential, particularly in the early stages of development of these programs, that a momentum be achieved and maintained if we are to have any chance of achieving our national housing goals for lower income families.

In addition, NAHRO firmly believes that the request of the administration for $6.5 million to assist housing authorities in financial distress is clearly inadequate. Since this request was projected in the fall of 1969, the tide of inflation has made the financial situation more critical in additional housing authorities. For this reason, we believe that the supplemental appropriation for fiscal 1970 should be raised to $20 million, so that these funds will be available without delay to assist local housing authorities, based on needs of this fiscal year.

In still a third area—that of urban renewal—we strongly request that this subcommittee add a supplemental appropriation of $587 million for fiscal 1970 to be available until expended. It is our understanding that the current year's appropriation is close to being fully committed. Many local communities throughout the Nation are being turned down in their requests for funding of approved urban renewal projects. This is having a damaging effect on city renewal, as well as being a source of discouragement and despair in neighborhoods that have counted on renewal funds. A supplemental appropriation of $587 million would bring the total appropriation for fiscal 1970 to the full amount of the authorization—$1.587 billion. In addition, we request that the committee recommends the $1.7 billion authorized in the 1969 HUD Act for fiscal year 1971.

APPROPRIATIONS FOR FISCAL 1971

Mr. Chairman, NAHRO strongly supports the requests of the administration in its budget for fiscal 1971—and in particular, the strong emphasis on funding the housing programs for low- and moderate-income families. At the same time, we must candidly point out that this is a "bare-bones, hold-the-line" request, which if allowed to stand, jeopardizes our already constrained capacity to move ahead with needed housing and urban improvement activity. First, NAHRO favors funding of the housing programs for lower income families at the full level of authorization. Only by this action, can a pipeline of activity be created and sustained.

On behalf of NAHRO, I would like to present our recommendations relative to two areas of great concern—where we have direct local responsibility—those of public housing and section 312 rehabilitation loans. Then, I will ask Mr. Adams, our vice president for renewal, to make some recommendations relative to the urban renewal program, which is of such concern to all of us.

Mr. Chairman, there are three items in the public housing appropriations that we would like to bring to your attention. First, in the matter of annual contributions for new housing contracts, you undoubtedly know that the authorization for the current fiscal year is at the point of total commitment. In fact, the backlog of applications is such that even the additional authorization of $150 million available on July 1, 1970, will be more than absorbed in outstanding requests. It is evident that the public housing program can move to the production goals programed for it under the housing goals, if the authorization and appropriations are forthcoming; and if there is a sufficient leadtime to permit a continuing applications and contracting cycle. This means for fiscal 1971, utilizing the current authorization for a level of 106,000 units. The capacity is in the public housing program to reach the level of over 200,000 units projected in the housing goals—if Federal support is available. I might point out, also, that this activity includes a full range of the different methods of assistance now available under the public housing program; conventional, turnkey, and leasing, with all of the options under each of these methods. I am attaching for the record the projected production potential as of February 28, 1970 (exhibit 1). I might also mention that this activity, and the utilization of some of the new methods is not just moving ahead in larger communities. Smaller communities as well are taking advantage of additional public housing opportunities. In larger communities we are the only game in town in many instances. We are the only operation that can produce housing at a price people can afford to rent, that is, low-income people. Smaller communities, as well as large cities are taking advantage of this program.

Recent use of the leasing program in Thompson, Georgia, and the Turnkey III homeownership program in Gulfport, Miss. are especially encouraging. The only thing holding up increased use of leasing in Thompson is lack of available Federal funding; in Gulfport, the homeownership project in public housing was the backbone of community leadership in responding to Hurricane Camille.

We are also pleased that the Administration, for the first time, has requested appropriations under the Tenant Services grants, although only at a level of $5 million. NAHRO believes that this level of funding, particularly in view of the delay in funding this authorization made available in 1968, is inadequate. We recommend the full funding of this authorization at the level of $30 million; this is particularly important since the authorization expires in July, 1971, unless it is utilized. I do not need to tell you of the difficult problems in the management of housing for lower income families. The other day, a local housing authority official from a small town in Alabama told me that their local housing authority had more Federal resources to work with tenants in World War II, than they have today with a far more disadvantaged clientele. These funds would permit local housing authorities to assist and involve tenants themselves in responsibilities connected with their residence in public housing, creating a sound housing environment. This includes counseling in housekeeping and money management, as well as involvement of tenants in management and maintenance responsibilities. This activity is long overdue; we earnestly request that it be funded.

Finally, I would like to address the question of the present fiscal crisis in public housing; and the need to fulfill the commitments of the 1969 Housing Act. Soon after the passage of this act, in December, 1969, I addressed a letter to every local housing authority concerning the new assistance made available for operating and maintenance expenses, and for the reduction of tenant rents (exhibit 2). Briefly, NAHRO saw this as an opportunity to overcome the serious financial situation brought about by rising costs due to inflation. I might add, if you have not seen it, that a report prepared by the Urban Institute in September, 1969, showed in its analysis of costs of 23 representative housing authorities over the past 5 years, that four-fifths of the increase in costs, was due to inflation—the increased cost of on-going functions.

At the same time as inflation was having its most potent impact, many housing authorities have been faced with a changing tenant clientele, able to pay less rent, and requiring new kinds of assistance from housing authorities to achieve an independent status. These two facts have placed a most difficult burden on local housing authorities.

After World War II and World War I we had a kind of clientele who were out of work. We have gradually gone into a type of clientele relying primarily on public assistance. One of our most difficult areas is the single head of the family, generally female, with three or four children who are stuck. In San Francisco alone, for example, we have this situation in the Hunters Point-Western Addition area. Whatever their problem, whatever their lack of education and appetite for living, we know these people didn't come from the south or anywhere else; they were born right there in San Francisco. They are our children and their children are our children. There is a need for attitude conditioning; all of the tenant clientele requires a tremendous, tremendous amount of assistance.

So you say "What do we do?" Do we admit or agree that all the existing public and private agencies that have been with us down through the years have failed in their effort to try to provide social services? We don't take that position, but we do say that we must have within our organization the kind of money that will provide the skills so that the tenants can be led to the service, not just dropped on the front door, not just given a telephone number, but actually put in touch with the service. Or that the tenants service be brought to the tenants. We feel that in this country we will continue to face this kind and character of problem—the kind and character of problem that has been publicized so much. We in NAHRO do not accept the responsibility for all tenant behavior. We do not believe this is public housing management's problem alone. We believe it is the problem of society. We want to do our part, but unless we are given the tools with which to work—social services, tenant services. We have heard about these for years; finally, at long last, we have a minimal appropriation to try to do this thing.

Many of the major cities feel as though the public housing programs in these cities is being abandoned because of the lack of support for services to combat vandalism; and all the rest of these things involved in public housing.

Mr. JONAS. They wouldn't think that if they could see the way the budget has gone up for the past 10 years. It is fantastic. You wouldn't think there was that much money in the world.

Mr. KANE. There is no question about that, but if public housing is a part of our society and if we, administrators, are expected to do the job—inflation has taken care of four-fifths of the increase in the last 10 years—we want a portion of the money to try to assist in doing away with the vandalism that is involved. We see the only outlet for doing it is a tenant services type of activity; not policing alone; not involvment of the tenants in the decisionmaking or veto process, but a kind of management and tenant training.

Mr. JONAS. Now we have some public housing authorities that have been experimenting with this around the country. Could you give us some examples that will show that these experiments have proven that you can improve the conduct of public housing clients by this kind of service?

Mr. KANE. Yes. I can give you San Francisco. I took over as Executive Director of San Francisco 4 years ago. At that time we had sit-ins, sit-downs and all kinds of things going on in San Francisco to the point that housing authority commissioners were held in rooms and weren't allowed to get out.

We have gone out into the community—I and my staff——

Mr. JONAS. What were the complaints?

Mr. KANE. The complaints were the usual complaints that we find around the country; rats, roaches, rent too high, bad schools, the entire gamut. Failure to pick up garbage. Failure to repair broken windows and all that sort of thing.

We went around to the entire group and said, "Now, wait a minute. People make dirt. People break windows, and you are the people. Now, let's get with this thing and let's see where we can go from here."

We have shown some improvement in San Francisco.

From time to time around the country we can point to individual communities where money was utilized out of an operating budget; when we were in bad shape financially, but felt that it was as important to make our people work just that much harder to try to protect the investment of the Government; and to indicate to tenants that these were in fact their homes and that perhaps——

Mr. JONAS. What I am trying to get you to say is that this has brought about an improvement and that your repair costs have gone down and that the vandalism has been reduced, but you haven't said that.

Mr. KANE. No, sir, I cannot say that.

Mr. EVINS. All this has grown up while we have had an increasing amount of public housing and rent supplement programs. The Congress has appropriated and continues to appropriate large sums, but the condition has not improved. We have just continued on down the road with situations getting worse and the Federal Government spending more money.

We have just had reports here that over $44 billion in 1971 is going into the cities for all kinds of programs and a great portion of it is in the housing program.

Mr. JONAS. We are groping for answers. We want you to tell us something that will make us feel a little better. We have been appropriating the money year after year and inaugurating new programs. We started off with public housing and then urban renewal and then rent supplements then sections 235 and 236, model cities. They were going to eradicate all of these conditions but they don't eradicate for some reason.

Mr. KANE. We could go on and on and I could answer those questions but I prefer at this time to continue my statement.

Increased assistance, to meet these circumstances, was authorized in the 1969 housing legislation. The administration has requested only $20 million of this amount, and this largely for reduction of tenant rents to 25 percent of income. This provides no adequate resource to enable local housing authorities to respond to inflationary cost rises, or to make up for delayed maintenance of the physical plants.

NAHRO believes that, in fiscal year 1971, an appropriation of $80 million should be provided for the stated needs; as well as restore reserve funds depleted for emergencies over the past few years. At the same time, let me assure you that NAHRO and local housing authorities are very conscious of their responsibilities to administer public housing in the most efficient and economical way. We are constantly examining our ways of doing business, and will continue to strive for new methods that are more economical and effective. There is too much to be done to waste anybody's money, either that of the Federal Government, the local government, or the tenants.

SECTION 312 REHABILITATION LOANS APPROPRIATIONS: 1971

Section 312 of the Housing Act of 1964 first authorized this program of rehabilitation loans to encourage the renovation and rehabilitation of the existing housing supply, rather than clearance—and in recognition of the fact that new housing construction could not move fast enough to meet housing needs.

This program is an outstanding success. The level of activity is increasing at a regular pace. There is a growing body of skilled local technicians to administer the program; it is extremely popular with neighborhoods in which it has been made available. Further, the record of loan repayment is an outstanding one. However, NAHRO is greatly concerned with what we detect as a slowing down of this program. Because of inadequate funding, the program has run out of funds twice within the past year. Commitments made to local citizens to rehabilitate their properties in declining neighborhoods have had to be postponed because of lack of funds, with consequent dismay and discouragement. Because of fund cutbacks, communities wanting to enter a second round of activity have been discouraged by Federal officials; new communities wishing to participate have been told that the available funding may not be sufficient to reach them. The administration has drastically reduced nonresidential loans in an effort to make inadequate money stretch.

The Administration has requested only $35 million in appropriations for fiscal 1971; even with some funds from loan repayments, this is greatly inadequate for the demand. Experience, reported to NAHRO by local agencies, indicates that this program could achieve the annual rehabilitation level of 21,000 dwelling units projected in the first budget request of 1970. NAHRO recommends that the full level of $84 million, projected in the first budget for 1970 be adopted in the budget for 1971.

A number of local communities are preparing individual case studies of the impact of inadequate 312 funding over the past year on their

rehabilitation operations. These should be available within the next week. We request permission to have them filed for the record, along with the record of loan repayment now included as exhibit 3.

(The case studies follow:)

CITY AND COUNTY OF SAN FRANCISCO,
DEPARTMENT OF PUBLIC WORKS,
April 8, 1970.

Re the 1969 shortage of section 312 loan funds
ENEAS J. KANE,
President, NAHRO, 2600 Virginia Avenue NW.,
Washington, D.C.

DEAR MR. KANE: You requested information concerning the affect of the shortage of section 312 rehabilitation loan funds in 1969 on the section 117 concentrated code enforcement program (FACE) in San Francisco.

The following summarizes our experience in the FACE program:

1. We had two periods of time in which HUD did not have section 312 funds in 1969: between April and August (3½ months) HUD held up 52 of our loans; and between September and December (2½ months) HUD held up 54 FACE loans to rehabilitate property.

2. Contractors were advised before bidding that a delay in funding existed. Some contractors refused to bid under the conditions of an indefinite date, as it made scheduling of their work virtually impossible. We were advised by other general contractors that their subcontractors would not give a firm figure for more than 30 days. Many "courtesy bids" at inflated prices, were submitted because of the uncertainty of when the job might start. These had to be rebid because we did not think the price reasonable. This of course resulted in delay in doing the work and extra staff time to prepare and evaluate bids.

3. When funds were again available approximately 10 percent of the contractors who submitted bids increased them by 5 to 10 percent. We also found that some contractors could not perform as they had reached their bonding capacity with other work in progress. This was due to the large number of jobs that suddenly had to be bid in order to catch up. Many contractors working in FACE are not large enough to run more than one or two jobs at a time, therefore they had to back out.

4. The property owners in most cases were disappointed and inconvenienced by the delay.

The staff spent a good deal of time selling the owners on the FACE program and then found themselves in the awkward position of trying to justify the delay to owners wishing to use Federal loans while at the same time trying to urge owners into getting the work done if they did not want to use Federal loans.

The delays in funding caused a delay in completing the program in the 3 year time alloted. Many cases had to go through the process of rebid which is time consuming and irritating to owners who must again go to the trouble of being available to have contractors and subs go through their building. In addition to the time lost and the added expense of administrating the program due to the loan fund shortage there is also the attendant demoralizing effect on the FACE staff—completely redoing a job that was previously done and done well.

Some owners were difficult to get motivated again as they felt the city was not sincere in wanting to rehabilitate their homes and neighborhood.

5. Another delay in funds will certainly tend to further disillusion owners and contractors with the efficiency in which the FACE program is being administered. I feel many contractors will say, "call us when you have something positive" as they don't have the time to go through the drill of token or meaningless bids.

6. We had one property owner whose first installment taxes were figured in the loan. When the loan was held up he had to scrape up the money to pay the taxes. He was so angry he insisted we refund to him from the loan, the amount of the first installment taxes.

We anticipate a need for $6 million in section 312 loan funds during the next 2 years to complete the present FACE program. If new areas are approved by HUD, additional loan funds will be required. To date 624 section 312 loans valued at $4,311,677, and 215 section 115 grants valued at $405,635.97 have been used in the San Francisco FACE program.

I hope this information will assist you in your testimony before Congress concerning the need for adequate and continuous funding of the section 312 rehabilitation loan funds which constitute a most valuable tool in carrying out the rehabilitation of housing. I am attaching for your information a recent letter to Secretary Romney from the president of a property owners association in one of your FACE areas and a newspaper article concerning the FACE program in San Francisco.

Very truly yours,

ALFRED GOLDBERG,
Superintendent, Bureau of Building Inspection.

Enclosures.

ROSSI PARK AREA PROTECTIVE ASSOCIATION, INC.,
San Francisco, Calif., March 24, 1970.

Hon. GEORGE W. ROMNEY,
Secretary, U.S. Department of Housing and Urban Development,
Washington, D.C.

Re federally assisted code enforcement (FACE) program, Arguello Park District, San Francisco, Calif.

DEAR SECRETARY ROMNEY: As the above program draws to a close, we thought you might like to know how the people who took part feel about it.

It is the opinion of the officers and directors of our association—based on various contacts with the residents—that much more than a majority highly recommend the FACE program; and the few who are unhappy, by and large, do not fault the conduct or the results of the program, but are concerned with principles: whether Government has the right to give away tax money or lend it at low interest to improve private property, etc.

From a practical viewpoint, however, almost everyone in the area seems to agree that FACE does well a job that needs to be done. It has been a kindly, helpful program with almost no hardship. Renters were not required to give up their apartments; or owners, their buildings. And because of the loans and grants, even those people short of money were not inconvenienced.

Our neighborhood now makes a good appearance. Most of the buildings are painted and in excellent condition inside and out; quite a few trees are planted; some overhead utility wires undergrounded, streets and sidewalks repaired; and additional traffic safety devices installed. In San Francisco, worry over fire is great because most buildings are erected side by side to conserve space. That worry in our area is lessened by the knowledge that each building now has adequate wiring to take care of modern electrical appliances without overloading the circuits.

As you undoubtedly know, urban renewal programs, involving total or partial clearance, create great antagonism against the Government. But perhaps you may not be aware that a FACE program has the opposite effect—the creation of a feeling of trust in Government among most of the people involved. For that reason alone, we feel FACE should be used more widely. In our opinion, FACE could be used even in those areas where a certain amount of clearance is desirable, as explained in the footnote below.[1] Also, FACE is less costly than other urban renewal programs, an important factor in these days of high taxes and inflation.

Our neighbors to the west—and also those to the southeast—have been watching our progress, and are now considering similar programs for their areas, to be known respectively as "Arguello Park Extension" and "Upper Haight-Ashbury".

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[1] The reason we feel a FACE program could be used in those areas where some clearance is desirable is this: In the Arguello Park district, building contractors—quite sure the area was soon to be improved—began purchasing rundown structures (presumably because of lower price), clearing the land, and starting new buildings, before the application for FACE was mailed to Washington. After FACE started, this market for rundown structures, gave owners an opportunity to weigh cost and work of code enforcement, plus probable building afterappearance, against the price offered by building contractors. A number chose to sell.

Thus land was cleared and put to better use, but without the bitterness that would have occurred had the change been ordered by Government. A few structures—not rundown, but of unworthy construction such as that in inexpensive beach cottages—were not sold for clearance. These are occupied mostly by elderly people. When the occupants die, undoubtedly the structures will be torn down, and the land used more efficiently. But in the meantime, they are not objectionable.

If this clearance process proves to be a natural byproduct of all FACE programs, we see no reason why FACE cannot be recommended for those areas that would be improved by some clearance.

Should they forward their applications, we hope your Department will see fit to approve them. Community enthusiasm for FACE, does much to insure its success.

We wish to extend our thanks and appreciation for the FACE program your Department made possible for our area.

Respectfully,

ROSSI PARK AREA PROTECTIVE ASSOCIATION, INC.,
PATRICK J. WALSH, *President.*

URBAN RENEWAL APPROPRIATIONS: 1971

Mr. KANE. Now, I would like to ask Mr. Adams, our vice president for renewal, to discuss the urban renewal appropriations for 1971.

Mr. ADAMS. Mr. Chairman, renewal has become a popular program, a local program, a program of government at the grassroots. Renewal, today, is the most effective mechanism any city has for shaping its future, for changing its land uses, for improving its way of life. Whether a city uses it properly or improperly can be questioned, but the continuing on-going need for the renewal process is beyond dispute. We have recent evidences of this support for urban renewal at both the national and local level.

On the national level, the President's Task Force on Urban Renewal, a group of distinguished citizens, fully supported the concept and contributions of the urban renewal in a report submitted in early 1970. While this report has not been made public in full, a rather complete reporting of the findings is contained in an article published in the New York Times; we request your permission to file this report for the record (exhibit 4).

On the local level, and directly demonstrating how the present shortage of renewal funds is hurting cities and neighborhoods throughout the Nation, I would like to discuss urban renewal in New Haven—in the city I know best, where I have been working for the past 11 years with renewal, with people, and with neighborhoods.

One of the reasons for the local popularity of urban renewal in its relationship to low- and moderate-income housing. If New Haven is typical, and in this respect I think it is, the bulk of housing developments for low- and moderate-income families will take place on urban renewal land. In New Haven, since 1958, a total of 2,050 units of housing for low- and moderate-income families have been built or are under construction. Of this amount, 1,427 units were built on urban renewal land.

As still further evidence of local support, I would like to cite the urban renewal experience in a New Haven neighborhood. Newhallville is a New Haven neighborhood of about 9,500 people—7,500 black and 2,000 white. It covers about 350 acres and is a pleasant neighborhood with one- and two-family homes, many badly in need of rehabilitation. Newhallville is by no means a slum, but it is a neighborhood in need of help to stem spreading dilapidation.

Renewal planning has been going on in Newhallville for some time. During the planning stages, the renewal agency project staff met twice a month with the United Newhallville Organization, the neighborhood citizens action group. UNO hashed over plans, bickered about them, formulated new ones. In order to get neighborhood reaction, UNO used surveys, questionnaires and interviews as well as more informal methods. It sponsored a series of public work sessions at which residents worked out details of the plan. The plan went through

many changes and finally it was passed at the two necessary public hearings, with strong support and enthusiasm by the neighborhood's citizens' action group and the neighborhood itself.

As the UNO president said, "This was black people having a say in what would happen in their own communities—not white people telling them what would happen. Nobody marched on city hall. It wasn't necessary."

The neighborhood alderman remarked, "This is a dream come true. The community did what it wanted to do."

It was in October 1968 that the Newhallville plan was submitted to HUD for funding. The citizens, understanding that it would take from 6 to 10 months to receive governmental approval, wanted to accompany the plan to Washington. Said the UNO president, "We asked to go to make sure there would be no deletions or changes in the plan. A plan on a piece of paper doesn't reflect how the people feel about it. The men in HUD don't walk up and down these streets with their children and see it as it is."

A year and a half has gone by since October 1968. A year and a half of empty promises. A year and a half of waiting by people in the neighborhoods to hear that the Federal Government has approved the plan and allocated the funds. A year and a half of waiting by people who have put hundreds of volunteer hours—without pay—into constructively working on a plan to make their neighborhood a better place for them to live.

There are Newhallvilles all over the country, where the momentum and enthusiasm of renewal, once at a high pitch, is slowly ebbing into discouragement and disillusionment; where the curtailment of renewal will be costly—not only in monetary terms, but, more important, in the human terms. For it will represent another in a series of broken promises by government, another frustration for people trying to help themselves. And this, perhaps, symbolizes, in capsule form, the problem that this great country faces in this critical period of our history.

The demands on the urban renewal program are the product of success. This is true whether we are talking about neighborhoods like Newhallville that are waiting for renewal funds to enter the execution stage; communities with projects in the execution stage that require more funds; communities that are waiting to move projects into the planning stage, or communities with neighborhood development programs.

The situation in urban renewal funding is indeed a grave one. It is estimated that at the end of this fiscal year—July 30, 1970—there will be a backlog of over $3 billion in urban renewal demands, after appropriated funds for fiscal 1970 are spent. This affects local communities, of all sizes and in every part of the United States. Many of these localities have proceeded in good faith with approved urban renewal projects, only to find that now when the funds are needed, they are not available. Applications for the neighborhood development program in fiscal 1970 are estimated to total $800 million for over 300 communities. In addition, as you all know, title I urban renewal funds cover more than just urban renewal project activities; they must also cover relocation, code enforcement grants, and demoli-

tion grants. All of these activities have outstripped the available funds.

In this fiscal year of 1970, the situation has been made more acute because the appropriations were held at a level of $1 billion—about $600 million less than the available authorization. We have made a number of special appeals for these appropriations for fiscal 1970; our latest request is in the first part of this testimony. In addition, it is our understanding that the Budget Bureau has not released the fully appropriated funds of $1 billion—that an allocation by the Bureau has been set below this figure.

The situation is made even more difficult because there is no advance authorization for fiscal 1972—in itself essential if we are to have an orderly process of reaching the backlog of $3 billion in accumulated requests. The absence of this advance commitment makes it even more urgent that the additional $587 million be authorized for fiscal 1970, and be available until expended. In addition, we recommend strongly that the full amount of *$1.7 billion for fiscal 1971*, authorized in the 1969 HUD Act, be appropriated for this coming fiscal year.

Mr. Chairman, we greatly appreciate the opportunity to present our views to the subcommittee.

(The exhibit follows:)

EXHIBIT 1

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

PUBLIC HOUSING PERFORMANCE ANALYSIS
PRODUCTION POTENTIAL - AS OF FEBRUARY 28, 1970

REGION	APPLICATIONS APPROVED					AA'S EXECUTED - FISCAL YEAR 1970					
	FY 70 TARGETS	ACTUAL TO DATE	SCHED. TO 6-30-70	ACTUAL PLUS SCHED.	NOT SCHED.	FY 70 TARGETS	ACTUAL TO DATE	SCHED. TO 6-30-70	ACTUAL PLUS SCHED.	NOT SCHED.	SCHED. AFTER FY 70
New York.....	11,700	10,789	1,797	12,586	5,783	18,700	5,127	13,701	18,828	19,094	1,641
Philadelphia.....	10,200	9,759	1,040	10,799	8,243	13,900	5,272	11,247	16,519	16,749	3,048
Atlanta.....	11,400	10,687	4,040	14,727	57,544	19,600	9,679	12,963	22,642	23,980	1,782
Chicago.....	19,200	17,124	.....	17,124	24,443	23,100	10,781	8,198	18,979	28,527	4,588
Fort Worth.....	10,300	9,102	.....	9,102	20,434	15,400	9,963	8,879	18,842	21,531	1,[illegible]
San Francisco.....	12,200	8,200	2,400	10,600	21,993	12,300	7,292	6,777	14,069	2,677	1,659
Puerto Rico.....	5,000	4,669	600	5,269	.....	5,000	4,361	1,367	5,728	3,988	2,847
Totals.....		70,330	9,877	80,207	138,440		52,475	63,132	115,607	116,546	16,724
FY 70 Targets.....	80,000					108,000					

REGION	CONSTRUCTION STARTS						COMPLETED FOR OCCUPANCY					
	FY 70 TARGETS	ACTUAL TO DATE	SCHED. TO 6-30-70	ACTUAL PLUS SCHED.	NOT SCHED.	SCHED. AFTER FY 70	FY 70 TARGETS	ACTUAL TO DATE	SCHED. TO 6-30-70	ACTUAL PLUS SCHED.	NOT SCHED.	SCHED. AFTER FY 70
New York.....	16,400	5,703	8,259	13,962	5,409	1,895	14,600	5,919	7,820	13,739	3,470	6,007
Philadelphia....	15,800	6,537	3,445	9,982	4,343	808	14,400	6,266	3,063	9,329	6,631	8,286
Atlanta.....	22,200	13,880	11,243	25,123	9,428	1,272	15,500	7,168	11,081	18,249	6,237	13,489
Chicago.....	21,300	10,760	4,407	15,167	5,478	192	22,000	14,195	10,250	24,445	4,406	13,720
Fort Worth.....	12,800	8,666	6,550	15,216	4,453	2,024	8,500	7,437	4,669	12,106	3,447	9,882
San Francisco...	9,500	3,671	5,126	8,797	2,293	4,791	14,200	8,455	4,589	13,044	1,970	12,433
Puerto Rico.....	4,000	2,741	3,692	6,433	690	.....	3,800	1,272	1,755	3,027	27	5,056
Totals.....		51,958	42,722	94,680	32,094	10,982		50,712	43,227	93,939	26,188	68,873
FY Targets.....	102,000						93,000					

Publicly Financed Programs Support Division

NAHRO PRESIDENT ENEAS J. KANE'S MESSAGE ON BROOKE AMENDMENT DECEMBER 23, 1969

As NAHRO President, I am sending you this special letter because the Housing and Urban Development Act of 1969, now awaiting the signature of the President, contains in the "Brooke amendment" one of the most important actions in the 32-year history of public housing. This provision affects *every* local housing authority. The means are provided whereby the long-time objectives of the public housing program can be realized, if we have the foresight and tenacity to utilize them.

You have already received a special message from Senator Brooke describing the details of the amendment. NAHRO commends Senator Brooke for his leadership. We are also grateful to the members of the housing subcommittees of the Senate and House Committees on Banking and Currency for their understanding and support. NAHRO worked closely with Senator Brooke and his staff, with the Department of Housing and Urban Development, with the National Tenants Organization, and with the housing subcommittee staffs in bringing this provision to its final form.

Basically, the "Brooke amendment" will provide an additional 75 million dollars in Federal contributions annually for local housing authorities:

1. so that no public housing tenant need pay more than 25 percent of his income for rent;
2. so that local housing authorities can maintain financial solvency;
3. so that "adequate operating and maintenance services and reserve funds" can be achieved and maintained by every local housing authority.

The "Brooke amendment" has been given supporting force by another provision in the 1969 Act that makes it possible to utilize Federal annual contributions for operating and maintenance expenses, as well as debt service.

HUD is proceeding to develop the administrative procedures to implement these new provisions of the 1969 Act and to formulate a request for immediate appropriations to carry them out. NAHRO has been informed by Assistant Secretary Cox that it will have an opportunity to review these proposed policies in draft form—probably sometime before January 10. You can be assured that the officers of NAHRO, its housing divisional committee, and the NAHRO staff will give these proposed policies their careful attention.

It is likely that the first two purposes of the amendment, as cited above, will be implemented first—in the fiscal year now in progress that ends on June 30, 1970. There is, in fact, a requirement in the law that makes mandatory, within 90 days of the enactment of the bill, the provision that no tenant will pay more than 25 percent of his income for rent. The one exception is in the case of welfare tenants, where there are special requirements spelled out in the law.

The Long-term Opportunity

As important as the first two objectives are, the third objective is potentially even more significant. I hope that all local authorities have read in the material sent them by Senator Brooke the concern of the conference committee over "lax management in many housing projects that has led to high operating costs, deterioration of property, and an intolerable environment for the families who live there." There is a particular concern over increases in vandalism and crime, which drive many occupants out of public housing. The conferees also make it clear that tenant responsibility, particularly the protection and care of property, is essential to the achievement of benefits of public housing. While we submit that these conditions, as described, are not typical of most public housing, NAHRO does not take these words lightly. Local housing authorities have long sought the necessary resources to take positive actions against such conditions. We believe that the third goal of the Brooke amendment—that of "adequate operating and maintenance services"—clearly envisions an effective administration that will address itself to such concerns. In a positive way, we believe that the amendment provides, for the first time in the history of the public housing program, the incentive and the resources to fulfill its basic objective: a sound living environment with maximum opportunity for advancement by the low-income family. Local housing authorities are challenged to exercise imagination and leadership in using the resources toward this objective.

The conferees in reporting the housing bill, also directed that a more comprehensive study be made of the future requirements of public housing, with a report

to be submitted to the Congress sometime in 1970. One of the major purposes of this study could well be the establishment of a standard for "adequate operating and maintenance services," including an identification of those operating techniques and services that will produce a sound living environment. The conferees also requested the Secretaries of HUD and the Department of Health, Education, and Welfare to determine the feasibility of a uniform method of setting public housing rents for welfare recipients in all parts of the country.

NAHRO indicates its intent to pursue the objectives of the "Brooke amendment" with force and determination. We pledge ourselves to work cooperatively with all those involved, including HUD and the National Tenants Organization, to achieve this mutual goal. As NAHRO president, I ask the participation and support of every local housing authority.

EXHIBIT 3

312 LOAN REPAYMENT RECORD

Information is available for 9,948 residential loans under the section 312 program, serviced by FNMA, as of February 1970. This portfolio represents about $58.8 million, a substantial proportion of the 312 program.

Of these total loans, only 734 or 7.4 percent were behind in payment; and of this figure, only 117 loans or 1.2 percent were delinquent for 3 months or more. Experience indicates that of those behind in payments less than 3 months, most will make up the payments. In fact, in the entire history of the 312 loan program, only five properties have had to be repossessed due to the default of the borrower.

EXHIBIT 4

PANEL BIDS NIXON CONTINUE EFFORTS IN URBAN RENEWAL—GROUP, SET UP BY PRESIDENT, SAYS PROGRAM COULD CURB POLARIZATION OF SOCIETY—PROPOSALS A SURPRISE—COMMITTEE ASKS OBJECTIVE OF ENDING THE 'SPECTER OF INCREASING APARTHEID'

BY JOHN HERBERS

WASHINGTON, Jan. 31—The President's study group on urban renewal has recommended that the controversial Federal program be continued and used as a major means of halting the "balkanization and polarization of American society."

The panel, appointed by President Nixon last Oct. 17, said that urban renewal should be used to "help exercise the specter of increasing apartheid" by building within the central cities communities that would bring together people of various ethnic and income groups.

"The objective could provide a major rationale for Federal expenditures for urban renewal," the group concluded.

SENT TO WHITE HOUSE

The study of urban renewal is considered particularly significant because high members of the Nixon administration have been displeased with several aspects of the program, including its demands on the Treasury.

The panel's findings and recommendations have gone to the White House, which has not released them. A copy of the report, virtually identical with the one sent to the President, was obtained from other sources.

The 11-member study group, headed by Miles C. Colean of Washington, a consulting economist, was one of several named by President Nixon last year to study and re-evaluate programs developed by the Johnson administration. Their reports are usually not made public but are used within the administration in formulating policy.

FRIENDLIER THAN EXPECTED

Urban interests have been in a turmoil for months. First because of a freeze on funds for the neighborhood development program, an aspect of urban renewal; and, second, because of a recent directive by the Department of Housing and Urban Development that would limit the funds to on-going projects. The freeze was lifted after several months, but neighborhood development is operating on a much smaller scale than envisioned by its Democratic authors.

The report of the study group, therefore, was much friendlier to the program than the urban interests had expected.

Urban renewal, first enacted in 1949, provides Federal funds for cities or other local authorities to buy land in blighted areas, clear it and sell it for new development. Under recent budgets it has been costing about $1-billion a year, with the local governments providing much smaller matching grants in cash or services.

Over the years, the program has fallen into wide disrepute. It has created urban wastelands that have remained year after year before redevelopment began, and it has been crowded into worse slum areas.

Lately, the Government has taken a number of steps to reform it, the latest of which is a provision in the Housing Act of 1969 that requires cities to provide low-income housing units for all those displaced.

Urban renewal remains one of the major resources available for attacking blight in the central cities, the study group said.

One problem with urban renewal, it said, is that there has never been any clear definition in the law or policy as to its objectives, and it has been used for a wide variety of purposes, some of which conflicted with national goals.

AIMS FOUND UNCLEAR

"Put together piece by piece and from year to year since 1949," the report said, "the urban renewal program has followed no clearly defined aim."

The panel recommended a set of objectives for carrying out national goals and policy. One of these was that urban renewal be used to stop racial and economic separation of citizens.

"There is perhaps no greater danger to the future of our democracy than the possibility that the cities as we have known them will be destroyed as the well-to-do and the white concentrate more and more in the suburbs, with the central cities converted into reservations for the black and the poor," the panel said.

"To help exercise the specter of increasing apartheid, the task force is of the opinion that land use subsidies or other aids to suburban communities undertaking low- and middle-income housing could contribute to a healthier dispersion and intermixing of the population by ethnic and income group. Urban renewal, for its part, can make a contribution by retaining and attracting persons of a wide variety of backgrounds to the central cities."

A TREND IS DEPLORED

In this regard, the panel deplored what it called a trend toward restricting urban renewal to providing sites for only low- and moderate-income families. Such a restriction, the members agreed, prevents orderly and rational development of land and tends to intensify racial segregation.

"Instead, the task force recommends that the power of eminent domain and, where necessary, the write-down of land prices be available for any prospective use of land considered to contribute best to the vitality of the community."

The panel also warned against letting the residents of the affected area make the decision as to the use of the land.

"The most satisfactory approach is that of public discussion and hearings before an official body, with the final decision left to the regularly elected members of the local government," the report said.

Another recommendation was elimination of the provision permitting cities to put up services instead of cash as the community's share of the cost.

90–10 RATIO BACKED

"Noncash contributions," the panel said, "have been difficult to assess and have added to the complexity and delay in project initiation and settlement."

A fair formula, the panel said, would be 90 per cent from the Federal Government and 10 per cent from the local jurisdiction.

At the same time, the panel said, "maximum freedom" should be given to the State and local governments to plan and carry out the projects. And, on the Federal level, the panel urged more continuity "so that plans may be made in the confidence that operations will not be subject to repeated interruptions."

Members of the panel, besides Mr. Colean, were:

Seymour Baskin, president of Urban Properties, Inc., Pittsburgh.

Marjorie M. Lawson, Washington Lawyer.

Murray J. Marvin, official of the North Carolina Mutual Life Insurance Company, Durham, N.C.

Ernest H. Miller, President of State Finance Company, Salem, Ore.
Richard F. Muth, professor of economics, Washington University, St. Louis.
Clarke C. Stayman, vice president, First National Bank of Chicago.
George S. Toley, professor of economics, University of Chicago.
Dempsey J. Travis, president, Siratt Mortgage Company, Chicago.
Roger C. Wilkins, president of Travelers Insurance Company, Hartford.
Archibald M. Wandruff, chancellor of the University of Hartford.

Mr. ADAMS. I am going back and wrestle with a city budget from here so I appreciate your problem.

We have housing developments in New Haven—221(d)(3) and 236 underway. These are developments that have low-income families as well as middle-income families. Some of the developments are 4 or 5 years old. It is like another world compared to some of the older conventional public housing projects. We think the answer may well be to mix low-income and moderate-income families in the same development with cooperative ownership, wherein in effect the low- and moderate-income families are making the management decisions. It is just a world of difference. That is the policy we are following in New Haven.

It should give some encouragement—and I think San Francisco has similar examples of projects of this kind. We do think renewal is a very popular program. It is the only process, really, that a city can have to try and change its land use, its physical character. It is the renewal program in New Haven and I'm sure in many other cities that has provided the bulk of the sites for low- and moderate-income housing.

Mr. JONAS. We just had contrary advice earlier today from some other experts who said that it is a mistake, this trend toward mixing, or bringing higher income level people into these programs, that this defeats the purpose of the program, that was intended to take care of only the lowest income people.

Mr. ADAMS. I am sure there are enough experts in the world to answer any question in any way.

Mr. JONAS. You are of the contrary opinion?

Mr. ADAMS. I am definitely of the contrary opinion. I think some of our traditional, older public housing projects, those low-income families who have begun to upgrade their income, like to get out of them and would like to move into the cooperative where every family doesn't have the problems that the very low-income may have.

In fact, some of our co-op families move from the low-income houses. There are a hundred thousand experts in the world, I am sure.

Miss NENNO. I would call the committee's attention to the question of 312 rehabilitation loans. There is a serious situation right now because funding has run out twice within the last year. It has become a popular program in the local communities and has a fine repayment-loan record. I think over its history only five properties have had to be repossessed. We get an impression from the level of funding and also from the requests that have been made, that expansion is being discouraged, new activity in this program.

Mr. EVINS. To the contrary, this committee has felt home ownership is of high priority and it is well to rehabilitate housing rather than tear it down and build new. Those costs may be high, but it seems the committee has long felt that rehabilitating housing would be an effective program.

Miss NENNO. The word I can bring from our local people is that they find it very, very popular and would like to move ahead with it. They are discouraged by the fact that twice within the last year money has run out and they have had to go back and delay pending activity.

Mr. EVINS. Has your association ever encouraged private initiative or do you always just come in for subsidized programs? Can you stimulate some private initiative, private construction?

Mr. KANE. Private enterprise has proven it cannot produce housing for low-income people at a price people can afford to pay.

Mr. EVINS. We had testimony just before yours that there seems to be a trend to keep pushing toward higher income limits because they don't bring the problems that the others bring.

Mr. KANE. Mr. Chairman, I beg to disagree violently with anyone who made that statement. If they are talking about public housing as it is administered by the public housing authorities throughout the United States——

Mr. EVINS. Mr. John C. Williamson, National Association of Real Estate Boards, says there is a push toward taking care of higher income people in the housing programs because they have less problems occur than when you have the low-income people. The Congress declared they should build housing for the low income.

Mr. KANE. I don't know where he gets his figures. I merely refer you to the record of the local housing authorities throughout the United States and specifically in San Francisco where 70 percent of our tenants currently receive all of their income from public assistance. Now, they certainly are the lowest income group of people.

Mr. EVINS. Very good. Perhaps your's is the exception but we have heard of other cases where the authorities want the higher incomes to come in to make it successful.

Miss NENNO. The national average shows an almost steady line for the last 10 years, despite inflation. I think the average income in public housing now is only $2,800 and this is only $400 over that of 8 to 10 years ago.

Mr. EVINS. We are glad to hear this. Mr. Lange, do you have a statement?

Mr. LANGE. The section 312 loan program did build up rapidly and there is an interest displayed by people in upgrading their property. This has increased a good deal. Their interest has run into a roadblock because they have run out of loan funds to be able to accommodate those families who want to participate. Ultimately they are subsidized loans but still in all, they are repayable and will be repaid, so I think it is a worthwhile investment for the Government to assist these people as much as possible to encourage this.

Mr. EVINS. Thank you, Mr. Lange.

WEDNESDAY, APRIL 8, 1970.

NATIONAL SCIENCE FOUNDATION

WITNESS

ROBERT W. MORSE, PRESIDENT, CASE WESTERN RESERVE UNIVERSITY, CLEVELAND, REPRESENTING THE AMERICAN COUNCIL ON EDUCATION

Mr. EVINS. We will call Mr. Robert W. Morse.

You are president of the Case Western Reserve University of Cleveland and you appear here in support of the National Science Foundation.

Mr. MORSE. I appear here in behalf of the American Council on Education in support of the National Science Foundation.

Mr. EVINS. The committee will be pleased to hear you.

Mr. MORSE. Mr. Chairman and members of the subcommittee:

I am Robert W. Morse, president of Case Western Reserve University in Cleveland, Ohio, and a member of the Commission on Federal Relations of the American Council on Education.[1] Speaking for the council, I wish to call the committee's attention to several matters of grave importance to the maintenance of the Nation's scientific strength. Decisions that are being made now will affect that strength for decades into the future.

Beginning in 1950, with the establishment of the National Science Foundation, the Congress, through a series of acts and with the participation of a number of agencies of Government, determined that the future of the country depended on strong and sustained Federal investment in all aspects of basic and applied science and engineering. Two approaches were used: to support excellence in those centers where it had already been achieved, and to help develop it in institutions of promising quality in every region of the country. Success has been so spectacular that I fear it has come to be taken for granted. As a result we are now faced with the strong possibility that the efforts of the past 20 years will be abandoned, as if what we have set in motion could forever roll on its own momentum. The scientific and educational structure on which America's future technical competence depends is in real and desparate jeopardy. And what I refer to is not a distant fear; collapse is already underway.

One cannot "mothball" the scientific and educational enterprise of the Nation and then revitalize it at will a few years from now. Its vitality is based on a vast number of long-range commitments made by all kinds of people—from students choosing careers to trustees and State legislators. This whole network of commitments is now approaching total confusion. Yet it is happening without any clear change in national needs or priority, and the process is rapidly occurring without any public assessment of its consequences.

Before 1950 there were perhaps 10 and certainly no more than 20 universities that might be regarded as great scientific centers, largely

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[1] The American Council on Education is the coordinating agency for higher education in the United States. It includes among its members 1639 colleges and universities and regional and national educational associations.

concentrated in the Northeast and the Far West. Although no two observers would agree on the dividing line between greatness and adequacy, all would agree that we have doubled or tripled the number of great institutions, and that we have, largely through the stimulus of Federal assistance, developed in all parts of the Nation at least 200 institutions capable of making a major contribution to the country's scientific capabilities. How has this been done?

The basic element has, of course, been the Federal investment in scientific research, awarded largely on the basis of project proposals, judged on a competitive basis by panels of scientists; and through fellowships, also awarded competitively. If this had been the only element in the program, however, it is likely that we would have seen an ever-increasing concentration of funds and talent in a small number of institutions.

The second element has been a conscious and deliberate program, funded through several agencies, to encourage more institutions to develop scientific competence, to expand existing doctoral programs, and to establish new ones. This has required a strong commitment to graduate education by almost every State, and the investment of enormous sums of State revenues and private philanthropy along with the Federal dollars, but the challenge has been met.

Perhaps the principal ingredient in starting almost a chain reaction was the assignment to *institutions* of what have variously been called traineeships, fellowships, and training grants. Providing, as they did, a stipend to the student to enable him to devote full time to his studies and a cost of education grant to the institution, they enabled universities to recruit promising graduate students. The presence of this strong core of graduate students in turn made it easier to attract additional capable teachers, who in turn placed the institution in a better position to compete for research funds. As research funds increased, additional graduate students could be supported as research assistants, and this in turn created additional openings for the support of students as teaching assistants.

The success of the entire effort was made possible by the participation of many agencies, each pursuing its own mission, but at the same time contributing to the common goal of building new widely-distributed centers of scientific excellence.

The National Science Foundation, whose fellowships were highly concentrated in a small number of universities, played a major role by establishing first its cooperative fellowship program and then its traineeships. This program has supported in a peak year as many as 5,123 students in 224 institutions in every State in the Union. The budget before this committee calls for no funds for this program, and it is apparently to be ended.

The Office of Education, through the national defense fellowship program, in its peak year, has supported as many as 15,328 students in over 200 institutions in all the States. That number is now down to 8,900, and it is proposed to discontinue the program next year.

The NASA traineeship program supported 3,681 graduate students 3 years ago, and an input that year of 1,335 new fellows. That program has already been terminated, as this committee knows. Similar reductions have taken place in the Public Health Service and the Atomic Energy Commission.

On top of all this there is a sharp reduction in the support of basic research in universities, as various agencies shift their research objectives. The shift required by the Congress in the kinds of reseach supportable by the Department of Defense has its counterpart in other mission agencies. The House Committee on Science and Astronautics estimates the reduction to be approximately $60 million for the coming year.

We would seem to be on the verge of setting off a new chain reaction in reverse with irreversible damage and waste in its wake. As traineeships decline, we will return to a situation in which federally supported students are concentrated in a small number of institutions. These same institutions are likely to be in the best position to compete for the reduced funds available for research. The institutions that for 20 years, and particularly since 1958, we have encouraged to develop a strong graduate capacity will find themselves with fewer graduate students, and almost no funds in the form of cost-of-education allowances, fewer research funds with which to support faculty and graduate assistants, and indeed, because of commitments to their permanent staff, fewer funds with which to support students as teaching assistants. It is no stretch of the truth to suggest that many fine graduate schools and laboratories will soon be ghost towns—well equipped and modern ghost towns built at great expense to the public.

No one agency of the Government and no one committee of Congress can halt this trend by itself. We do believe, however, that the National Science Foundation is the agency where the start should be made and, therefore, that it is your committee, Mr. Chairman, that can take the necessary action.

The House Committee on Science and Astronautics has recognized the problem to which we are addressing ourselves. They have authorized an appropriation of $527.5 million for the National Science Foundation for fiscal year 1971. They would restore $9.5 million to the Foundation budget, so that the traineeship program may be continued. They would also provide an additional $10 million for the support of academic science as a partial offset to the reduction in funding planned by other agencies, such as the Department of Defense and NASA. And they have proposed an increase of $4 million for the college science improvement program that has so greatly strengthened the undergraduate schools educating a large percentage of the future graduate students. We respectfully urge this committee to assist in sustaining the scientific capacity so painfully built across the country by appropriating this increase in funds. The alternative would seem to be to return to an age when a few elite institutions represented our total capacity to forward the Nation's effort to expand the frontiers of scientific knowledge.

We have one other concern, Mr. Chairman, and that relates to the language adopted last year in the Independent Offices Appropriation Act having to do with cost sharing in research. Higher education is unanimous in its conviction that cost sharing should not be mandatory. We hope and believe that the day will come when it will not be. At this particular moment in time, however, we are not seeking to argue that point. What we are seeking is a return to a consistency of approach by all agencies supporting research—a consistency made impossible by the new language adopted last year. I am attaching to my

statement an appendix on this subject to which I urge the committee to devote serious consideration.

I appreciate the opportunity to testify before the subcommittee. We sought this privilege this year for the first time because of our deep conviction that recent trends in Federal appropriations for science and for the training of scientists are generating a serious threat to the future of the country. I shall be happy to try to answer questions or to supply any further information the committee may seek.

(Attachments follow:)

APPENDIX

TESTIMONY OF THE AMERICAN COUNCIL ON EDUCATION, APRIL 8, 1970, MANDATORY COST SHARING

INTRODUCTION

Cost sharing has been required under Federal grants for research projects under a clause that has been consistently phrased in all appropriation bills. This clause reads as follows:

"None of the funds provided herein shall be used to pay any recipient of a grant for the conduct of a research project an amount equal to as much as the entire cost of such project."

This clause was the basis for Bureau of the Budget Circular No. A–74, issued December 13, 1965. While individual agency policies differed somewhat from one another, all were based upon and consistent with Circular A–74 except those of the National Science Foundation. NSF created its own special cost sharing regulation by combining with the legislative requirement its determination that, as a matter of policy, it should pay no more than half of the faculty salaries charged to NSF research grants in the academic year.

The 1970 appropriation act for the Independent Offices and HUD, signed into law November 26, 1969 as Public Law 91–126, contains a substitute cost sharing clause. This reads as follows:

"Section 408. None of the funds provided in this Act may be used for payment, through grants or contracts, to recipients that do not share in the cost of conducting research resulting from proposals for projects not specifically solicited by the Government: Provided, that the extent of cost sharing by the recipient shall reflect the mutuality of interest of the grantee or contractor and the Government in the research."

CONSISTENCY OF REGULATION

Senate Report No. 91–521, dated November 6, 1969 (see appendix), which accompanied this bill, expressed the hope that the new language "will permit the orderly evolution of administrative regulations to incorporate the new principles." In actual practice, however, the new language has the opposite effect. The principles of Circular A–74 have been operating as well as any cost sharing regulation can be expected to do. They still apply to the Department of Health, Education, and Welfare and to the other agencies that remain subject to the earlier clause. The application to the independent offices of a different cost sharing clause creates inconsistency and complication. Circular No. A–74 cannot be revised to accommodate conflicting legislative requirements.

Into decisions relation to cost sharing, the new clause introduces two new factors: mutuality of interest and solicitation by the Government.

MUTUALITY OF INTEREST

To attempt to relate shares of cost to proportions of probable "interest" in research is to place judgment on most insubstantial ground.

The Senate report states that colleges and universities performing research under federal sponsorship are benefiting thereby. The implications, none new to considerations of the Government-university research relationship, are: (1) That colleges and universities are receiving Federal funds for doing what they most want to do anyway; (2) that the benefit to the institution is a measurable element not sufficiently recognized in the establishment of terms of grants and contracts; and (3) that the benefit is something that the institution acquires

as its own—as a possessable, purchasable advantage—rather than a product that the institution contributes to learning or to society.

Impressions such as these seem to surround the "mutuality of interest" matter. Yet there is no reason to pursue rationale too far in any direction. It simply should be asked what weight may be given to the "mutuality of interest" factor. Grants and contracts are agreements, and why is it necessary to point out, where colleges and universities are concerned, that there is mutual benefit? If this were not so, agreements would not exist. And why are educational institutions singled out because they frequently find in Government-sponsored research new opportunities to perform work related to their interests and objections? Benefits and opportunities certainly exist also for noneducational contractors—for aircraft manufacturers, for example—who have their own quite separate and quite valid missions and motives. To place too much weight on the element of "mutuality" is to say that, while the objectives of the profitmaking corporation are easily enough understood, the nonprofit college or university must prove again and again, by confessing its interests and sharing the cost of research, the purity of its nonprofit motives.

SOLICITATION BY THE GOVERNMENT

The decision as to whether a given proposal is or is not solicited by the Government will be a difficult one to make in many cases. Some proposals may originate in an institution because of a request from an agency program director made orally at a technical meeting. Other proposals may arise in response to a formal "request for quotation" that resulted from an unsolicited university suggestion. The important point is not who thought of the idea but recognition of the fact that the Government agency and the institution are cooperating in what the Congress has determined to be a field in the national interest. The suggestion of a research topic that the agency finds will help to fulfill its assigned mission or, in the NSF case, to be worthy of pursuit solely on its scientific merit, is a contribution to that mission. It is hardly a proper basis on which to exact a penalty from the source of the suggestion.

KINDS OF COSTS SHARED

The Senate report states that cost sharing in educational institutions "should generally be related to the amount of faculty salaries associated with the research project." While it is true that faculty salaries are the most commonly used form of cost sharing, there is considerable doubt as to whether this form should be rigidly mandated. All institutions would be further burdened by additional cost sharing, but those in the less populated areas of the country are faced with relatively inflexible teaching salaries. Each new project undertaken by a faculty member requires a corresponding release of instructional time which must then be assumed by another instructor.

The Senate report mentions, as an example, the cost sharing principles of the National Science Foundation. However, as pointed out above, these principles result from an independent NSF policy which became effective simultaneously with the legislative cost sharing requirement but which arose from other considerations. The NSF, as the one agency that makes no use of the results of the research it sponsors, has always considered itself to be in a separate category, in this respect, to the mission-oriented agencies.

In testifying before the Subcommittee on Government Research of the Senate Committee on Government Operations on April 23, 1969, the Director of the National Science Foundation said:

"In considering policies of mandatory cost sharing and of arbitrary ceilings on overhead, which are inextricably related, the Federal Government must recognize that colleges and universities are carrying on research and educational activities that are essential to the welfare of the community, and it must not insist on practices which place unnecessary burdens on the institutions' other academic activities. I believe that both arbitrary cost sharing and arbitrary indirect cost ceilings do place such burdens. Accordingly, I would suggest that cost sharing not be retained as a formalized legal requirement. As I have pointed out, institutions are voluntarily contributing to research costs in total amounts greater than is required of them, and the legal requirement only adds to the administrative burden of both the Government and the recipient institutions without any discernible, significant benefits."

CONCLUSION

Colleges and universities are opposed in principle to the entire concept of mandatory cost sharing. Until such time as the Congress can be convinced that its disadvantages are real and that its alleged benefits are chimerical, it is urged that whatever cost sharing is required be as flexible as possible. Certainly, there should be no further restrictions than those stated in Circular No. A–74, and no requirement that faculty salaries be the required yardstick. And, in the interest of consistency, clarity, and orderly administration, it is strongly recommended that cost sharing, to the extent that it continues to be required, be on the basis of consistent principles for all agencies.

APPENDIX

EXTRACT—SENATE, REPORT NO. 91–521, INDEPENDENT OFFICES AND DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT APPROPRIATION BILL, 1970 (TO ACCOMPANY H.R. 12307), NOVEMBER 6, 1969.

SECTION 408

Section 408 of the bill has been redrafted. The present status of Government policy concerning cost sharing on research projects is confused. The new language in section 408 requires cost sharing on both grants and contracts for the support of research resulting from proposals for projects not specifically solicited by the Government. Cost sharing is currently required on all grants but not contracts, even though these two fiscal instruments are used interchangeably by some Federal agencies.

The new language permits reimbursement of full costs of research projects in those few instances where they are solicited by the Government and supported by a grant instrument, which is not permissible under current bill language. But, general notice issued by an agency for research proposals in a given field is not construed as soliciting proposals.

Most Government support of research results from proposals by institutions for projects not specifically solicited by the Government. It is the view of the committee that research projects resulting from such unsolicited proposals generally benefit the performing organization as well as the sponsoring Government agency. This is reflected by a long history of cost sharing in this type of research by educational institutions, not-for-profit organizations, and industrial research laboratories. The unsolicited proposals usually represent the ideas of a scientist or group of scientists in an institution and therefore are ordinarily closely related to the fundamental long-term objective or function of the performing organization. Thus, in universities, unsolicited research projects and the universities' educational function often overlap or serve similar ends. These characteristics of unsolicited proposals and the resulting research lead naturally to the question of mutuality of interest between the Government and the perofrming educational, industrial, or not-for-profit institution. The new section 408 requires cost sharing on projects resulting from such unsolicited proposals. The extent of sharing by the institution should be related to the benefit accruing to it.

Although different from language appearing in previous bills, the new language is generally consistent with section 305 of Public Law 90–550, and will permit the orderly evolution of administrative regulations to incorporate the new principles. The purpose of any new regulations promulgated as a result of the change in the bill language should be designed to establish equitable and uniform policies among the various governmental agencies insofar as practicable. Such regulations should encourage efficient utilization of our limited governmental resources, promote sound planning and prudent fiscal policies at the performing organizations, and foster mutually beneficial relationships between the performing organizations and the Government.

Kinds of costs shared, as well as the amount of cost sharing, should be a paramount factor in developing such regulations. In educational institutions cost sharing should generally be related to the amount of faculty salaries associated with the research project. The cost sharing principles of the National Science Foundation as outlined in its important notice dated January 24, 1966, provide one example of requirements for this type of cost sharing by educational institutions. For not-for-profit and industrial performers the cost sharing should be re-

lated to the relative benefits of the research to the performer and to the Government.

It is realized that careful consideration must be given in extending the principles of required cost sharing to all unsolicited research projects, especially those with industrial performers. For instance, special circumstances regarding health-related research should be accommodated in any new administrative regulations.

The committee feels that the imposition of a statutory limit on reimbursement of indirect costs is not an equitable or effective mechanism for implementing a policy of cost sharing.

Mr. MORSE. Mr. Chairman, I also speak as a university president. I would like to add some comments from the light of being a university president, as to the issue of the fture of graduate education and the scientific educational basis in this country. I assure you that most of the university presidents have long since given up special pleading or looking for special sympathy from anywhere. I would like to use my own institution as an illustration.

In Cleveland 3 years ago we embarked on a unique step in higher education. We consolidated two major institutions, the Case Institute of Technology, and Western Reserve University. We did it for two reasons: First, because we felt that that part of the Midwest very much could benefit from a major private university of the first magnitude.

Second, we felt that the scientific and technical backbone of Case Institute of Technology combined with the medicine and health sciences, law and engineering, or law and social sciences and so on, of Western Reserve University, were precisely what the future demanded. Both institutions had completed a decade of great growth, both in quality and in activity. To illustrate that, at the beginning of the decade, in 1960, the two institutions awarded 77 Ph. D. degrees. In 1969, a decade later, we awarded 265, or four times as many in 10 years.

I would like to emphasize that this expansion was based not just on Federal support in many ways, but there was an enormous investment by the private public as well. By local industry, by alumni, by a great many other people in the private sector.

Today we are faced with an almost insuperable financial problem. We are running and have run for 2 years an annual operating deficit of $3 million to $4 million out of a $60 million budget. Our total income this year was 2 percent higher than last year, and next year's projection suggests it will be less than 2 percent higher than this year.

During the last year and this year, we are bringing on line in the universities $40 million of new educational and research building in engineering and health sciences. I am not mentioning other buildings, but I am just mentioning these in particular. These buildings were financed by $15 million of Federal funds, but I would emphasize $25 million of private funds as well, and they are going to add $1 million just in maintenance and utilities to the budget next year.

What is a single university trying to do about it? We are cutting expenses wherever we can and I assure you we are in fact eliminating high quality programs which took years to establish.

With respect to graduate students it would appear that next year the fellowship and research support for graduate students available to us will be 60 percent of what it was last year and since we have to

support the students we have, this means a radical cut in input of graduate students to our institution.

In fact, we have debated in the last week as to whether we would, in fact, put on the line a $20 million medical school building in order to see if we could save $200,000 a year in utilities.

I mention these matters only to suggest the disarray that is appearing at a great rate around the country in universities, and I only regret to say I have spoken to so many other university presidents who are reluctant to talk about it because they have spent a decade boasting about their successes.

The impact of rapid changes in funding and policies, force at the local level consequences and decisions that are really far more damaging than people see when they are introduced, or can imagine they are.

Mr. EVINS. The picture is not as dire as you would make it. You are a good advocate. You make a strong appeal, Mr. Morse.

Mr. MORSE. It all depends on where you sit.

Mr. EVINS. You have made a good statement. You appear in support of the full funding of the budget of the National Science Foundation in all their programs.

Mr. MORSE. For the authorization; yes, sir.

Mr. EVINS. You spoke of the cutback at the graduate level and this is a decision that has been made in the Foundation. This committee has urged funds in the summer seminar programs for teachers and the Science Foundation wants to cut that program back. What is your view with respect to that?

Mr. MORSE. This is primarily for high school teachers and I have participated in such programs myself and I think they are valuable programs.

Mr. EVINS. Any further questions, gentlemen?

Mr. JONAS. No questions.

Mr. EVINS. We thank you very much for your testimony and we thank you for appearing.

WEDNESDAY, APRIL 8, 1970.

HOUSING PROGRAMS

WITNESS

REV. LOYAL H. VICKERS, EXECUTIVE DIRECTOR, COUNCIL OF CHURCHES, RIVERSIDE AND SAN BERNARDINO COUNTIES, CALIF.

Mr. EVINS. The committee will hear Rev. Loyal H. Vickers, executive director, Council of Churches, Riverside and San Bernardino Counties, Calif.

Reverend Vickers you appear here regarding HUD financing.

Reverend VICKERS. That is right.

Mr. EVINS. Are you for cutting the budget, sustaining the budget, or increasing the budget?

Reverend VICKERS. I am for getting all the money for housing that you can possibly let us have.

Mr. EVINS. That is a good statement. You are supporting the budget. We will be pleased to hear you.

Reverend VICKERS. Sir, and gentlemen, I am not going to read this statement that you have in your hand.

Mr. EVINS. If you will highlight it for the committee, we would appreciate it.

Reverend VICKERS. What I am interested in is interpreting to you our experience because we have been in it two and a half years under the multiple dwelling sections of the act. We found it to be an exciting experience for many reasons.

What I tried to picture here for you are some of the experiences we have had in furnishing housing-plus, we call it, for the people. I do not know whether you know it or not, but we were the first religious organization to sponsor these projects under 221(d)(3).

There was one preceded us sponsored by the Carpenters Union in Albuquerque, N. Mex. We have had people in our project in Colton now for two and a half years. In that period of time we have seen people's lives change from one of discouragement and despondency into a life of hope and encouragement, largely due to the fact that along with furnishing housing, we have furnished programs that they desired—and we know they desired it because the first thing we did, we formed a community council which we consulted with and they advised us on the kind of activities that we as management and sponsors provided for them. The housing made it possible because we were able to get them together in a relatively small area, thus providing these programs.

Mr. EVINS. How large is the project sponsored by your church?

Reverend VICKERS. This particular project has 129 units in it. We have a breakdown in the back that gives you the cross-section of ethnic and cultural groups.

We have another one of 100 units about 100 miles away, Cochilla, down near Palm Springs. That is our second project.

We opened one just about 3 months ago in Riverside with 150 units in it.

We have had the same kind of experiences there. We have the smallest rent deficit of any apartment house in the whole area, regardless of the kind of people that live there. We have less than one-half of 1 percent deficit. We have 100 percent occupancy at all times.

We have a large waiting list. We have at good mixture of ethnic and cultural groups. We have one of the finest apartment complexes in the area. The people respond. Many of them have said to me that they want us to express their appreciation to you people for what Congress has done for them.

Also, on behalf of the people who have sponsored it, we want to say thank you, too. We are particularly appreciative of the Federal Housing Administration and the kind of cooperation they have given us in pointing us with directions and giving us help and assistance. All we need is a little more money. That is why I am here today.

If you have any questions.

Mr. EVINS. We want to thank you for your testimony. This committee likes to hear success programs where the program has succeeded and is doing well. This is a fine example of success in housing, bringing housing to those in need.

Your church is to be commended for your work.

Reverend VICKERS. We have enjoyed doing it and it has been a real privilege.

Mr. EVINS. You want to expand and do more?

Reverend VICKERS. Yes. One of the big problems in relation to this is the fact that we have to get contractors, engineers, architects, and the sponsoring groups involved financially. It costs us money, a great deal of money before we even find out whether we are going to be funded or not. Then we get these people to do this and they are not funded and it is a tragic situation for us. It is costing lots of people lots of money with no chance for reward.

Our suggestion is that there be some way found whereby we who are in the planning end of it can find a way whereby we can make our plans so we do not get frustrated.

Mr. EVINS. Any questions?

Mr. SHIPLEY. I want to congratulate you and commend you for the job you are doing. I just wish we had more of it.

Mr. EVINS. Thank you for being here, Reverend.

(Prepared statement follows:)

Honorable Gentlemen, I am the Reverend Loyal H. Vickers, executive director of the Riverside-San Bernardino Counties Council of Churches of California. My address is 3746 Elizabeth Street; Riverside, Calif.

I want to congratulate you for the imagination and creativeness you have shown in passing legislation which provides better housing for the disadvantaged in our country. I am here today to tell you about our experience with two of these programs—which you have made possible. We, in the business, know them as the 221(d)(3) Rent Supplement or the 221(d)(3) Below Market Interest Rate, and the other is the 236 Rent Subsidy and Interest Subsidy.

Our Council of Churches has now been involved in housing for the past two and a half years. We now own 379 units; manage 250 more; and have in the process of development, another 2,000 for other church groups and nonprofit organizations throughout California. There are other variations to these housing programs, through the Housing Authority and other designated numbers; but I have had experience in the 221(d)(3) Below Market Interest Rate Rent Supplement, and now, the 236 (which includes rent supplement and interest supplement). I want to report to you, that I think these programs are most commendable—as are the others.

Most of these disadvantaged people (or many of them), with whom we work, are people who have been left behind because of the change in the industrial and agricultural world in which they live. No longer is there a need for great numbers of cotton pickers; or stoop labor; for lettuce, cantaloupe and watermelon are now harvested by machine. Where it took twenty men to harvest a crop, now two or three can do it. Multiply that by the thousands of farms in the nation and it reduces the work for the common laborer; the man who doesn't have an education or a skill—the builder no longer needs a ditch digger, nor does the factory use unskilled workers in large numbers. It all adds up to an unhappy situation existing in America; where millions of people are terribly unhappy, hungry, and because of circumstances beyond their control, are now deprived of the advantages most of us enjoy.

The majority of the poor in our part of the country are people with handicaps or educational limitations. They did not have an opportunity to learn trades or skills—nor do they now.

They are stranded. They live miserably. If they are not on welfare, they have a very limited income—far below what is necessary to stay out of the poverty area (as defined by our Government), and the only way they can exist is by living in cheap housing, not eating properly, and using cast-off clothing. And some of the houses and places they live in are terrible; and not so cheap. Some of these dwellings have been abandoned by the cows, goats and chickens. Many of these places are not fit for animals and I'm not exaggerating! It is serious and tragic.

Since we started our housing projects, we have, literally, moved people out of old sheds without floors, chicken houses, goat sheds, and barns. We've moved them out of pig pens and homes where 12, 15, and as many as 20 people live

in a one-bedroom house or apartment. Don't ask me how they do it, they just do it. Often, they are without a bath or toilet, and one water spigot to a half a dozen homes.

I know these people are grateful for the housing we now supply. They can't write you, or come to see you as I am doing today; but many of them have said to me "Mr. Vickers, whoever it is that is resonsible for this—would you say thank you?" And they are appreciative. Sometimes, they don't act as if they are and some don't know how to show their gratitude, but most of them do express their appreciation. And on their behalf, I want to thank you and the rest of the Congress.

I want to tell you about the little girl who was raised in a church, went to Sunday school, had good parents who were well-meaning. Then she met a boy. This boy and girl didn't intend to be bad, but they fell deeply in love (or thought they had), and got a little too friendly. The first think you know, the girl was pregnant. And finally, she had to tell her parents. And they, in chagrin and shame, didn't know any better and they kicked her out of the home. She had only one place to go. That was welfare. So she went to welfare. She had her baby. And sometimes she wanted to put it up for adoption and other times she wanted to keep her baby. Maybe it was unwise, but you can't blame her, and she finally decided to keep her baby. She tried to establish a home. About the time she thought she was getting along, some rascal came along and said "honey, I'm in love with you, but I have to get a divorce from my wife before I can marry you. We are already separated and we are not living together, until my divorce is final, why don't we just move in together?

This is a story that has been told over and over by some of the girls living in our homes. Of course, the fellow doesn't intend to marry the girl in the first place. but he moves in. She is grasping at straws. She knows it isn't right; she knows she shouldn't; but she thinks maybe this is the answer to her problem. Hopefully, it will work out, but 99% of the time, it doesn't. About the time the girl gets pregnant again, this guy moves on and looks for new prey. So often this kind of situation (or a similar one), is reported throughout America. It's the other world that exists side by side all over our Nation—yes, and right here in Washington.

To take these people out of a slum and put them in a new home with training, social, health, and cultural opportunities provided (such as we have in our homes), makes all the difference in the world.

And these are some of the kinds of people who live in these homes. There are many other circumstances contributing adversely to the lives of these unfortunate people. Not all our residents are like this, but the story serves as reminder of what is happening to many of the families with whom we come in contact.

There are people who've never lived in a place with a stove and refrigerator. Some have never lived in a place with water coolers or air-conditioning. And believe me, in some parts of California, we really need cooling. The temperature rises to 120° and higher in some parts of California.

There are thrilling things that happen. Not long ago, a lady came to me and said, "Mr. Vickers, I've found a good man, and he is going to marry me. He is going to take the children and me to Los Angeles, where he works. And the reason I found this good man is because I have a better home and I don't have to take him to a shack or slum. Now I am happy and feel secure again. I found a good man who loves me and my children." This kind of thing has been said time and time again.

I am happy to report to you that the housing in itself has been most significant and helpful. However, because we have people in sufficiently large numbers, and in close proximity to each other, we are able to use our facilities to provide many services not otherwise possible, such as:

1. Health programs.
2. Job training programs.
3. Tutoring for elementary through high school.
4. Headstart.
5. Nursery schools.
6. Cultural classes.
7. Counseling sessions.
8. Family planning for those desiring it (and most do).

We are able to do all of this because our churches, synagogues, public and private agencies on all levels are so willing to cooperate and help.

Through the cooperation of the people in HUD and the department heads (particularly those with FHA), we have been able to pioneer in these fields of endeavor and they have proved to be successful.

So I'm making a plea to you today to consider seriously and favorably, programs of Housing and Urban Renewal—the building of homes, and developing of programs for the poor which will be creative, constructive and redemptive. I believe that housing is a very important ingredient, but it isn't the sole answer. Provision must be made so that nonprofit public and private agencies can provide the programs that will make it possible for these people to improve their lives and become content and happy and with more opportunity for their children.

I am convinced that the kind of partnership between private enterprise, government, and nonprofit organizations, made possible by the Housing Acts of 1965 and 1968, are the ideal way of accomplishing a better life for underprivileged persons.

This idea fits into the tradition of our basic philosophy in America and can accomplish the most, with the least possible tax dollars; in addition to bringing the private sector of our nation into a meaningful and significant partnership in solving one of our most pressing problems.

We need additional funds badly. And hopefully, we will have much larger amounts during the next years. We, in California and Arizona alone, have 20 projects as yet unfunded and very badly needed.

Inadequate funding is so frustrating and costly. The purchase of land and planning takes time, and costs money. After an application is denied, because of lack of funds, many will never try again, and the money and time spent is wasted. I would suggest $50 million more right now, $3 billion for the next 5 years, and $1 billion for the next year so we can plan and proceed now. The nonprofit sponsor needs more assistance on a loan basis, now known as the 106 funds.

Soon after sponsoring our first project, we discovered some fundamental attitudes had to be established. They were (in order of importance), as follows:

1. The people must come first.
2. The buildings next.
3. Better housing and surroundings alone, would not in themself, change people's lives much.
4. With intelligence, patience, love, and concern; yet with firmness, we could help people rise above the situation in which we found them.

We have accomplished our objectives. They are:

1. People, growth and development.
2. Good housing and surroundings.
3. New hope and prospects for the disadvantaged.

By:

1. Letting the people know that management cares about them.
2. Making sure they pay their rent.
3. Insisting they take care of their apartment properly.
4. Making sure the buildings, grounds, shrubbery, and grass are always in first class condition.
5. Providing all the opportunities for self-improvement possible. The people and God take care of the rest.

Thank you for giving me this opportunity to say "thank you" and report briefly about our objectives * * * and a little of what we are doing. I want to urge you to put high priority now on eliminating some of the damaging effects of poverty.

I have with me some pictures of some of our projects and manuals of operation which I am happy to leave with you. I would be happy to answer any questions about what we are doing if you should have some.

LOYAL H. VICKERS,
Executive Director.

COLTON COMMUNITY HOMES

TENANT REPORT, MARCH 31, 1970

129 Apartments.
2 Vacancies (one used for office).
92 Applications on waiting list.
46 Approved but did not move in.
4 Deceased.
4 Full rent tenant report.
22 Men.
126 Women.
148 Adults.
284 Children.
432 Total.

* * * * * * *

106 Receiving welfare.
8 Receiving social security.
12 Other.
16 Employed.
10 Qualified by age.
22 Qualified by physical disability.
90 Qualified by substandard housing or overcrowded.
40 Negro families.
39 Mexican-American families.
47 Caucasian families.

COACHELLA COMMUNITY HOMES

TENANT REPORT, MARCH 31, 1970

100 Apartments.
3 Vacancies (one used for office, two burned out apartments).
52 Men.
93 Women.
232 Children.
377 Total.

* * * * * * *

62 Receiving welfare.
7 Receiving social security.
3 Other.
24 Employed.
8 Qualified by age.
17 Qualified by physical disability.
71 Qualified by substandard housing or overcrowded.
69 Mexican families.
15 Negro families.
12 Caucasion families.

RIVERSIDE COMMUNITY HOMES

TENANT REPORT, MARCH 31, 1970

150 Apartments.
3 Vacancies (one used for clinic).
7 Applications in Los Angeles.
6 Full rent tenants.
49 Applications on waiting list.
56 Have been approved but have not taken apartments.
179 Adults.
344 Children.
644 Total.

* * * * * * *

127 Tenants receiving welfare.
13 Tenants receiving social security.
12 Tenants on pension.
16 Tenants employed.
14 Qualified by age.
25 Qualified by physical disability.
101 Qualified by substandard housing or overcrowded.
66 Negro families.
37 Mexican and Mexican American families.
39 Caucasion families.

COLTON COMMUNITY HOMES

	SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
1ST WEEK		8:30 – 1:00 P.M. HEAD START 3:30 – 5:00 P.M. GIRLS' CLUB 7:00 P.M. CLINIC (COMMUNITY CENTER)	8:30 – 1:00 P.M. HEAD START 6:00 – 8:00 P.M. BOYS' BAND PRACTICE	8:30 – 1:00 P.M. HEAD START 8:30 A.M. WELL BABY CLINIC (ALL DAY) 6:30 – 7:30 P.M. TUTORING (COMMUNITY CENTER) 8:00 P.M. WELFARE RIGHTS	8:30 – 1:00 P.M. HEAD START 7:30 P.M. COMMUNITY COUNCIL	8:30 – 1:00 P.M. HEAD START 1:00 – 2:30 P.M. SEWING CLASS 6:00 – 8:00 P.M. BOYS' BAND PRACTICE	
2ND WEEK		8:30 – 1:00 P.M. HEAD START 3:30 – 5:00 P.M. GIRLS' CLUB 7:00 P.M. CLINIC (COMMUNITY CENTER)	8:30 – 1:00 P.M. HEAD START 1:30 P.M. COMMODITY FOOD DEMONSTRATION 6:00 – 8:00 P.M. BOYS' BAND PRACTICE	8:30 – 1:00 P.M. HEAD START 1:00 – 2:30 P.M. PARENT-CHILD STUDY 6:30 – 7:30 P.M. TUTORING	8:30 – 1:00 P.M. HEAD START	8:00 – 12:00 NOON FAMILY PLANNING 8:30 – 1:00 P.M. HEAD START 1:00 – 2:30 P.M. SEWING CLASS 6:00 – 8:00 P.M. BOYS' BAND PRACTICE	
3RD WEEK		8:30 – 1:00 P.M. HEAD START 3:30 – 5:00 P.M. GIRLS CLUB 7:00 P.M. CLINIC (COMMUNITY CENTER)	8:30 – 1:00 P.M. HEAD START 6:00 – 8:00 P.M. BOYS' BAND PRACTICE	8:30 – 1:00 P.M. HEAD START 1:00 – 2:30 P.M. PARENT-CHILD STUDY 6:30 – 7:30 P.M. TUTORING	8:30 – 1:00 P.M. HEAD START	8:30 – 1:00 P.M. HEAD START 1:00 – 2:30 P.M. SEWING CLASS 6:00 – 8:00 P.M. BOYS BAND PRACTICE	
4TH WEEK		8:30 – 1:00 P.M. HEAD START 3:30 – 5:00 P.M. GIRLS' CLUB 7:00 P.M. CLINIC (COMMUNITY CENTER	8:30 – 1:00 P.M. HEAD START 1:30 P.M. COMMODITY FOOD DEMONSTRATION 6:00 – 8:00 P.M. BOYS' BAND PRACTICE	8:30 – 1:00 P.M. HEAD START 1:00 – 2:30 P.M. PARENT-CHILD STUDY 6:30 – 7:30 P.M. TUTORING	8:30 – 1:00 P.M. HEAD START	8:30 – 1:00 P.M. HEAD START 1:00 – 2:30 P.M. SEWING CLASS 6:00 – 8:00 P.M. BOYS BAND PRACTICE	
5TH WEEK		8:30 – 1:00 P.M. HEAD START 3:30 – 5:00 P.M. GIRLS' CLUB 7:00 P.M. CLINIC (COMMUNITY CENTER)	8:30 – 1:00 P.M. HEAD START 6:00 – 8:00 P.M. BOY'S BAND PRACTICE	8:30 – 1:00 P.M. HEAD START 1:00 – 2:30 P.M. PARENT-CHILD STUDY 6:30 – 7:30 P.M. TUTORING	8:30 – 1:00 P.M. HEAD START	8:30 – 1:00 P.M. HEAD START 1:00 – 2:30 P.M. SEWING CLASS 6:00 – 8:00 P.M. BOYS' BAND PRACTICE	

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COACHELLA COMMUNITY HOMES

	SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
1ST WEEK		2:00 - 4:00 P.M. ENGLISH CLASSES 7:00 - 9:00 P.M. SEWING CLASS (RECREATION ROOM) 7:00 - 9:00 P.M. PREPARATION FOR CITIZENSHIP (OFFICE)	2:00 - 4:00 P.M. CRAFT CLASS 3:30 - 5:00 P.M. CUB SCOUTS 7:00 - 9:00 P.M. WEBELOS BOY SCOUTS	ALL DAY: - WELFARE COUNSELLING 4:00 - 6:00 P.M. CAMP FIRE GIRLS (THREE GROUPS)	2:00 - 4:00 P.M. ENGLISH CLASSES 7:00 - 9:00 P.M. SEWING CLASS (RECREATION ROOM) 7:00 - 9:00 P.M. PREPARATION FOR CITIZENSHIP (OFFICE)	2:00 - 4:00 P.M. GOLDEN AGERS 9:30 - 12:00 NOON PUBLIC HEALTH: PRE-NATAL, CHILD CARE, NUTRITION	7:00 - 11:00 P.M. TEEN CANTEEN
2ND WEEK		2:00 - 4:00 P.M. ENGLISH CLASSES 7:00 - 9:00 P.M. SEWING CLASS (RECREATION ROOM) 7:00 - 9:00 P.M. PREPARATION FOR CITIZENSHIP (OFFICE)	2:00 - 4:00 P.M. CRAFT CLASSES 3:30 - 5:00 P.M. CUB SCOUTS 7:00 - 9:00 P.M. WEBELOS BOY SCOUTS	ALL DAY: WELFARE COUNSELLING 4:00 - 6:00 P.M. CAMP FIRE GIRLS (THREE GROUPS)	2:00 - 4:00 P.M. ENGLISH CLASSES 7:00 - 9:00 P.M. SEWING CLASS (RECREATION ROOM) 7:00 - 9:00 P.M. PREPARATION FOR CITIZENSHIP (OFFICE)	9:30 - 12:00 NOON PUBLIC HEALTH: PRE-NATAL, CHILD CARE, NUTRITION 2:00 - 4:00 P.M. GOLDEN AGERS	7:00 - 11:00 P.M. TEEN CANTEEN
3RD WEEK		2:00 - 4:00 P.M. ENGLISH CLASSES 7:00 - 9:00 P.M. SEWING CLASS (RECREATION ROOM) 7:00 - 9:00 P.M. PREPARATION FOR CITIZENSHIP (OFFICE)	2:00 - 4:00 P.M. CRAFT CLASSES 3:30 - 5:00 P.M. CUB SCOUTS 7:00 - 9:00 P.M. WEBELOS BOY SCOUTS	ALL DAY: WELFARE COUNSELLING 1:00 - 2:30 P.M. WELL BABY CLINIC 4:00 - 6:00 P.M. CAMP FIRE GIRLS (THREE GROUPS)	2:00 - 4:00 P.M. ENGLISH CLASSES 7:00 - 9:00 P.M. SEWING CLASS (RECREATION ROOM) 7:00 - 9:00 P.M. PREPARATION FOR CITIZENSHIP (OFFICE)	9:30 - 12:00 NOON PUBLIC HEALTH: PRE-NATAL, CHILD CARE, NUTRITION 2:00 - 4:00 P.M. GOLDEN AGERS	7:00 - 11:00 P.M. TEEN CANTEEN
4TH WEEK		2:00 - 4:00 P.M. ENGLISH CLASSES 7:00 - 9:00 P.M. SEWING CLASS (RECREATION ROOM) 7:00 - 9:00 P.M. PREPARATION FOR CITIZENSHIP (OFFICE)	2:00 - 4:00 P.M. CRAFT CLASSES 3:30 - 5:00 P.M. CUB SCOUTS 7:00 - 9:00 P.M. WEBELOS BOY SCOUTS	ALL DAY: WELFARE COUNSELLING 4:00 - 6:00 P.M. CAMP FIRE GIRLS (THREE GROUPS)	2:00 - 4:00 P.M. ENGLISH CLASSES 7:00 - 9:00 P.M. SEWING CLASSES (RECREATION ROOM) 7:00 - 9:00 P.M. PREPARATION FOR CITIZENSHIP (OFFICE)	9:30 - 12:00 NOON PUBLIC HEALTH: PRE-NATAL, CHILD CARE, NUTRITION 2:00 - 4:00 P.M. GOLDEN AGERS	7:00 - 11:00 P.M. TEEN CANTEEN
5TH WEEK		2:00 - 4:00 P.M. ENGLISH CLASSES 7:00 - 9:00 P.M. SEWING CLASS (RECREATION ROOM) 7:00 - 9:00 P.M. PREPARATION FOR CITIZENSHIP (OFFICE)	2:00 - 4:00 P.M. CRAFT CLASSES 3:30 - 5:00 P.M. CUB SCOUTS 7:00 - 9:00 P.M. WEBELOS BOY SCOUTS	ALL DAY: WELFARE COUNSELLING 4:00 - 6:00 P.M. CAMP FIRE GIRLS (THREE GROUPS)	2:00 - 4:00 P.M. ENGLISH CLASSES 7:00 - 9:00 P.M. SEWING CLASSES (RECREATION ROOM) 7:00 - 9:00 P.M. PREPARATION FOR CITIZENSHIP (OFFICE)	9:30 - 12:00 NOON PUBLIC HEALTH: PRE-NATAL, CHILD CARE, NUTRITION 2:00 - 4:00 P.M. GOLDEN AGERS	7:00 - 11:00 P.M. TEEN CANTEEN 00-4-3-70

RIVERSIDE COMMUNITY HOMES

	SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
1ST WEEK		4:00-6:00 P.M. BLUE BIRD MEETING 6:00-7:30 P.M. STUDY HALL	9:00-11:30 A.M. HEAD START MOTHERS 3:30-5:00 P.M. SEWING CLASS (GIRLS) 4:00-6:00 P.M. ARTS AND CRAFTS CLASS 6:00-7:30 P.M. STUDY HALL	10:00-12:00 NOON HOMEMAKERS CLUB 6:00-7:30 P.M. STUDY HALL 7:30-9:30 P.M. HEAD START BOARD	10:00-11:00 A.M. NUTRITION CLASS 3:00-6:00 P.M. BOYS RECREATION (AGES 6-12)	4:00-6:00 P.M. ARTS AND CRAFTS	
2ND WEEK		4:00-6:00 P.M. BLUE BIRD MEETING 6:00-7:30 P.M. STUDY HALL	9:00-11:30 A.M. HEAD START MOTHERS 3:30-5:00 P.M. SEWING CLASS (GIRLS) 4:00-6:00 P.M. ARTS AND CRAFTS 6:00-7:30 P.M. STUDY HALL	10:00-12:00 NOON HOMEMAKERS CLUB 6:00-7:30 P.M. STUDY HALL	10:00-11:00 A.M. NUTRITION CLASS 3:30-6:00 P.M. BOYS RECREATION (AGES 6-12)	4:00-6:00 P.M. ARTS AND CRAFTS	12:00 NOON YOUTH BOARD MEETING
3RD WEEK		4:00-6:00 P.M. BLUE BIRD MEETING 6:00-7:30 P.M. STUDY HALL	1:00 P.M. COMMUNITY COUNCIL MEETING 9:00-11:30 A.M. HEAD START MOTHERS 3:30-5:00 P.M. SEWING CLASS (GIRLS) 4:00-6:00 P.M. ARTS AND CRAFTS 6:00-7:30 P.M. STUDY HALL	10:00-12:00 NOON HOMEMAKERS CLUB 6:00-7:30 P.M. STUDY HALL	10:00-11:00 A.M. NUTRITION CLASS 3:30-6:00 P.M. BOYS RECREATION (AGES 6-12)	4:00-6:00 P.M. ARTS AND CRAFTS	
4TH WEEK		4:00-6:00 P.M. BLUE BIRD MEETING 6:00-7:30 P.M. STUDY HALL	9:00-11:30 A.M. HEAD START MOTHERS 3:30-5:00 P.M. SEWING CLASS (GIRLS) 4:00-6:00 P.M. ARTS AND CRAFTS 6:00-7:30 P.M. STUDY HALL	10:00-12:00 NOON HOMEMAKERS CLUB 6:00-7:30 P.M. STUDY HALL	10:00-11:00 A.M. NUTRITION CLASS 3:30-6:00 P.M. BOYS RECREATION (AGES 6-12)	4:00-6:00 P.M. ARTS AND CRAFTS	12:00 NOON YOUTH BOARD MEETING
5TH WEEK		4:00-6:00 P.M. BLUE BIRD MEETING 6:00-7:30 P.M. STUDY HALL	9:00-11:30 A.M. HEAD START MOTHERS 3:30-5:00 P.M. SEWING CLASS (GIRLS) 4:00-6:00 P.M. ARTS AND CRAFTS 6:00-7:30 P.M. STUDY HALL	10:00-12:00 NOON HOMEMAKERS CLUB 6:00-7:30 P.M. STUDY HALL	10:00-11:00 A.M. NUTRITION CLASS 3:30-6:00 P.M. BOYS RECREATION (AGES 6-12)	4:00-6:00 P.M. ARTS AND CRAFTS	

R-4-3-70

WEDNESDAY, APRIL 8, 1970.

FEDERAL POWER COMMISSION

WITNESS

WILLIAM C. WISE, COUNSEL, MID-WEST ELECTRIC CONSUMERS ASSOCIATION, DENVER, COLO.

Mr. EVINS. Now Mr. Wise, you represent the Mid-West Electric Consumers Association of Denver, Colo.?

Mr. WISE. That is correct, sir.

Mr. EVINS. You appear here in support of the budget for the Federal Power Commission?

Mr. WISE. Of $18.450 million.

Mr. EVINS. Fine. That is a concise statement.

Mr. WISE. Yes. I would like to summarize my statement briefly, if I may.

Mr. EVINS. You may. The entire statement will be included.

(The prepared statement follows:)

STATEMENT OF WILLIAM C. WISE, COUNSEL, MID-WEST ELECTRIC CONSUMERS ASSOCIATION, INC.

Mr. Chairman, members of the committee, my name is William C. Wise. I am counsel for Mid-West Electric Consumers Association, Inc.

Mid-West, with headquarters at Denver, Colo., is the regional service organization of the rural electric cooperatives and municipally owned electric systems located in the nine States comprising the Missouri Basin: Colorado, Iowa, Kansas, Minnesota, Montana, Nebraska, North Dakota, South Dakota, and Wyoming. Our organization is composed of approximately 250 systems, which serve almost 1,500,000 consumers. Our organization was formed to obtain an adequate supply of low cost electric power for these groups, and generally to promote the interests of electric consumers in the region.

Mid-West appears here today in support of the budget request for $18,450,000 for the Federal Power Commission for fiscal year 1971. It is our belief that such amount represents the minimum appropriation which will permit the Commission to perform the responsibilities delegated to it by the Congress. The public interest must suffer if the Commission is not adequately funded.

For a number of reasons, Mid-West is deeply interested in the proper functioning of the Commission. A large number of both the cooperative and municipal members of Mid-West purchase their power requirements at wholesale from public utilities whose wholesale rates are regulated by the Commission. It now appears that many of the public utilities will be seeking rate increases in the next year or two. If the Commission is to give adequate review to such proposed rate increases and assure that our members are not overcharged, a substantial increase in the portion of the staff devoting its time to electric rates will be required.

In view of the numerous statements made by executives of electric utilities during the past year concerning the need for rate increases and the comments to the same effect appearing in almost every issue of the various magazines published by the electric utility industry, it is reasonable to expect that the filings with the Commission will sharply increase in the months ahead.

There can be no concealing of the fact now that a prolonged heat wave this summer will result in brown-outs and in some areas could result in devastating black-outs. The Commission simply must have sufficient funds to deal with this threat to the well-being of millions of citizens, as well as to the economy of the Nation and our national defense itself. The Commission has already made a notable contribution to the improvement of the reliability of the Nation's power supply, but much remains to be done.

We would also anticipate that there will be an increase in the number of 202(b) cases before the Commission. The cases decided in the past few years

demonstrate the critical importance to cooperatives and municipalities of obtaining connections under this section.

During the next 5 years, licenses for more than 70 hydro projects will expire. Here, again, it is imperative if the public interest is to be protected that most careful and comprehensive investigations be carried on to determine whether the public interest would be best served by the Federal Government taking over any of such projects, the license being issued to a new licensee, or relicensing of the present licensee. This new activity on the part of the Commission alone will require a substantial funding.

Another new activity being imposed upon the Commission results from the desire of small electric systems, mostly cooperative or municipal, but some investor-owned, to participate with the large companies in the development of the giant nuclear or fossil units which represent the best opportunity to generate truly low-cost power. Attention to cases involving this problem is going to require much staff time.

In closing, we should like to cite a recent experience on the part of Mid-West which demonstrates the very real need from the standpoint of the public interest for additional appropriations for the Commission. Mid-West wrote to the Commission on December 24, 1969, forwarding to the Commission documents relating to the activities of North Central Electric Association, a group of investor-owned power companies operating in the same region as Mid-West members, which documents evidenced an organized campaign on the part of North Central Electric Association and its members to destroy competition from consumer-owned utilities to the detriment of communities in an eight-State area. In its letter, Mid-West requested that the Commission conduct an audit of the corporate records of North Central Electric Association and its members to determine whether moneys expended by those organizations in furthering their anticompetitive conspiracy were in fact paid by consumers through wholesale or retail rates and, if so, that the Commission require jurisdictional utilities to make appropriate refunds and halt any further consumer-financed activities of this type.

The chairman of the Commission replied on January 24, 1970, that the Commission had initiated a comprehensive audit program in 1964 covering all Class A and B electric utility companies subject to their jurisdiction, and that among other things the audit program provides for testing of transactions to determine compliance with the Commission's Uniform Systems of Accounts including the accounting for political expenditures. The audit program contemplates that the utility companies will be audited on a regular cycle basis of about 5–7 years, although the first round of comprehensive audits has not been completed.

The letter from the Commission attached a list showing the members of North Central Electric Association which are covered by the comprehensive audit program and the status of the audits of such companies. Five of the ten companies were scheduled for audit in this fiscal year, but the other companies would not be audited for several years in the future.

The Commission stated that its resources would not permit it to make special audits of the companies, but that when the regular audits were made, the auditors would be directed to give special attention to the propriety of the accounting for expenditures that appear to be of a political nature. Mid-West was later informed that adjustments were being made in the timing of the audits because of certain developments which made possible the making of such adjustments, which would result in the audits being made earlier.

The point which we wish to make now is that it is essential that the Commission be provided with adequate funds to conduct special audits in situations where the propriety of the accounting practices of a utility or utilities is subject to question. It seems to us that the inability of a regulatory commission to make special audits in such circumstances because of a lack of adequate funds makes a mockery of the regulatory process.

We respectfully urge this committee to recommend the appropriation of the full budget request of $18,450,000.

Mr. WISE. Mid-West is a service organization of the rural electric cooperatives and the municipalities in the nine States comprising the Missouri Basin. I will not take the time to reel them off now.

There are about 250 members who serve more than 1.5 million consumers. That figure is increasing. It is somewhat more than that now.

It is our belief that the $18,450,000 budget request represents a bare minimum that will enable the Commission to function adequately. If the public interest is to be protected, it requires that amount.

There are a number of reasons that Mid-West is directly interested in the proper functioning of the Federal Power Commission.

First, many of our members buy their electric power and energy at wholesale from public utilities which are subject to the regulation of the Commission.

It would appear that within the next year, certainly the next 2 years, many of those companies are coming in for an increase in rates.

The statements made by the executives of the companies—almost every issue of any publication put out by the electric public utility industry points up that they are preparing for rate increases. We feel if our members are to be protected properly, the Commission simply must have the staff to review those rate filings and not go along with just whatever the company asks for.

It would seem, definitely, additional staff in the electric rate filing activity will be required within the next fiscal year as well as for the year or two thereafter.

I do not think anyone can disagree today that if we have any prolonged heat wave this summer there are going to be brownouts for sure, and very likely serious blackouts in several parts of the country, including the part in which we are located just now.

The Commission has already been doing good work in the field of trying to improve the reliability of our power supply, but much remains to be done. That requires a staff and money with which to do it.

Mr. JONAS. They have a real problem, have they not? They are running out of locations?

Mr. WISE. I am not agreeing with your characterization of it, sir, but it certainly is presenting a very real problem for the utility companies.

Mr. JONAS. Take New York. I read in the newspapers where they are fearful they will have to block out sections of the city. They have been trying to build new plants up the river and have been stymied because of the conservationists. People are going to have to decide whether they want scenery and environment or power?

Mr. WISE. Or perhaps to say a little more for the power and put in the necessary protective devices.

Mr. JONAS. You are opposed to paying more for the power? You want to keep that low.

Mr. WISE. We want to keep that low. But we also recognize there are a number of considerations here and balance must be given to them.

Very likely, ultimately Congress is going to have to establish a policy. But certainly in the meantime the Commission could.

However, while that is a real problem, it also has been used as an excuse.

Most of the shortages with which we are faced today does not grow out of that, although it certainly has contributed to it, a small amount, and it is going to contribute to it much more, you are right.

Mr. JONAS. You think the increased use of air-conditioners has had a lot to do with it, too?

Mr. WISE. Unquestionably. Some people argue we ought to do away with that. But which ones of us want to give up our air-conditioners. There are real conflicts here. That is one of the jobs for the Commission to try to help resolve, to make recommendations to Congress and make studies; also to push the technological advance.

Some of our members, one of our largest members is the Basin Electric Cooperative outside of Bismarck, N. Dak., which has its plant located right next to a lignite mine. That cooperative, working with the manufacturer, is spending some money to try to solve the problem.

Mr. JONAS. Who fixes your retail rates?

Mr. WISE. Ultimately the members themselves, the people who pay for it. They do it through a board of directors. In some States it is subject to Commission jurisdiction.

Mr. JONAS. Have there been any rate increases imposed on them?

Mr. WISE. A few, but very few. Some of them operate in such thin areas, not very many but there have been some.

Mr. JONAS. Some of them do not have to pay the same cost for money that the private utilities pay, do they?

Mr. WISE. None of them pay the same cost for money.

Mr. JONAS. I do not see how you can keep these rates down, yet keep expanding. I know one private utility that is having to pay 8 or 9 percent for money to finance expansion.

Mr. WISE. TVA is doing that, paying 9 or more percent. The Chairman knows so much more about that than I do.

Mr. EVINS. I am glad that the gentleman alluded to the great work of the TVA, how they are paying $58 to $60 million in the Treasury every year from the profits for the sale of power.

Mr. JONAS. You do not want to put that on the record, do you?

Mr. EVINS. It also provides a yardstick for the cost of electricity for the private utilities to measure their costs by. It is well to have the yardstick.

Mr. WISE. I should like to say that that yardstick not only benefits the TVA area, but has a definite impact on our Missouri Basin area. We are paying less for power today than we would be paying were it not for the existence of the TVA.

Mr. JONAS. I have heard that TVA is going up on their rates.

Mr. EVINS. I wrote them a letter and they said the bond sales caused it. They are selling the bonds. We do not appropriate to TVA. We allow them to sell bonds in the private market. The interest rate has gone up, this is the reason why the electric rates have gone up.

Thank you for your appearance Mr. Wise.

WEDNESDAY, APRIL 8, 1970.

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

WITNESSES

REV. MURRAY GOODWIN, EXECUTIVE DIRECTOR, EPISCOPAL METROPOLITAN MISSION, HARTFORD, CONN.
MRS. ALICE KORNEGAY, PRESIDENT, COMMUNITY ASSOCIATION OF THE EAST HARLEM TRIANGLE
ALBERT HILLIAN, JR., BROOKLYN, N.Y.
MRS. CAROL BERNSTEIN, HOUSING RESEARCH CONSULTANT, NEW YORK, N.Y.

Mr. EVINS. We have Rev. Murray Goodwin, executive director of the Episcopal Metropolitan Mission, Hartford, Conn.; Mrs. Alice Kornegay, president, Community Association of the East Harlem Triangle; Mr. Albert Hillian, Jr., Brooklyn, N.Y., and Mrs. Carol Bernstein, Housing Research Consultant, New York, N.Y.

The committee will be pleased to hear you, Reverend Goodwin.

Reverend GOODWIN. Thank you, sir.

The Episcopal Metropolitan Mission is a federation of 11 Episcopal churches in the Greater Hartford, Conn., area.

Just before Christmas in 1965 we began exploring what we might do to help ease the critical shortage of housing for low-income families in our area. Four and one-half years later, in May of 1970, the first of 112 units of garden apartments which are being built under our sponsorship will be occupied.

Understandably, we have recently found ourselves thinking back over these years and the successes and failures, the achievements and frustrations which we have experienced in our endeavor. One thought has concerned the economics of the project.

We are a nonprofit sponsor (and have in fact donated money to the cause), and we have had the help of an excellent nonprofit consultant (set up by the Greater Hartford Chamber of Commerce). The State of Connecticut has provided seed money, full tax reimbursement to the city of Hartford, and extensive help in tenant selection, orientation, and counseling. Beyond what is provided in the mortgage, the church has made possible adequate play areas and supplementary parking, and a private foundation has contributed substantial additional landscaping. Our architectural and legal advisors have contributed effort far beyond that represented by the minimum fees they are receiving. For 2 years local insurance companies have held to a 6 percent mortgage. Countless man-hours of volunteer time have been given toward the development of these units.

In short, just about everything possible has been done to provide suitable housing without increasing construction cost. Still (as of the closing last May) the economic rent necessary to maintain the apartments and pay back the 40-year mortgage would have been $183 a month for a three-bedroom unit, and undoubtedly the final figure will be even higher.

Using the "25-percent-of-income-for-rent" guideline, this would mean that a family would have to earn almost $8,800 a year to live

there. In Hartford a low income family of four is one which earns less than $5,500 a year. Quite a difference, $8,800 and $5,500.

The point is simple and I hope clear. If we are talking about providing adequate and decent housing for low-income families, we are talking about providing some form of subsidy. The rent supplement program has made possible our project and many others across the country. The 236 program will be used in our next project under Project Rehab.

As I have said to you before, it is because we recognize the great social importance of these programs for our country, and because we have seen firsthand how such programs make it possible for nonprofit groups to help meet the need for adequate and decent housing for low-income families, that we continue to urge full funding of the rent supplement and 236 programs.

Mr. EVINS. Mrs. Kornegay, do you have a statement for the committee?

Mrs. KORNEGAY. Yes.

Mr. EVINS. You may proceed.

STATEMENT OF MRS. ALICE KORNEGAY

Mrs. KORNEGAY. I am Mrs. Alice Kornegay, president of the Community Association of the East Harlem Triangle, a community group that is sponsoring an urban renewal project in the northeastern section of Harlem in Manhattan. Thank you for granting me the opportunity to testify before this subcommittee. I am here to ask for the maximum funding of two programs: the 236 interest rate reduction payment program and the rent supplement program.

First I would like to summarize our story as an illustration of how Federal housing programs can stimulate self-help techniques. In 1961 it was proposed that our neighborhood be turned into an industrial park. We were able to convince the city administration that urban renewal could be used for the benefit of the people of the neighborhood, who were in need of new homes. Our group was designated the sponsor of the urban renewal project. Neighborhood residents were hired to survey the population and gather the statistics necessary for urban renewal planning. Since then we have become increasingly active. Last year we reported completing the rehabilitation of 65 apartments. We have now finished the work on 40 more apartments, and the families are moving in this week. We have submitted our plans for the rehabilitation of the four vacant buildings next door, and these will consist of 72 apartments. When these are finished, the whole block front will have been rehabilitated.

This rehabilitation is serving as a relocation resource for the new construction we are planning on sites with housing that must be demolished. One of these will be a small public housing turnkey project, and another, in cooperation with the National Corporation for Housing Partnerships, will be a 400 unit project, using section 236, rent supplements and public housing leasing. We plan eventually to construct 2,400 apartments, 70 percent for the people in the neighborhood, 30 percent for others.

Our policies are geared to the overall urban renewal plan. The first priority for new housing goes to people who must move out from nearby dilapidated buildings that must be demolished. We accept everyone in this category for if we, their neighbors didn't, who would?

The one exception is narcotics addicts who have not been rehabilitated. Hopefully, our neighborhood in the next few years will be transformed into one where families can live decently and give their children a chance to direct their own lives. All these plans, of course, would come to a halt if Federal funds for keeping rents low are not available.

Our work in housing has led us to work in other fields as well. For example, we are encouraging some new light industries in the neighborhood, as a way to get people and jobs together. We have also participated in improving the public school system in our neighborhood. During the New York City garbage strike, we hired our own trucks and local residents helped to cart out the garbage. This was 2 years ago, and although we sent the bill to the city, we are still awaiting a reply. As a followup, we had an ongoing summer program involving 66 young people to keep the Harlem Triangle area clean.

We have also started a neighborhood management company, trained by professionals, to run our buildings. Managing low income buildings is a difficult problem that traditional management firms have not successfully coped with. Although there have been some problems, on the whole our group is doing quite well. We are now tentatively contemplating starting a neighborhood construction company if our building program continues, as expected.

In spite of the variety of things we do, we are most concerned about people in decrepit housing. We need funds, flexibility and speed in administration of these programs.

We are building housing that neighborhood people can afford, and this is in an area where the mean per capita income is $1,250. To do this we must avail ourselves of 236 interest reduction payments, plus rent supplements and public housing leasing. Some of the families, who have taken advantage of newly opened opportunities, can now afford the full "236" rent (i.e. $160 for three bedrooms). In addition, the New York City Department of Social Services will pay the full rent for public assistance families. However, for low income working people, rent supplements and public housing leasing are essential. Both of these are excellent programs. We are emphasizing rent supplements because through them we can reach lower income families. We feel that the availability of decent apartments for low income families is the best method of encouraging poor people to remain off public assistance.

Because of our experience over the past 9 years we feel fully justified in asking this committee to grant at least $145 million for the 236 program and $100 million for the rent supplement program.

Mr. Evins. Very good.

Mr. Hillian, do you have a statement for the committee?

STATEMENT OF MR. ALBERT HILLIAN

Mr. Hillian. Yes, sir.

First of all, gentlemen, I wish to thank you for permitting me to testify here today.

My name is Albert Hillian, and I am president of the West End Housing Development Corp., a nonprofit organization, in Coney Island in Brooklyn. I am interested in full appropriations of $145 million for the section 236 program and $75 million for the rent supplement program. Our organization is a group of poor people who asked to sponsor an urban renewal project. In 1968, after quite a struggle,

the New York City Housing Development Administration designated our corporation as sponsor of "site C," one of three sites in the urban renewal project. We have been approved by FHA as a sponsor. We were fortunate enough to obtain small seed money loans from the Community Church and the New York Urban Coalition, as well as a commitment from the New York City Administration.

We are planning a 400-unit cooperative apartment development. Our architectural renderings show some units in high rise and others in four-story clusters. We will use the section 236 program to reduce the interest we would pay. For some of the apartments—at least 20 percent—we will also need rent supplements. We plan to begin construction next winter, and it is important to us that there are enough funds in these programs to enable us to go on.

Our corporation is composed of a community group, the Coordinating Committee of Coney Island, Inc., and two church groups: the Naomi AME Zionist Church and the Lady of Solace Roman Catholic Church. The board of directors is composed of five local residents, including a Catholic priest, and one church member who does not live in the area. As you see, this is a project in which the local residents are in control of the planning and development of their future homes.

Coney Island as a community is more than the famous amusement park. It is an area where extreme poverty and relative prosperity exist side by side. There is a welfare load of some 3,000 families. There is a large concentration of dilapidated housing. In contrast, there are some elaborate high rise apartments built under previous urban renewal projects. There is an intense desire by those in substandard housing to get into some better accommodations in their own neighborhood at a price they can afford.

In Brooklyn, as in many other areas of the country, construction costs are at a new high. With no subsidy, the cheapest new 4-bedroom apartment would rent at over $400. With section 236 interest reduction payments, the rents would be $133 for one bedroom, $157 for two bedrooms, $179 for three bedrooms and $191 for four bedrooms. For the rent supplement apartments, we will be able to charge as little as $60 including utilities for four bedrooms, and more for those who could afford it.

These low rent apartments are the ones most needed by our neighborhood people.

As a businessman (I am also vice president and general manager of a fully licensed community-owned moving company), I can understand your desire to be thrifty with the Federal dollar. But as a person who has first hand experience with decrepit housing, I can assure you that the funds for both the 236 program and the rent supplement program are badly needed.

Thank you.

Mr. EVINS. Thank you very much.

Mrs. Bernstein, do you have a statement?

Mrs. BERNSTEIN. No, sir.

Mr. EVINS. I just want to thank you all for coming and for your testimony and to say that we like to hear testimony of projects that are succeeding and are successful. We like to know the programs are doing well.

One or two questions.

Mrs. Kornegay, it seems that you are doing an excellent work, from

your testimony, of community services; they are taking an interest in housing, the maintenance of projects.

What problems have you had in crime and violence and vandalism and how are you able to solve it?

Mrs. KORNEGAY. We have a police-community council within the neighborhood. The people are their own protection to see that vandalism does not go on.

We also are working on a program to work with the youngsters, keeping them from being involved in this type of thing. Also to work on the drug program, to get some of the problem off the streets in our area. So we are trying to work with all the social problems as well as building new homes, because if you do not have some type of program to work with those, then it is a waste of building up the new homes. We are involving the local people from the community to work in that community.

Mr. EVINS. I think this is very good. The Committee is pleased to hear this. We commend you.

Has it been the experience of all of you that in the low-cost housing projects that more and more people with the higher income or the higher income levels are moving in rather than the real poor?

Mrs. KORNEGAY. I am talking about the area where I am. No, this is not it.

Mr. EVINS. You can speak from your own experience?

Mrs. KORNEGAY. Yes.

Mr. EVINS. We have had some testimony that in some of the public housing projects, they prefer to move in people with higher income because they do not bring in as many problems. This housing is designed for the low income, not for those in the higher income brackets.

Mrs. KORNEGAY. First, our obligation is to the people who are in the 70 percent bracket, and then we will go into the 30 percent afterwards, but we must work with the problem that we have.

Mr. EVINS. You are all here in support of appropriations for the various HUD programs?

Rev. GOODWIN. Yes.

Mr. JONAS. Mrs. Kornegay, when you speak of rehabilitating these apartments, what does it consist of?

Mrs. KORNEGAY. On the first five buildings, the rehabilitation was for relocation so we could build new construction. We cannot do any more than nine rehabilitation projects in the project because the other buildings are not substantial for them.

Mr. JONAS. You have not actually rehabilitated any units then?

Mrs. KORNEGAY. Yes. It was all done.

Mr. JONAS. You have rebuilt it?

Mrs. KORNEGAY. That is right.

Mr. JONAS. All the insides were torn out?

Mrs. KORNEGAY. All the inside, new wiring, everything else. The only thing we saved was the outside.

Mr. JONAS. What was the average cost per unit?

Mrs. KORNEGAY. I do not have that figure with me offhand.

Mr. JONAS. Do you know about what it was?

Mrs. BERNSTEIN. For the first building it was $17,000. It is going to be much more than that.

Mr. JONAS. You mean the average will be higher than $17,000?

Mrs. BERNSTEIN. Yes. It is just a fact of life.

Mr. JONAS. What size units would that apply to?

Mrs. BERNSTEIN. I think the average is two and a half to three bedrooms.

Mr. MCDADE. What would the square footage be, do you know?

Mrs. KORNEGAY. It has to comply with the Housing Authority Code, because we did not want the people to go into small-apartment sizes like it was before.

Mr. JONAS. Are these units accessible to work?

How close are they to places where the people work?

Mrs. KORNEGAY. The people work right around in the community. We are right by the 125th Street subway station.

Mr. JONAS. Generally, what kind of work do these tenants do?

Mrs. KORNEGAY. What we are doing is trying to train people—one is trained as a manager of the building, our superintendent is from the community. Our director of urban renewal is from the community also.

Mr. JONAS. I am talking about the tenants, where do they work?

Mrs. KORNEGAY. Some of the people work downtown. Some of them work in factories. You must realize that automation has taken a lot of the jobs from the people. They have to be retrained for other jobs now.

Mr. JONAS. That becomes important to determine the income levels.

I understood a worker in a factory was pretty well paid in New York City. Can you tell us, Mrs. Bernstein, what are the general work classifications of these people?

Mrs. BERNSTEIN. There are some on public assistance.

Mr. JONAS. I can understand that.

Mrs. BERNSTEIN. I am not sure about the others.

Mrs. KORNEGAY. Some of the people's average income would be about $65 per week, with taxes taken out.

Mr. JONAS. What kind of things do they do?

Mrs. KORNEGAY. Dress factories.

Mr. JONAS. They cannot work in a dress factory in New York for $65 a week.

Mrs. KORNEGAY. I am saying when you take the tax out. If you are a trimmer——

Mr. JONAS. You are talking about take-home pay?

Mrs. KORNEGAY. Take-home pay, yes.

Mr. SHIPLEY. What is the scale there?

Mrs. KORNEGAY. Some of them work part-time because they have kids. A lot of the parents work only during school hours, maybe 10 to 3. That is not 8 hours per day. Some of them are school crossing guards.

Mr. EVINS. We think you are doing an excellent work. We commend you all for coming in. Thank you for your testimony.

WEDNESDAY, APRIL 8, 1970.

HOUSING PROGRAMS

WITNESS

TONY HENRY, DIRECTOR, NATIONAL TENANTS ORGANIZATION, INC.

Mr. EVINS. Mr. Henry, director of the National Tenants Organization, Inc.

I believe you appear here in connection with HUD appropriations?

Mr. HENRY. That is correct.

Mr. EVINS. You may proceed.

Mr. HENRY. Very well, Mr. Chairman and members of the committee:

The Federal Government has become America's largest slumlord. A slumlord is by definition a landlord who has the financial capacity to provide safe and sanitary housing for tenants but obstinantly refuses to do so.

As landlord of the Nation's 2.4 million low-income public housing tenants, the Federal Government is charged with the responsibility of providing decent housing to individuals who cannot afford housing offered in the private market. Historically, whenever the opportunity arose to upgrade the welfare of these tenants, the Government deftly turned its back.

An opportunity has again arisen with the passage of the 1969 Housing Act, but the Federal Government seems prepared, as before, to shun its responsibility.

To state that the nation's local housing authorities which operate public housing are in the throes of financial chaos, one would be guilty of criminal understatement. Some local housing authorities have shown operation deficits which are unspeakably high and others have deficits which have persisted several years. Even HUD had admitted that public housing, nationally, is in debt over $100 million. In an effort not to succumb to this situation, local housing authorities have shifted the burdens to the public housing tenants themselves, increasing rents which poor families are compelled to pay coupled with the rapid decline of expected maintenance services for their units.

In the District of Columbia, over 40,000 housing code violations exist in public housing, while the Springfield, Mass. housing authority found itself without sufficient funds to provide adequate heat for its tenants last winter.

Poor tenants were relieved when the Congress enacted the public housing amendments of the 1969 Housing Act, but sighed in utter disbelief when the administration transformed that legislation into impotent rhetoric.

Congress is worthy of praise for its initial commitment on behalf of the Nation's poor tenants, but we must remind you that you still have the responsibility of protecting these tenants' newly acquired benefits, although another branch of the Federal Government is disposed not to.

Section 213(a) of the Housing Act of 1969 provides that the rent of a public housing tenant may not exceed 25 percent of the family's income. The act also provides authority for HUD to pay annual contributions in excess of debt services requirements up to the statutory annual maximum, and it provides for that purpose an additional $75 million in contract authorization, under section 212(a), which may be used to make payments for the following purposes: To cover existing operation deficits of public housing agencies and enable them to maintain adequate operating and maintenance services and adequate reserve funds, and to make up the amount by which the proportionate share of operating and maintenance expenses attributable to a dwelling

unit exceeds 25 percent of the tenant's income, provided the tenant is paying 25 percent of income for rent.

These amendments suffered a severe setback when HUD requested only $6.5 million for the remainder of fiscal 1970, to be used for meeting existing deficits in operations and maintenance costs in only six of 3,200 local housing authorities. Here, the Federal landlord refused to respond to the depth of the public housing dilemma.

There are local housing authorities which presently are unable to cover operating and maintenance expenses, although they are charging tenants well in excess of 25 percent of their incomes. Since HUD requested no section 212(b) money to cover these existing discrepancies, such a local housing authority will only be able to receive Federal contributions representing the difference between what the tenant is now paying and what he will pay when his rent is reduced to 25 percent of his income. This leaves the local housing authorities and the housing condition of poor tenants in precisely the same predicament as before, and housing authorities will be forced to allow the hazardous and unhealthy conditions of their buildings to linger.

If it is not funded sufficiently, the provision placing a 25-percent ceiling on public housing rents will have the effect of restricting rather than expanding the number of very low-income tenants in public housing.

Housing authorities will be restricted to admitting only those applicants who incomes are high enough that 25 percent of income will cover operational and maintenance costs, and the most needy families will be forced to seek private market housing at higher rents and of inferior quality.

Congress authorized $15 million in fiscal 1969 and $30 million in 1970 to upgrade tenant services in public housing which would include counseling services on household management, housekeeping, family budgeting, and child care. With this money, tenants could be helped to locate and take advantage of job training, education, welfare and health services. The House Appropriations Committee succeeded in completely cutting out funding for these programs, although public housing tenants have larger problems and fewer resources to deal with them than other groups. In the 1969 Housing Act, Congress has once again authorized $45 million for vital tenant services. Unfortunately and unwisely the Department of Housing and Urban Development has requested only $5 million for these purposes.

Five million is less than an amount which would be necessary to touch even the surface needs of occupants of public housing. If there is to be any hope for the success of public housing in human and institutional terms, the Appropriations Committee must vote the full $45 million authorized.

We should also like to go on record as stating that we believe that the rent supplement, public housing leasing, and turnkey programs should also be fully subsidized, for these programs have suffered equally severe setbacks through Federal financial restraint.

Unless this committee heeds the cry of the poor for decent housing, unless it accepts its obligation for Federal financed housing, this country will continue to be wracked by dissention and discord, and extra-legal actions such as rent strikes will become the order of the day. If the Federal Government wants low-income tenants to behave responsibly, then it must shoulder its responsibility as well.

We have faith that this committee will not become the agent of the Federal slumlord. We are confident that members of this committee will act for the benefit of the people, where others have turned their backs.

Mr. JONAS. It does not help for people to accuse us of shunning our responsibilities and failing to have any conception of this problem or refusing to do anything for the poor when we cite figures like this.

Mr. HENRY. If I could explain why I say that, even though there is money being put into the construction of public housing, there is the problem of maintaining these dwellings at a period when the cost of operating them is increasing and the income of the poor people who live in them is not increasing.

Mr. JONAS. May I ask you a question?

Mr. HENRY. And you have only appropriated, the administration is only requesting $6.5 million out of $75 million that Congress has authorized to help with that problem. So that you can eliminate housing code violations that are in public housing.

Mr. JONAS. You are the Director of the National Tenants Organization. Can you tell the committee what your organization is doing to cut down on vandalism and that sort of activity that is bankrupting public housing authority after public housing authority all over the country?

The Government had to bail out the National Capital Housing Authority the other day to the extent of $900,000, it had exhausted its reserves. That same situation is happening elsewhere in the United States. You cannot blame it all on lack of code enforcement.

What are you doing to instill into the tenants a sense of responsibility, an appreciation for the opportunity of living in subsidized houses? They ought to make a contribution, ought they not, instead of tearing down what we are trying to give them?

Mr. HENRY. I agree with you wholeheartedly. I would say that is the main focus of our organization, to get tenants to exercise responsibility where they are living. The problem in the past has been that public housing has been turned into a political boondoggle in many cities, with people running the housing who do not understand the people who live there, who are not sympathetic with their needs and who are not able to communicate with them.

We have demonstrated in place after place that where tenants are given maximum responsibility and opportunity for involvement in planning, in policymaking, in running and operating the housing themselves, they will do those things that cut down costs, they will do those things that reduce vandalism, because they know the problems, they can deal with their neighbors in a manner that the banker from the suburbs cannot deal with them.

That also cuts down the type of politics that has gone on in public housing in many cities, and I suspect that the District of Columbia is one of them, which has driven the costs up out of proportion to the real services that are being provided. The tenants know those janitors who only work 2 hours a day when they are paid for 8. They will deal with that problem if you give them the power and the authority to do it.

Mr. JONAS. You do not have to ask us to give it to them. You have a National Capital Housing Authority that runs the housing in the District of Columbia.

Mr. HENRY. Right.

Mr. EVINS. Most of these housing authorities are run by local authorities.

Mr. HENRY. Yes.

Mr. EVINS. The city councils set them up, as you know, they name the people, they run the authority. All we do is appropriate money to subsidize them. Some of them continue to deteriorate. So I think your association can do a fine work if you will encourage your tenants not to bring about this vandalism and destruction.

Mr. JONAS. Do you know how many housing units are vacant in the city of Washington, D.C. because they have become unfit for occupancy due to vandalism?

Mr. HENRY. Talking about public housing?

Mr. JONAS. Yes.

Mr. HENRY. No, I do not know. I know there are some 5,000 units in D.C. that could be rehabilitated.

Mr. JONAS. What is the use rehabilitating them unless the people occupying them are going to live by a higher standard than those who made them unfit for occupancy in the first place? That is where your organization can make a great contribution instead of coming up here and abusing Congress.

Mr. HENRY. Sir, the reason that these units, in reference to those units that are subsidized in public housing have been abused and, through neglect allowed to deteriorate, is not because the people who live there do not want a decent place to live. The tenants in the District of Columbia have organized themselves just recently, with some assistance from us, and are beating on the doors for an opportunity to show what they can do to provide better housing.

You, yourself, have been exposed too frequently, I feel, to public officials who, in order to protect themselves and their mismanagement, have said that the problem is not us, but the tenants. But let me assure you that our organization intends to organize tenants to exercise their responsibility, if they are merely given responsibility, and one does not have responsibility without authority and power to use that responsibility.

I do not feel that a program of punishment of tenants, which many housing authorities think they are pushing when you talk about responsibility——

Mr. EVINS. Who is punishing tenants?

Mr. HENRY. Many housing authorities, for example, take the attitude that they have too many broken windows, therefore, if a window is broken in a tenant's apartment under any circumstances or condition, the tenant must pay a fine of $10, which may be fare more than the cost of replacing the unit.

Mr. SHIPLEY. Where is this done?

Mr. HENRY. Some cities where that is done would include—well, actually most housing authorities I believe, D.C. is one of them. Some housing authorities are now moving away from this policy.

Let me finish the statement because you only got half of how bad it is.

Mr. EVINS. We know it is bad. What can we do to improve the conditions? This is what we are interested in.

Mr. HENRY. You can never improve the living conditions of people without giving them the authority and the power to work on that

problem themselves. These housing authorities have for too long been suppresing organizations of tenants, not allowing them to emerge and use their full ability.

Mr. JONAS. You do not need an act of Congress to give the occupant of a tenant unit the responsibility of safeguarding and protecting the dwelling he has been provided by tax dollars.

Mr. HENRY. Well, what you need, in order to improve that unit and the living conditions for that tenant, is authority for that tenant to deal with the problems that face him, not only within his unit but in the area around his unit.

For example, tenants can deal with the problems of light bulbs that get snatched, tenants can deal with the problem of grass on the lawns.

Mr. EVINS. I wish they would. In many instances we provide decent housing and in a short while it has deteriorated.

Mr. HENRY. They have no authority to do that. The housing authority does not let them deal with that kind of problem.

Mr. EVINS. We had a black man in here testifying that in Pennsylvania he had a wonderful housing authority, which he has been managing. We commended him for this successful operation. You come and tell us about the bad ones.

The thing to do is get good management in the housing authorities as the gentlemen testified this morning.

Mr. HENRY. Give the tenants the authority to do it and they will get you good management.

Mr. EVINS. The tenants are the ones that are breaking the windows.

Mr. HENRY. I say this out of experience, not out of theory. In those places where tenants have been enabled to organize and given the responsibility for the operation of a project, for the selection of a manager for that project, and an opportunity to look at the budget and be involved in the planning of the housing authority, vandalism has in every instance decreased significantly.

Mr. EVINS. You have made a significant statement and your testimony is very helpful and appreciated. We thank you for coming in.

WEDNESDAY, APRIL 8, 1970.

HOUSING PROGRAM, SECTION 235

WITNESS

MRS. PAMELIA C. JEFFERY, BOARD MEMBER, HOME BUYERS, A NONPROFIT DISTRICT OF COLUMBIA CORPORATION

Mr. EVINS. Mrs. Jeffrey, you have a statement?

Mrs. JEFFREY. Yes.

Mr. EVINS. You may proceed.

Mrs. JEFFREY. Mr. Chairman and members of the committee: I am Mrs. Pamelia Jeffrey, an Arlington homeowner, housewife, and mother. I am testifying for a nonprofit housing organization called Home Buyers, for which I am a volunteer and a member of its board.

We of Home Buyers wish to urge your committee to substantially increase the allocation of funds for 235 housing for the fiscal year 1971. Our reasons are numerous but, in testifying before you, we are going to mention only those which are based on our personal experience.

First of all, we feel that:

A. Nonprofit housing organizations cannot significantly ease the housing problem of lower income families.

Home Buyers' original plan of privately-financed mortgages is virtually impossible in the foreseeable mortgage market.

Home Buyers was organized and operating prior to the existence of 235 home mortgages. Our purpose was and still is to help interested and qualified families who rent substandard housing to become homeowners. Our original plan was based on a fund which revolved every 5 years.

In the past 2½ years we have been able to raise $80,000 by issuing debentures at five per annum with which we have bought 21 houses in the Washington Metropolitan area. We contract these houses to families who want to own them, charging $150 rent per month until we have recovered our downpayment and costs for closing and repairs, at which time we transfer the title to individual families.

Our original plan has helped only 21 families—which, needless to say, is a mere drop in the housing bucket. Most of these families find $150 beyond their means. The rise in interest rates has prevented our buying homes financed at the current rate. Until the prime interest rate goes down to 7 percent, which is very unlikely, Home Buyers cannot buy a $15,000 house, rent it to a family for $150 and regain its investment in 5 years, as was our original plan.

Assumptions at lower than the current interest rate require very large downpayments and are difficult to find. So you can see Home Buyers is faced with four problems.

We can help far fewer families than we originally anticipated. Those families we are renting to will own their homes not in 5 years (as was our original plan) but in about 10 to 15 years;

Three, the families cannot afford $150;

Four, we are concerned as to how we are going to pay back our debenture holders when our funds do not revolve every 5 years.

Consequently, Home Buyers effectiveness depends on an adequately funded 235 program.

Home Buyers is now trying to sell its homes through the 235 plan, thereby accomplishing two things, First, we can recover our investment sooner and thereby help more families with that money. And, second, the family's monthly payment is greatly reduced.

Also, we are helping each family on our waiting list to become qualified for a 235 mortgage and to find a home that meets their needs. We offer to assign to each family a couple who will help them with home maintenance techniques, budgeting and repairs. This plan has worked very successfully with the eight families whom we have already helped to obtain 235 home mortgages.

CONCLUSION

Although Home Buyers accomplishments compare very favorably with most nonprofit housing organizations, those accomplishments are extremely meager when taking into account the total number of lower income families with housing problems.

Second, we feel that local jurisdictions cannot properly house lower-income families.

Some jurisdictions—Arlington County, for example—have no housing authority and, consequently, no federally funded program operated by the local government.

Jurisdictions that do have housing authorities have long waiting lists of screened, qualified families waiting for public housing. Alexandria currently has 411 families on the waiting list. One family Home Buyers has been trying to relocate for over a year is the Freeman Drayton family. The Draytons have been on Alexandria's waiting list for public housing since 1962. They have seven children.

Of Alexandria's public housing units, only eight have five bedrooms and only 56 have four bedrooms. The Draytons have been told that it will be another 3 to 5 years before they can be accommodated. They are presently renting a substandard house, but hesitate to complain about it to the health authorities as neighbors who did so about the faulty plumbing were evicted 3 days later by their landlord. If the Draytons were evicted, where would they go?

Another point worth mentioning is that the funds for existing standard housing lasted only 8 months for fiscal 1970. That alone is proof that such funds were inadequate. However, under normal circumstances they would very likely have lasted for even less than 8 months. In some jurisdictions, the rises in prime and FHA interest rates exceeded the limits set by usury and interest ceiling laws, making 235 funds unavailable there. For example, in the District of Columbia lenders were willing to finance 235 mortgages during only 3 of the 8 months funds were available. The following chart shows how intermittent the opportunities for a 235 loan were in Virginia and the District of Columbia:

	1969—Rise in prime rate			FHA interest 8½ percent	Virginia State law changed		No funds
	March to	July to	August to	January 1970 to	February to	March	
Virginia	No	Yes		No	Yes	No	
District of Columbia	Yes		No	Yes		No	

Now that the market has opened up there are again no funds.

Second, we strongly urge Congress to allow more than 10 percent of the funds for section 235 for the fiscal year 1971 to go for subsidizing mortgages on existing homes in standard condition.

Subsidizing mortgages for existing standard homes not only gives larger families homes of adequate size, not only helps to disperse lower income families among other income groups, but it also helps to keep neighborhoods from depreciating. When an older home comes on the market in a neighborhood that is slipping, and when a lower income family cannot buy that home, no one else will, so it will be rented and will probably not be maintained. After some years this home is likely to be abandoned or condemned thus depleting the market for lower income housing further. Washington, D.C. has a large number of abandoned units. Allowing 30 percent of the funds for 235 housing to go for existing standard construction prolongs the life of the construction and, in this sense, adds to the market of lower income housing since such homes will not be taken off the market.

I would again, as a representative of Home Buyers, strongly urge the committee and Congress to increase substantially the allocation of funds for section 235 for the fiscal year 1971 and urge that a far greater percentage than 10 percent be allotted for existing homes in standard condition.

(Prepared statement follows:)

ON THE FUNDING OF 235 HOUSING FOR FISCAL YEAR 1971—SUBMITTED BY MRS. PAMELIA C. JEFFREY, MEMBER OF THE BOARD OF HOME BUYERS

Home Buyers, a nonprofit housing organization incorporated since 1967, submits these recommendations to the subcommittee on Independent Offices and Department of Housing and Urban Development of the House of Representatives of the U.S. Congress:

I. First, we strongly urge Congress to substantially increase over previous years, the allocation of funds for section 235 of the 1968 Housing Act for the fiscal year 1971 for the reasons that follow:

A. Nonprofit housing organizations without Federal participation cannot significantly ease the housing problem of lower income families.

1. Home Buyers' original plan of privately financed mortgages is virtually impossible in the foreseeable mortgage market.

Home Buyers is a nonprofit organization which was organized and operating prior to the existence of 235 home mortgages. Our purpose is to help interested and qualified families who rent substandard housing to become home owners. In the past 2½ years we have been able to raise $80,000 by issuing debentures at 5 percent per annum with which we have bought 21 houses in the Washington Metropolitan area. We contract these houses to families who want to own them, charging $150 rent per month until we have recovered our down payment and costs for closing and repairs at which time we transfer the title to individual families.

Our original plan has helped 21 families—a drop in the housing bucket. Most families find $150 beyond their means. The rise in interest rates has prevented our buying homes financed at the current rate. Assumptions at lower rates require very large down payments and are difficult to find. We can help far fewer families than we originally anticipated, and those families we are renting to will own their homes not in 5 years (as was our original plan) but in about 10 to 15 years.

2. Home Buyers effectiveness depends on an adequately funded 235 program.

Home Buyers is now trying to sell its homes through the 235 plan, thereby accomplishing two things. One, we can recover our investment sooner and thereby help more families with that money. And, two, the family's monthly payment is greatly reduced.

Also, we are helping each family on our waiting list to become qualified for a 235 mortgage and to find a home that meets their needs. We offer to assign to each family a couple who will help them with home maintenance techniques, budgeting and repairs. This plan has worked very successfully with the eight families whom we have already helped to obtain 235 home mortgages.

3. *Conclusion:* Although Home Buyers' accomplishments compare very favorably with most nonprofit housing organizations, those accomplishments are extremely meager when taking into account the total number of lower income families with housing problems. Most volunteer organizations shy away from complications, long-range projects and personal commitments to needy families. Most investors consider lower income housing too risky. Most contributors prefer giving to long established, status institutions. In short, Home Buyers, like other nonprofit housing organizations, cannot make its money and staff of volunteers stretch much further without additional Federal funds for 235 housing. The families that need our help also need the monthly subsidy.

B. Local jurisdictions cannot properly house lower income families.

1. Some jurisdictions—Arlington county, for example—have no housing authority and, consequently, no federally funded program operated by the local government. Fortunately, the 235 program does not require the sancition of the majority of people in a particular area in order to operate.

2. Jurisdictions that do have housing authorities have long waiting lists of screened, qualified families waiting for public housing. Alexandria curently has 411 families on the waiting list. One family Home Buyers has been trying to relocate for over a year is the Freeman Drayton family. The Draytons have been on Alexandria's waiting list for public housing since 1962. They have seven children. Of Alexandria's public housing units only 8 have 5 bedrooms and only 56 have 4 bedrooms. The Draytons have been told that it will be another 3 to 5 years before they can be accommodated.

3. Local housing programs are inadequate or nonexistent. But funds for 235 housing are needed in all types of jurisdictions and are needed in greater quantities than in previous years so they can be continously available. The funds for existing standard housing lasted only 8 months for fiscal 1970. We feel it is important to point out that under normal circumstance they would very likely have lasted for even less than 8 months. In some jurisdictions the rises in prime and FHA interest rates exceeded the limits set by usury and interest ceiling laws, making 235 funds unavailable there. For example, in the District of Columbia lenders were willing to finance 235 mortgages during only 3 of the 8 months funds were available. The following chart shows how intermittent the opportunities for a 235 loan were in Virginia and and the District of Columbia :

	1969—Rise in prime rate			FHA interest 8½ percent	Virginia State law changed	No funds
	March to	July to	August to	January 1970 to	February to	March
Virginia	No	Yes		No	Yes	No
District of Columbia	Yes		No	Yes		No

Now that the market has opened up there are again no funds. After our having worked 1 year with the Drayton family they still do not have a 235 mortgage.

C. Rental property is not a sufficient answer to the needs of lower income families.

1. Rental property for lower income families is on the decrease.

(*a*) Code enforcement programs have been so intensified that home which in the past at least served as shelter are no longer in existence. We feel quite sure that the Drayton's home, for example, would be condemned. Neighbors who merely complained to the health authorities of faulty plumbing were evicted 3 days later by their landlord. If the Draytons were evicted, where would they go?

(*b*) The new tax laws have made the depreciation factor in renting slum housing less attractive.

(*c*) The tight money situation has made it less possible to invest in low income property.

2. Rental property is much more often of substandard quality than owner occupied property. In the District of Columbia there is a tremendous number of abandoned rental units. Such depletion of lower income housing from the market should be stopped. We believe that the single family row house neighborhoods of the District will be upgraded with family owner occupancy. But strong funding of section 235 is needed because only lower income families are willing to move into such neighborhoods.

II. Second, we strongly urge Congress to allow more than 10 percent of the funds for section 235 for the fiscal year 1971 to go for subsidizing mortgages on existing homes in standard condition.

A. New construction is predominately needed, but it has some limitations.

1. New construction does not accommodate a large family as well as some of the older existing homes. Porches, entrance halls, basements, separate dining room, and the fourth bedroom are for cost reasons often eliminated. In effect, you get less house for your money in new construction.

2. Builders, again for cost reasons, tend to concentrate lower income families in a subdivision. We feel a mixture of income groups in a neighborhood is healthier for all income groups.

3. In high cost areas where housing problems are often severest, builders cannot easily afford to build 235 homes. In the District of Columbia there is almost no land available for the construction of single family units.

B. Subsidizing mortgages for existing standard homes not only gives larger families homes of adequate size, not only helps to disperse lower income families among other income groups, but it also helps to keep neighborhoods from depreci-

ating. When an older home comes on the market in a neighborhood that is slipping, and when a lower income family cannot buy that home, no one else will, so it will be rented and will probably not be maintained. After some years this home is likely to be abandoned or condemned thus depleting the market for lower income housing further. Washington, D.C. has a large number of abandoned units. Allowing 30 percent of the funds for 235 housing to go for existing standard construction prolongs the life of the construction and, in this sense, adds to the market of lower income housing since such homes will not be taken off the market.

Home Buyers concludes its statement summarizing our request that Congress increase substantially the allocation of funds for section 235 for the fiscal year 1971 and that a greater percentage than 10 percent be alloted for existing homes in standard condition.

Mr. EVINS. Mrs. Wright, do you have a statement for the record?

Mrs. WRIGHT. No.

Mr. EVINS. Thank you ladies for appearing before this committee.

WEDNESDAY, APRIL 8, 1970.

PUBLIC HOUSING IN FAIRFAX COUNTY, VA.

WITNESS

CARL AUVIL, CHAIRMAN, FAIRFAX COUNTY CITIZENS FOR ADEQUATE HOUSING

Mr. EVINS. Do you have a statement for the committee, Mr. Auvil?

Mr. AUVIL. Yes, sir. My name is Carl E. Auvil, I am chairman of the Fairfax County Citizens for Adequate Housing, a member of the Housing Hygiene Board of Fairfax County.

So, I come before you, Mr. Chairman, and members, as a fellow public official. However, I only make $15 per meeting of the committee. I also had the honor of 4 years ago being a chairman of the referendum campaign for public housing in Fairfax County. We had a successful campaign. We won by 125 votes out of 138,000 cast. I trust each of your elections are somewhat with a greater margin than that.

I have been working on this issue for some time. I want to endorse from my own personal experience public housing in Fairfax County, which I believe is one of the few suburban areas in the country to have a successful program, to endorse what Mr. Henry said about the economic difficulties of our very small public housing program, and also second what Mrs. Jeffery has said about the fine work her group has done, but also second her thought that it is a drop in the bucket compared to what is needed.

We had an official study in Fairfax County by our planning staff this last year, which showed there were 10,000 families in Fairfax County alone, one of the richest counties in the country, some of you may live there, who are paying more for their housing than they should. In other words, they should qualify for moderate housing, but such housing is not available in the county. Many of them are low-income families. They are spending more money for their housing than they should, having less money for food, clothing, or educational opportunities for their children; or crowded together in ghettos.

Some houses have three families. One of our communities has more than 50 homes with more than one family living in these dwellings. You can imagine the resulting damage to the health and morale of family life in such situations.

Our county needs a tremendous supply of additional housing. In order to upgrade moderate housing, we have a new hygiene code. In the last 8 years we have removed from the low-income housing market, by official county action, over 1,100 dwellings, mostly inhabited by low-income people because they were substandard, former chicken coops people were actually living in. They forced these people out. We have put in 150 units of public housing, which is only about 1 to 6 in terms of ratio of replacement.

In the next 5 years, we plan to remove another 1,600 dilapidated houses from the housing market by county action. Our remaining housing program is 300 units in the public housing.

In addition to this, our highways and schools and shopping centers and apartment developments and so on remove hundreds of additional houses from the housing market.

I would say altogether we are probably replacing only about one in 10 of the substandard houses or low-income dwellings removed from the market in Fairfax County.

We also have a great need for the moderate income programs, 235 and 236 and the others. We have a little. We are putting in more.

I am a member of the board of directors of a nonprofit housing corporation which is sponsored by a group of churches out in Fairfax, including my own Congregational Church, we call it CRUFS, or Congregations United for Shelter.

We have been in business for a year, we have some money to spend, but cannot spend it for land at prices we can afford and still meet the Federal guidelines. The only places moderate income housing can be built is either in very marginal areas, which are now becoming black ghettos or in subsidized areas like the new town of Reston where the management of the town, because they want to have Geological Survey out there, is putting in a certain amount of low and moderate income housing and subsidizing the land cost 50 percent in order to come under the regulations.

Elsewhere in the county, we find it impossible to find the land and meet the FHA cost requirements. So we need several things in Fairfax County in order for us to meet the very urgent housing needs which our people have. We need an increased rate of Federal subsidy for both moderate income housing and public income housing. By increased rate, I mean total amount of Federal dollars. I also mean increased unit cost allowances because in our county particularly, land costs and construction costs are so high and there are probably many other suburban cities and urban counties in the country which have the same problem.

So we need not only more money, but increased limits per unit, even beyond the special increases which are allowed in certain instances by FHA. We need a greatly increased availability of funds and program reservations for both public housing and moderate income housing.

The public housing people, as I said before, need to have additional money in order to maintain the public housing apartments, in order for them to buy or lease scattered large houses throughout the county

which are both socially and politically acceptable and which also meet the needs of the larger families who are out of luck as far as housing in Fairfax County is concerned these days.

I think what I am saying can also be applied in large part to all of Northern Virginia, since I also represent Northern Virginia Fair Housing. We need two or three times as much money as we are getting now in Fairfax County. We really need four or five times as much.

Mr. EVINS. Mr. Auvil, you are going to have to involve yourself some more. I understood from earlier testimony that just across the river, in Arlington, they do not have any public housing.

Mr. AUVIL. That is true of Arlington. The State legislature has a law which prevents them from having public housing.

Mr. EVINS. Congress in the Housing Act of 1968 declared a goal of 26 million housing units for low income, and provided many tools and many programs. Secretary Romney testified that he wants to consolidate some of them and simplify them. So that you may not go away thinking that the Appropriations Committee and the Congress are not doing anything, I want you to read a few things that are in the budget for next year, $140 million for Section 235.

You multiply that over 30 years, that is $4.2 billion. For section 236, an additional $145 million of contract authority which could cost a total $5.8 billion over the 40 year period.

The rent supplement programs starting just a few years ago through this committee, are now up to the annual level of $75 million in new contract authority per year as requested for 1971.

The cost of this over the 40-year period could be $3 billion.

In public housing the cost for the 1971 program could well be $6.8 billion over the next 40 years.

Do not go away feeling that the Congress is not responding, that the Congress is not doing anything. It is very costly, and it is very extensive and it continues to grow.

Here is a brief excerpt from the budget in which it shows that in 1971 an estimated $44 billion will go into the cities of this Nation from Federal appropriations. So do not go away thinking that the Congress is not responding and that massive sums are not going into the housing and into cities.

Mr. AUVIL. We appreciate this. We are suggesting that the need is much larger.

Mr. EVINS. Thank you very much Mr. Auvil. Your statement was most helpful.

NATIONAL SCIENCE FOUNDATION

LETTER OF DR. PHILIP HANDLER, CHAIRMAN, NATIONAL SCIENCE BOARD

Mr. EVINS. The committee has received a letter from Dr. Philip Handler, chairman of the National Science Board in support of the National Science Foundation. The letter will be placed in the record at this point.

(The letter follows:)

NATIONAL SCIENCE FOUNDATION,
NATIONAL SCIENCE BOARD,
Washington, D.C., March 24, 1970.

Hon. JOE L. EVINS,
Chairman, Subcommittee on the Independent Offices, Committee on Appropriations, House of Representatives, Washington, D.C.

DEAR MR. EVINS: Our small delegation of members of this Board deem it a great privilege to have appeared before your committee on Wednesday, March 4, to discuss the appropriation request from the National Science Foundation. As we left, at the end of the morning, there was one major point which, it seemed to us, had not been made with sufficient clarity or force. The entire Board joins with us in this statement.

Since the birth of the National Science Foundation, 20 years ago this spring, this agency has only occasionally been permitted to grow at a rate commensurate with the aspirations which led to its formation. Until fiscal year 1968, however, our Nation suffered little penalty on that account because support of the national scientific endeavor was more adequately provided through appropriations to the major science-based, mission agencies, particularly the Department of Defense, the Atomic Energy Commission, the National Institutes of Health, the National Aeronautics and Space Administration, and, in some part, the Department of Agriculture.

But it is now apparent that the tide has changed. Support of frontier science through these "mission agencies" no longer is deemed appropriate by some of the Congress and of the public, except to that extent to which such research is clearly and immediately relevant to agency missions. Meanwhile, beginning with fiscal year 1968, the combination of inflation and level or declining appropriations has resulted in a decrease in the overall scale of the national scientific endeavor of the order of perhaps 25 percent, whereas the national capability for the conduct of science, the result of quite deliberate national policy in previous years, continued to grow as does the inherent cost of the conduct of science itself. The impact of the overall appropriation requests for fiscal year 1971 on the total of all Federal science-supporting agencies will be a yet further decline in the scope and intensity of the national research endeavor. Moreover, in several agencies where, seemingly, the support of research is not being seriously reduced, it is being given new directions more closely related to the immediacy of the agency mission, at the expense of the fundamental research effort.

These circumstances have generated a fiscal crisis on every university campus: senior investigators find their support reduced to levels insufficient to permit their research to continue at a lively pace while others find themselves totally without funds; junior investigators are unable to commence their independent research careers; graduate students attracted by past Federal policies now find it impossible to secure stipends; university administrators who had constructed an elaborate research-supporting service, funded through indirect cost payments, must dismantle that apparatus in some part but cannot know to what extent, while they must also confront the necessity for assuming responsibility for faculty salary payments which have, in the past, been defrayed in part from research grants and contracts. The total magnitude of this crisis is unknown but the level of apprehension, across the country, is very high indeed and morale has seriously deteriorated. At this writing the National Academy of Sciences is endeavoring to gather some quantitative data to illustrate the magnitude of this crisis and we shall be pleased to make it available to you at the earliest possible moment.

Accordingly, this year, truly for the first time, the scale, the scope, the intensity and, presumably, the success of our national research enterprise as well as the fiscal solvency of our universities, will depend upon the appropriation to the National Science Foundation as never before.

Under these circumstances, it seems to us the previous history of the National Science Foundation and its appropriations is an improper perspective in which to view the budget request for fiscal year 1971. Now, as never before, it is imperative that the appropriation to the National Science Foundation be viewed as the real pacemaker of the national research effort. For the first time, if insufficient funds are provided to this agency, it can genuinely be stated that there can be no possibility that our national system for the conduct of research will remain intact, that our leadership position in the worldwide effort in science

will be maintained and that the momentum generated over two decades can be sustained.

Indeed, our analysis of the budget situation for fiscal year 1971 indicates that, simply to sustain previous momentum, to maintain the overall scientific enterprise of the Nation in the face of altered fiscal arrangements in the other Federal agencies would require an appropriation to the National Science Foundation significantly greater than that in the budget request which has been presented to you, of the order of about $600 million. Accordingly, we must urge that the appropriation for fiscal year 1971 be no less than the sum to be authorized by the Science and Astronautics Committee.

I regret that our testimony failed to make these points sufficiently clear and hope that this letter may be placed in the record of our hearings. We would be pleased to make copies of this letter available to all members of your committee, if you feel such action to be appropriate, and we look forward to hearing from you in this regard.

Sincerely yours,

PHILIP HANDLER, *Chairman.*

HOUSING APPROPRIATIONS

STATEMENT OF MR. NATHANIEL S. KEITH, PRESIDENT OF THE NATIONAL HOUSING CONFERENCE

Mr. EVINS. The committee has received a statement in support of the housing appropriations from Mr. Nathaniel S. Keith, president of the National Housing Conference. The statement will be placed in the record at this point.

(The statement follows:)

STATEMENT OF NATHANIEL S. KEITH, PRESIDENT OF THE NATIONAL HOUSING CONFERENCE

On behalf of the National Housing Conference, I appreciate the opportunity to present our views on the administration's request for supplemental appropriations for fiscal year 1970 for the section 235 and section 236 programs and on the pending appropriation measure for fiscal year 1971. I shall begin with our views for the supplemental request.

1. SUPPLEMENTAL REQUEST

The administration has requested supplemental appropriations for fiscal year 1970 of $25 million for section 235 and $25 million for section 236. Our research has indicated that this $25 million is desparately needed for each of these highly successful programs.

This subcommittee is well aware of the fact that the housing industry is in a full scale depression, and that it is becoming more and more difficult for the average American to own his own home or to rent an apartment. The median price for a single family house is now over $30,000 and only one out of every five Americans can afford this median priced house. Just 10 years ago, three out of five Americans could afford such a home. A supplemental appropriation on section 235 and section 236 moneys would immediately translate itself into construction of needed housing. FHA has significantly increased its ability to process applications and has done an outstanding job in keeping its pipeline primed for action when funding becomes available. In addition, the Federal National Mortgage Association (FNMA) and the Government National Mortgage Association (GNMA) have established a "tandem" plan which assures par financing for a large percentage of the section 236 program and also assists the section 235 program.

Therefore the National Housing Conference strongly urges that this subcommittee not only give favorable consideration to the administration's request for $25 million for section 235 and $25 million for section 236, but also give careful consideration to appropriating the full amount authorized by Congress for these valuable programs.

2. THE HUD BUDGET FOR FISCAL YEAR 1971

I have identified five areas below to which I particularly want to draw the subcommittee's attention:

(*a*). Tenant services: The 1968 Housing Act authorized HUD to make grants to local housing authorities to assist in financing tenant services for tenants of public housing projects. Appropriations for the grants are authorized up to $15 million for fiscal year 1969 and $30 million for fiscal 1970. The 1969 Housing Act authorizes that prior authorizations for tenant services are extended through fiscal year 1971. The proposed services include: counseling on household management, housekeeping, budgeting, money management, child care, and similar matters; advice as to resources for job training and placement, education, welfare, health, and other community services; services which are directly related to meet the tenants' needs and providing a wholesome living environment and referral to appropriate agencies when necessary for the provision of such services. As you know, no appropriation has been made of the $15 million authorized for fiscal 1969, or the $30 million authorized for fiscal 1970 to assist in financing tenant services in public housing. However, after requesting no funds for tenant services last year, the administration is now requesting $5 million out of the $45 million authorized for fiscal year 1971. NHC strongly recommends the appropriation for the coming fiscal year of the entire $45 million authorized for grants to local housing authorities to finance tenant services in public housing.

The tenant services program was passed by Congress not only to upgrade some of the basic elements of everyday living of public housing tenants, but also because Congress realized that such services aimed at improving the way of life for public housing tenants would also help to protect the substantial investment that Congress has made for the American people in public housing. NHC believes that the funding requested for tenant services represents a necessary and intelligent way to protect this investment.

(*b*). Urban renewal and advance funding: While the present administration's budget contemplates advance funding for some programs, its request again does not follow the practice of allowing "lead time" for the urban renewal and model cities budget. This elimination of an important planning tool is harmful and unfortunate and in the past Congress has recognized the exigency of advanced appropriations to allow cities to adequately plan for the future.

While the administration is requesting $1 billion for urban renewal for fiscal 1971, NHC recommends an increase in the authorizations for appropriations of $2.5 billion for fiscal 1971, $2.75 billion for fiscal year 1972, and $3 billion for fiscal year 1973. Such an appropriation will make realistic the national objective of overtaking the decay in our cities and making urban renewal more immediately responsive to urban needs. In addition, when there are such additional legislative authorizations, there should be additional appropriations for each fiscal year and an advance appropriation for the succeeding fiscal year. This will follow the past precedent established by Congress to give communities more lead time for planning their urban renewal programs.

(*c*) Full funding for sections 235 and 236 interest subsidy programs for home ownership, rental and cooperative programs; and advance funding: While the admiinstration's budget calls for full funding of sections 235 and 236 in fiscal year 1971, NHC wants to take this opportunity to express again the extreme importance of this full funding. The need for full funding is more than apparent from the demand and backlog of applications. Last year at this time there was a backlog of over 50,000 units of section 235 home ownership housing and a backlog of over 500 projects for rental and cooperative housing under section 236. This backlog has more than doubled and for the section 236 program there is $143 million of contract authority requested in excess of money available. The goals established by the 1968 Housing Act contemplated a schedule of authorizations necessary to meet those goals. Since the 1968 act there have been two increases in the FHA–VA interest rate. This means that interest assistance money will currently build about 25 percent less housing than in 1968. Therefore, NHC strongly recommends that the administration's request for $140 million for section 235 $145 million for section 236 in interest assistance contract authority for fiscal year 1971 be appropriated. NHC also recommends $170 million of contract authority authorized for fiscal year 1972 be appropriated for both the section 235 and 236 programs.

NHC is happy to note that the administration is requesting advance appropriations for section 235 and 236 for fiscal year 1972. NHC has long advocated that there should be advance authorizations in appropriation acts for at least a 2-year period for the interest subsidy programs to allow necessary lead time. The biggest drawback in these programs is the uncertainty of the availability of funds. Full funding with proper advance authorizations in appropriations acts would create a more reliable atmosphere for private developers and nonprofit sponsors to make plans for their participation and providing low income housing.

(*d*) New communities assist grants: The 1968 Housing Act authorized HUD to guarantee obligations issued by new community developers and to make up to 80 percent supplemental grants to help construct facilities such as water and sewer to serve the new community. Five million dollars was authorized for fiscal year 1969 and $25 million for fiscal year 1970. The 1969 Housing Act authorized for fiscal year 1971 all monies authorized but not yet embodied into appropriation acts. Thus far $2.5 million has been appropriated for fiscal year 1970, and the administration is requesting $10 million for fiscal year 1971. NHC, however, recommends that the full $25.5 million be appropriated for fiscal year 1971. Since 40 million additional people will be living in cities during the next decade, we need new communities to help take care of this increased urban population and to provide for orderly disbursal of population and relieve further city congestion.

(*e*) Necessity for advance contract authorization for two years for urban renewal, model cities, and the interest subsidy programs: I would like to conclude this statement with a plea for at least a 2-year advance contract authorization for the urban renewal program, model cities program, and the interest assistance programs. All of these programs have felt the serious problem and uncertainties of "stop and go" funding. The area of urban renewal and housing is, as Secretary Romney pointed out, "too big and too complicated a business to be turned off and on at will. Lack of continuity costs not only time but money. We have to fill the pipeline of production and keep it full if we are to realize the economics we need."

Emergency Health Services

Statement of Dr. Oscar P. Hampton, Jr., American College of Surgeons

Mr. Evins. The committee has received a statement from Dr. Oscar P. Hampton, American College of Surgeons, in support of adequate funding for programs to improve emergency health services throughout the United States. The statement will be placed in the record at this point.

(The statement follows:)

Statement by Oscar P. Hampton, Jr., M.D., F.A.C.S., Supporting the Budgetary Requirements of the Division of Emergency Health Services, Health Services and Mental Health Administration, Department of Health, Education, and Welfare

The information and opinions contained in this statement are based upon observations and knowledge gained from some 37 years as a practicing orthopedic surgeon in St. Louis, during which time I served as chairman of the Subcommittee on Transportation (1958–1964) and as chairman—1964–1968—of the Committee on Trauma of the American College of Surgeons. Currently, I am the assistant director, Trauma Activities, and Director of the Field Activities in Trauma of the College. As its representative, I also am a member of the Commission on Emergency Medical Services of the American Medical Association and I serve on a subcommittee of the Committee on Injuries of the American Academy of Orthopaedic Surgeons. The college, through the committee on trauma, has carried out voluntary activities for nearly 50 years designed to improve all phases of management of the injured from the accident scene to and within the hospital.

While these and concurrent voluntary activities of other medical organizations and those of governmental agencies, such as the Public Health Service and, in recent years, the National Highway Safety Bureau, have had some favorable

impact on the problem, the current status of emergency health services throughout the United States leaves a great deal to be desired and is deemed much inferior to those in many European countries. These statements can be documented.

The National Safety Council 1969 edition of Accident Facts reveals that in 1968 in the United States there were 125,000 deaths and 11 million persons disabled from injuries. Of these, 55,200 deaths and 2 million disabling injuries resulted from motor vehicle accidents. It has been said that 20,000 lives might have been saved if optimal systems of emergency health services had been in effect throughout the country. Certainly it is reasonable also that such systems would reduce significantly the extent of disabilities resulting from injuries.

The mission of the Division of Emergency Health Services of the Public Health Service is to insure that emergency health services are of the quality, quantity and availability necessary to meet the needs of the people of this country. To accomplish this mission will require application of advanced techniques employing a broad multifaceted program which will require expenditures of sizable sums of money annually for several years. Fortunately, the Division of Emergency Health Services has exceedingly knowledgeable personnel who are well organized to provide leadership for improved emergency health services, including trained ambulance personnel, effective transport of the ill or injured, emergency communications and professional services in hospital emergency departments.

Even on a limited budget in recent years, this Division has made significant contributions in several ways. In cooperation with the National Academy of Sciences-National Research Council, standards for training of ambulance and rescue personnel have been developed and published; in cooperation with the American College of Surgeons, a curriculum of training has been developed and field tested, utilizing pilot training programs in several States; packets of material on emergency health services, including material regarding regulation of ambulance services, lists of recommended equipment for ambulances, curricula of training for ambulance attendants, and descriptions of systems of communications have been distributed to the State representatives which the Division of Emergency Health Services has on duty at this time and to others interested in improving emergency health services in their respective areas.

The Division of Emergency Health Services is prepared to embark upon an aggressive program in fiscal year 1971, but continued accelerated action over a period of several years is needed. One urgent matter is the assignment of knowledgeable field personnel to each State and metropolitan urban area. This system would assure a standard across-the-board approach for advice and consultation throughout the country. Funds for financial assistance to initiate constructive programs should be available for many activities.

Some of the major activities essential to assuring coordinated community emergency health services include:

1. Conduct of workshops of varied nature.
2. Training of prehospital and hospital emergency service personnel.
3. Development of teaching packages for small rural groups.
4. Development and promotion of emergency communications systems.
5. Development of statistical information and its computerized use.
6. Conduct of research on emergency health services.

Certainly it is reasonable that implementation of these plans would make a profound contribution toward upgrading emergency health services throughout the Nation and result in many lives being saved and decreased morbidity and permanent disability for the survivors. It should be appreciated that planning for a disaster, natural or man-made, demands first improvement in day-to-day emergency health services. Definitely the Division of Emergency Health Services will have full support of medical organizations such as the American College of Surgeons, the American Academy of Orthopaedic Surgeons and the American Medical Association in implementing these programs.

The outstanding requisite for their implementation is adequate funding for the Division of Emergency Health Services. I urge favorable action on their budgetary request which appears most reasonable particularly in the light of the magnitude of the problem of improving emergency health services throughout the United States.

VARIOUS HUD PROGRAMS

STATEMENT OF CARTER L. BURGESS, CHAIRMAN, NATIONAL CORPORATION FOR HOUSING PARTNERSHIPS

Mr. EVINS. The committee has received a statement from Mr. Carter L. Burgess, chairman of the National Corporation for Housing Partnerships, in support of various HUD programs. The statement will be placed in the record at this point.

(The statement follows:)

STATEMENT OF CARTER L. BURGESS, NATIONAL CORPORATION FOR HOUSING PARTNERSHIPS

Mr. Chairman and members of the subcommittee, my name is Carter L. Burgess. I submit this statement as chairman of the National Corporation for Housing Partnerships. The Corporation was established pursuant to Title IX of the Housing and Urban Development Act of 1968 as a method of involving American industry more substantially in the national effort to increase the quantity and quality of housing for low and moderate income families.

The National Corporation for Housing Partnerships strongly endorses the administration's request for $360 million of appropriations including $145 million for the section 236 rental, $140 million for the section 235 home ownership, and $75 million for the rent supplement programs in the fiscal year 1971 budget for the Department of Housing and Urban Development. We also urge approval of the supplemental request for the current fiscal year of $25 million for each of the sections 235 and 236 programs.

The Congress in the Housing and Urban Development Act of 1968 authorized the creation of the National Housing Partnership:

The Congress finds that the volume of housing being produced for families and individuals of low or moderate income must be increased to meet the national goal of a decent home and a suitable living environment for every American family, and declares that it is the policy of the United States to encourage the widest possible participation by private enterprise in the provision of housing for low or moderate income families. The Congress has therefore determined that one or more private organizations should be created to encourage maximum participation by private investors in programs and projects to provide low and moderate income housing.

Pursuant to this authorization, the National Corporation for Housing Partnerships was incorporated in December 1968, as the first of two interlocked entities in a program to engage private enterprise in the low income housing field on a sound business basis. The venture consists of the National Corporation for Housing Partnerships and the National Housing Partnership. The National Corporation for Housing Partnerships, as the only general partner of the National Housing Partnership, will control all activities of the venture. The shareholders in the Corporation will participate as limited partners in the partnership. The National Housing Partnership will provide a vehicle for investments by the private sector in low and moderate income housing on a profit seeking basis. The partnership will work through its general partner—the Corporation—to invest its funds in local housing developments for low and moderate income families. The venture is a flexible instrument prepared to tailor its operations to meet specific local needs and problems. It will aid local developers of low and moderate income housing in processing applications for Federal and other assistance, and will help them in obtaining local financing, acquiring land, and in securing architectural, engineering, construction, legal, accounting, planning, management, and other services. In addition to establishing close practical relations with local developers, builders, contractors, and nonprofit housing corporations, the venture plans to work with community development groups and others engaged in activities relating to low and moderate income housing.

The venture is currently about midway in its drive for $49.9 million capitalization from the private sector—business corporations, financial institutions, labor unions, and other substantial private organizations. It appears that it will have broad based ownership with a highly diverse cross-section of American private industry and financial institutions. It aims to focus the best skills of industry

and commerce on low and moderate income housing problems through enlisting the investments of business, labor, and other private organizations in a national commitment to help free America of one of its most threatening and most shameful problems.

But private enterprise must have strong and continuing Government financial support if it is to produce housing within the means of low and moderate income families. It can be effective in this field only so long as funds are available to subsidize those who cannot afford the full cost of new housing. The funding request for subsidized housing programs in the administration's fiscal year 1971 budget request is, therefore, critical. We respectfully urge the appropriation of the full $145 million for the 236 program, $140 million for the 235 program, and $75 million for the rent supplement program—cuts in any of these programs would seriously reduce the number of housing units produced for low and moderate income families. In light of the Nation's accelerating housing needs, particularly for low and moderate income families, we cannot afford these lossses.

We understand that simultaneous with the consideration of the 1971 budget request, the committee is considering the Department of Housing and Urban Development's supplemental request for this fiscal year of $25 million for each of the 235 and 236 programs. These funds, authorized by the Housing and Urban Development Act enacted in December 1969, are urgently needed in order to fund projects and to begin meeting requirements during the balance of this fiscal year.

One other provision of the budget request must be mentioned. We are encouraged and pleased at the administration's request for advance authorization of $145 million for 236, $140 million for 235, and $75 million for rent supplements for fiscal year 1972. Housing development typically involves a rather long tooling-up period for market research, land acquisition, preparation of architectural and engineering plans and the like. This is expensive and risky work and without assurance that Federal funds will ultimately become available may be very unwise investment. A typical 200 unit project may involve expenditures of $50–100,000 prior to start of construction. To place development of low and moderate income housing on a businesslike basis requires longer range Federal planning and commitments. The 1 year advance authorization for subsidized housing programs requested by the administration is an important first step in this direction and we support it wholeheartedly. Not only will it facilitate responsible planning but it will enable business to tackle projects with unusually long leadtime—inner city projects involving staged relocation for instance—knowing funds will be available when the project is ready to proceed but not tying up current year funds in a project that cannot realistically proceed this year. Tackling the housing problems of the 1970's requires this continuing commitment on the part of the Federal Government. We respectfully urge your approval of the advance authorization.

Thank you for the opportunity to present our views during your deliberations. We trust that the National Corporation for Housing Partnerships will soon be ready to do its part for low and moderate housing needs of the Nation.

Housing Programs, Section 235

Statement of Mrs. Theodore Walters, Housing Committee, the Town of Herndon, Va.

Mr. Evins. The committee has received a statement from Mrs. Theodore Walters, Housing Committee, the town of Herndon, Va., in support of section 235 of the National Housing Act. The statement will be included in the record at this point.

(The statement follows:)

Before the Subcommittee on Independent Offices and Housing and Urban Development

Mr. Chairman and members of the committee: The following is presented in favor of the appropriation of $140 million being considered for section 235 of the National Housing Act for fiscal year 1971.

Section 235 meets the needs of low- and moderate-income families who desire to own their homes, especially those who own land or now own and occupy sub-

standard housing. Approximately 90 percent of the housing requirements of the town of Herndon fall in this category.

In December, 1966, the town of Herndon, in conjunction with Fairfax County, surveyed its housing needs. This survey disclosed that there were 55 substandard structures. Of this number, 30 were found to be in deteriorating condition and 25 were considered to be dilapidated. This survey was updated in December 1969, and the number of substandard structures was found to have increased to 60. Five units previously considered to be in deteriorated condition had become dilapidated. Five single-family housing units which were considered sound had deteriorated. Forty-eight of these 60 units are occupied. All but 2 of the occupied units are owner-occupied.

This reverses an earlier trend. In 1960, 83 units were considered to be in deteriorating condition, and 49 were classified as dilapidated. The total number of housing units increased by 264 units over the same period.

Herndon is a small community (5,000 population, estimated). It is in the process of change from a rural to a suburban community. A large portion of the town is only now being provided public water and sewer service. Some streets are unimproved. The neighborhoods where concentrations of deteriorating and dilapidated housing are found are those where water and sewer were not available and other improvements could not be provided. These conditions preclude home improvement loans and other financing which would have enabled the owners to rehabilitate their homes.

The town's current water and sewer program will be completed this year. Through assistance from the University of Virginia, redevelopment plans have been completed for one of these neighborhoods (Cooktown). Fairfax County has appropriated funds to improve streets, provide drainage, and extend water and sewer services in accordance with this plan. These improvements are also scheduled for completion this year.

Loans under section 235 would enable approximately 15 families to erect acceptable housing units on the land they now own in this neighborhood. A like number of dilapidated substandard units could be demolished. Without this assistance or something equivalent, improvement is doubtful due to the income level of the neighborhood—poverty level, up to $6,000 per year.

It is believed that there are many small towns similar to Herndon, Va. It is also our belief that their housing problems are not unlike ours. Adequate funding of section 235 is particularly important and applicable to small towns with growing pains. Favorable action upon the matters before you will help Herndon and towns like it to solve their housing problems.

Proposed Policy on Applied Science Programs

Statement of Dr. Thomas G. Fox, Governor's Science Advisor, Commonwealth of Pennsylvania

Mr. Evins. The committee has received a statement from Dr. Thomas G. Fox, Governor's science advisor, Commonwealth of Pennsylvania. The statement concerns a proposed policy on applied science programs. The statement will be included in the record at this point.

(The statement follows:)

Statement of Dr. Thomas G. Fox, Science Advisor to the Governor of Pennsylvania, Chairman of the Governor's Science Advisory Committee and Chairman of the Board of the Pennsylvania Science and Engineering Foundation

To: The Subcommittee on Independent Offices and HUD of the House Appropriations Committee, February 21, 1970.

Subject: A joint NSF-State strategy to utilize effectively science for society in the seventies.

Purpose: To present an outline of premise and a proposed NSF policy on applied science programs.

Questions. How do we effectively generate and locally adapt new domestic technology?

What can State governments and NSF (and other agencies) do in concert that contribute more than the sum of their uncoordinated efforts?

PREMISE*

The transition: National science to domestic technology.—We are in a period of national transition from a need of the past 30 years for new programs in national science (defense, space, atomic energy) to an urgent need to mount new programs generating domestic technology meeting the pressing public needs of housing, health, transportation, environment, and education.

The innovative development of domestic technology (in housing, health, transportation, environment, and education) insuring the quality of life throughout the United States is the major goal of the seventies.

PRACTICAL PAYOFF AND THE STATE SCIENCE ROLE

It is apparent that needs in housing, health, transportation, environment, and education are traditionally and properly the responsibility of State and local governments.

It is absolutely necessary that State leadership in development, adaptation, and use of domestic technology according to local needs and desires be mounted speedily.

Federal leadership to stimulate and to coordinate national attacks on domestic problems is mandatory.

Thus, Federal and State programs must operate in concert to contribute more than the sum of uncoordinated efforts.

Some States (Connecticut, New York, North Carolina, Pennsylvania, Georgia) have in recent years supported interdisciplinary applied research centers in their universities. They have found effective ways to provide continuing responsible communication and mutual response between the academics in such centers and the practical leaders in the appropriate State, local and Federal agencies, and the related industry.

INTERDISCIPLINARY APPLIED SCIENCE PROGRAMS

Dr. DuBridge, the President's Science Advisor, has called for the establishment of interdisciplinary centers of applied science working innovatively on these problems.

The NSF is beginning a new program of this type in the universities.

PROPOSED POLICY

We believe

The Nation's science and universities will serve us better in the 1970's if:

There are NSF and States monies supporting in concert applied research on innovative developments of the required domestic technology.

States are given a leading role in seeing that the centers are responsive and contributing to practical needs of the region.

NSF (and other agency) funding of applied programs encourage, assist, and accept State leadership in State and region-oriented programs throughout the United States.

We believe that congressional leaders and committees can greatly accelerate the certain and effective use of our scientific knowledge and universities to serve urgent human needs by adopting this policy.

PROGRAM PROPOSAL

We propose an NSF budget for pioneering applied research on new domestic technology of:

Thirty million dollars in fiscal year 1971.

Forty-five million dollars in fiscal year 1972.

Sixty million dollars in fiscal year 1973.

REMARK

Thirty million dollars is just 10 times the annual budget proposed in Pennsylvania for this purpose.

Sixty million dollars is 12 percent of the current NSF budget, and may well be closer to 5 percent of the NSF budgets later in the 1970's.

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*See appendix for a further perspective on this premise.

Five percent to 10 percent of NSF funding to promote use of our science to serve domestic human needs throughout the regions of the Nation does not seem excessive.

NSF SHOULD BE INSTRUCTED BY CONGRESS

1. To adopt funding procedures and programs which—encourage, promote, assist: the development of State and regional science policy groups and programs of State funding throughout the country. Fund jointly programs of applied research initiated by individual States with strong coupling to agencies and industries responsible for practical domestic problems throughout the Nation.

2. To establish an advisory committee, comprised of representatives of industry, State and local governments, and universities knowledgeable and concerned with the development and adaptation of domestic technology, meeting regional needs, to advise on the implementation of policy and programs described above.

3. In implementation, the NSF would need to draw up statements of goals and suggested structures of these State organizations, and criteria for acceptability. NSF should plan in-depth briefing on a continuing basis as needed to advise State representatives as to useful approaches.

SUCH A PROGRAM

Will promote in each participating State a conscious and growing dedication and utilization of local leadership and local resources to solve local problems.

State governments will develop the sophistication and means to understand, to develop or adapt, and to use technology. They will learn to cope.

Universities will become more concerned with local domestic needs and will better serve their communities and students. A better interface between universities and the real world of local government and industry will result.

Greater coordination of Federal and State policies and programs will be fostered, thereby increasing the efficiency and effectiveness of national programs designed to meet our domestic problems.

APPENDIX

I. Perspective on the Nation's scientific and engineering programs.
II. Proposed criteria for NSF-State demonstration programs.
III. Examples of successful State Science Programs.
IV. Domestic technology for the 1970's: An outline of premise and policy.
V. Roles for different institutions.

APPENDIX I

PERSPECTIVE ON THE NATION'S SCIENTIFIC AND ENGINEERING PROGRAMS

Measures of the Nation's scientific and engineering programs include (1) their intellectual quality in advancing knowledge, and (2) the vigor with which they apply this knowledge to meet human needs.

On the application of science, the U.S. experience in this century may, perhaps, be categorized under three main headings:

First Period—Science for industry (chiefly consumer-oriented)

In the first third of the century we learned to organize research and development undertakings in industry to speed technological progress in selected areas. The universities grew to support this effort through basic research and training of scientists and engineers. The happy result was to escape from the economy of scarcity of all previous eras.

Second period—Science for defense

In the middle third of the century we learned how to mount massive national undertakings to assure technological progress in areas vital to our national defense. Congress, Federal agencies, our university communities, and the new aerospace industry learned to work together to do the job effectively.

Third period—Science for society (chiefly domestic technology)

In the last third of this century our Nation is faced with critical domestic economic urban and environmetnal problems whose solutions involve both

technological and social factors. We must learn how to use our knowledge and resources effectively to insure technological and social progress. There needs to be a revival of engineering scholarship in the broadest sense with close participation by Federal, State and local governments and industry in new partnerships—working together in ways as yet undefined.

APPENDIX II

Prosped Criteria for the NSF–State Demonstration Programs

1. Programs submitted by the state Science board or other appropriate State agency are designed to meet the State's environmental and social needs and utilize more effectively the resources of the State.
2. Individual projects are directed at the problems or opportunities within the State, with promise of applicability in other States generally.
3. Individual projects should be preferably interdisciplinary and inter-institutional.
4. Projects are to be conducted with effective communication among the appropriate government, professional, and industrial agencies and institutions, acting as advisory bodies or as joint client-sponsors or in other arrangements to couple development with potential users.
5. Projects can be funded by grants or contracts with universities or non-profit institutions, including State or local government agencies, or by contract with industry.
6. In general, the project should better mobilize the State's scientific and technological resources in concentrated effort to innovate, demonstrate, or promote new conceptual and/or technological approaches to local problems or opportunities and to train professionals and students in the disciplines required for their implementation. Ideally, the project provides a focal point for input from all appropriate elements of the community to define the problem and find new solutions.

APPENDIX III

Examples of Successful State Science Programs

"Riverine-estuarine systems" is the scientist's term for lakes and rivers which connect with one another and with the sea. Such waterways link our seacoasts with vast land areas inland and are important fishing grounds, sources of fresh water, recreational areas and natural highways for the transportation of goods and people. Eastern Pennsylvanian is served by two such systems, the Delaware and the Susquehanna-Chesapeake. Both link forest and farmland in northern Pennsylvania with the Washington-New York megalopolis which spans the southeastern part of the State. Usage of these waters ranges from fishing and hydroelectric production through irrigation, drinking water and industrial use.

In August of 1966, G-SAC pointed out the vast potential which the Delaware and Susquehanna held for Pennsylvania and decried misuse of these waters, particularly through pollution. G-SAC sponsored a program called Operation Cleanstreams to alert people in business, the sciences and numerous civic groups to their stake in conserving these waterways. Soon the business community, after evaluating the economic impact of pollution, became active promoters of cleanstreams. Citizens' groups began to recognize that the Delaware and Susquehanna could provide sorely-needed recreational facilities for southeastern Pennsylvania. And scientists in both industry and the universities set to work looking for ways to eradicate pollution and develop the Delaware and Susquehanna as transportation and recreation centers.

P-SEF, which had been monitoring all this activity, became convinced that systematic research into the two riverine-estuarine systems held great promise for the economic future of Pennsylvania. The Federal Government, too, was interested in this concept, and accordingly in June 1968, the National Science Foundation joined with P-SEF in funding and Institute for the Development of Riverine-Estuarine Systems (IDRES).

IDRES is an alliance of universities and research centers which share a strong interest and competency in various facets of riverine-estuarine study: marine biology, waste removal, conservation, and systems analysis, among others. Participating institutions include Lehigh University, the Academy of Natural

Science, Temple University, the Franklin Institute, and most recently the Marine Science Consortium, a group of 10 Pennsylvania institutions already cooperating in various phases of marine study. Because the lower Delaware and Susquehanna extend into New Jersey and Delaware, there are exofficio IDRES members from both States.

A unique aspect of IDRES is reflected in the structure and operation of its management. Membership and participation on both the Policy and advisory board and the technical board consists of representatives of industry and the relevant government agencies, Federal, State and regional sitting with the university and institutional personnel. This special partnership assures constant communication and interaction between the innovators and the ultimate users to promote effective and efficient use of the results.

The money provided by P–SEF and NSF is being used for research apparatus, research by professors and graduate fellows, and information gathering. The guiding concept is a "systems approach" which recognizes the interaction between various uses of the waterways and which minimizes overlapping and duplication between research projects.

A number of IDRES have already borne fruit. IDRES researchers have devised a new method of laying undersea pipelines for disposing of concentrated industrial wastes, so that this material can be carried far out to sea rather than being dumped directly into rivers and estuaries. Core-sampling studies of sedimentation in the Delaware have indicated that unsuspected portions of the riverbank are being eroded. And studies of thermal pollution have revealed that temperature changes caused by industrial discharges into the water are changing the life forms in certain parts of the Delaware, which in the long run could result in serious disruption of the "balance of nature" in these waters. Future plans include a study of how greater access and the elimination of floating debris can once more make the lower Delaware and Susquehanna suitable for boating and fishing.

IDRES activities will have repercussions far beyond Pennsylvania's borders. Hailed by the National Science Foundation as a landmark in Federal-State collaboration in applying science and technology through a systems approach to regional problems, IDRES is expected to serve as a prototype for similar programs in entirely different fields.

REGIONAL LABORATORIES AND PROGRAMS

1. The Governor's Council of Science and Technology in 1963–64 identified advanced research laboratories in the forefront of new science and innovative applications of science as having major potential for advancing the economy of the State.

2. The Governor's Science Advisory Committee in 1965 and thereafter identified areas of research and innovation, such as transporation, health care delivery, and environmental control where potential for such centers existed.

3. The Pennsylvania Science and Engineering Foundation in 1968 and 1969 funded eight proposals from such centers totaling $327,000 or 12% of the 2-year budget. These include:

The Regional Development Laboratory in Philadelphia.

The Great Lakes Research Institute in Erie.

The Northeastern Pennsylvania Educational Consortium.

The State Science Planning Center (Penn State; jointly sponsored with NSF).

The Pennsylvania Junior Academy of Sciences.

The NSF New England Conference.

The central concern of each of these centers or programs is to promote the effective utilization of science and engineering to serve the region. In each case, local (regional) support and leadership, involving regional consideration of common goals, resources, and opportunities, is central to the activity.

The RDL in Philadelphia represents an effort to encourage inventions and/or entrepreneurism at various levels, including some successful examples of black entrepreneurisms. This center has enjoyed Federal, local, and Commonwealth support in the 3 or 4 years of its existence.

The Great Lakes Research Institute enjoys financial support and leadership from the industrial and academic communities, and local government. Consideration of regional needs and creation of the Great Lakes Research Institute was the direct result of an impetus given by the Pennsylvania Science and Engineering Foundation. The interests of the Institute initially center on waste disposal

and pollution abatement. Conceivably, GLRI will provide a mechanism for cooperative advanced study involving the colleges and serving the young people, industry, and local government in the area.

The Northeast Pennsylvania Educational Consortium is seeking to mobolize the region toward similar ends.

The purpose of the State science planning center is to develop further insight as to mechanisms whereby states can generate effective programs to utilize innovative science and engineering to meet modern needs.

The NSF New England Conference is a regional conference to explore how states can utilize science and technology to serve society.

APPENDIX IV

DOMESTIC TECHOLOGY FOR THE 70'S: AN OUTLINE OF PREMISE AND POLICY, T. G. FOX, NOVEMBER 30, 1969

Premise: The Innovative Development of Domestic Technology Insuring The Quality of Life Throughout the U.S. Is The Major Goal of the Seventies.

Innovation: A dominant theme.—Characteristic of our age is the rapid generation of new scienfific knowledge and the deliberate innovation of new technology vitally affecting our economy and culture.

NEW KNOWLEDGE, NEW TECHNOLOGY, NEW SERVICE TO HUMANS

Today many Americans ask whether we are aggressively using science to solve our critical domestic problems and whether the harmful effects of new technology outweigh its benefits.

Innovation for private consumption.—New technology for private consumption is developed through R. & D. efforts of private corporations strongly dependent on universities for basic research and for training scientists and engineers.

National science.—Development of technology for defense, space, and atomic energy is done through programs mounted by the Federal Government in its own laboratories, in universities, and especially in the captive aerospace industry. The programs in leading universities in basic and engineering science are suited to the high science needs of industrial and aerospace programs.

The transition: National science to domestic technology.—We are in a period of national transition from a need for new programs in national science characteristic of the past 30 years to an urgent need to mount new programs generating domestic technology meeting the pressing public needs of housing, health, transportation, environment, and education.

Domestic technology: Special characteristics.—The choices of technological approaches to environment, education, transportation, housing, and health are distinguishing marks of the local culture and must be made collectively by the people in a given locale or region. In a democracy, such decisions are made by State and local governments, influenced by the informed opinions and desires of diverse local groups, professions, business, and industry.

In a decade, the national housing needs will cost a total of about a trillion dollars, health care nearly as much, and the price tags for transportation and environmental control may exceed many times over the national space budget. We shall meet the as yet incompletely defined goals of the 1970's only by marshalling private and industrial as well as government resources at all levels and only by widespread utilization of more efficient innovative technology.

STATE OR REGIONAL

Mobilization of resources.—Mobilization of human enterprise on the required scale will be effective only if the individuals and institutions involved identify themselves as local constituencies working toward clearly visible local benefits. In most instances the mainfold governments in a given urban area are too fragmental to generate effective regional approaches to domestic technological developments. State governments with broad responsibility for environment, education, highways, health, industrial development, employment, and welfare and providing the environment under which local governments and industry operate in many cases motivate and mobilize the political and technology—generating constituencies in its boundaries. In other instances, a regional organization of a number of States will represent a natural focal point for a sophisticated and coordinated regional approach to developing "Domestic Technology."

FEDERAL

Federal agencies, with greater sophistication and experience in leading technological developments and with greater resources than any single State, have great opportunity to initiate, promote, and coordinate innovation of "Domestic Technology". Minimum national standards, for example, in environmental control, are necessary to avoid inequitable regional competition; national programs are required to avoid undue duplication of developmental efforts.

UNIVERSITIES

It is essential that universities generating knowledge and concepts and trained professionals and the great bulk of the domestic industry be involved in the great rebuilding of our urban civilization. Various Federal agencies with close relations with the universities working with the individual States bear a special responsibility: to help the universities achieve at least a partial reorientation of interdisciplinary academic engineering programs directed towards "Domestic Technology."

INDUSTRY

It is equally imperative that the incomparable resources and might of America's private enterprise be dedicated to the high national goals of the seventies. Not only are the needs so great that no other course will suffice; equally important, the stakes are so high that no element of American culture can afford to "cop out" on their ultimate challenge to our systems. State governments, close to the industrial leaders who necessarily have a stake in the community and region in which they are located, have a special responsibility to challenge and mobilize this force locally. Federal agencies, accustomed to work with the captive aerospace R. & D. industry, have a special responsibility to avoid preferential selection of the latter as most convenient and familiar centers for the new national "Domestic Technology" developments. The facts are, that the resources of the familiar Federal-aerospace companies will fall woefully short for the greatest task of national rebuilding ever attempted.

The "New Federalism" and the Domestic Technology of the 70's Challenges

The key practical questions appear to be:

How do we generate a sophisticated policy on the utilization of science and technology in the individual States or, when appropriate, their regional groupings?

How can we alert our universities and other innovative technology-generating centers to today's problems and utilize present resources in new ways to provide centers of excellence in applied interdisciplinary research on today's domestic problems? How can we insure that this is done in close interface with those ultimately responsible for the choice, adaptation and installation of the end product?

How can we mobilize the private and industrial resources regionally and nationally to meet the challenge of improving and preserving the physical plant and environment of communities throughout America?

How can the Federal Government stimulate and support the necessary locally oriented political-academic-industrial apparatus in individual States or regional associations?

We believe it the responsibility of the NSF and of the academic scientific and engineering community.

To make it unequivocally clear that the goal of responsible use of knowledge to serve society in at least as challenging and important as that of the generation of knowledge.

To encourage inderdisciplinary academic engineering oriented toward real problems in interface with governmental and industrial authorities, preferably local, responsible for practical programs.

To meet its responsibilities to other governmental agencies and to the several states, we believe NSF should:

Promote the formation of high level science policy advisory groups in individual States (or regions).

Through matching funding, join with individual states in establishing interdisciplinary applied research centers of the type envisioned by Dr. duBridge.

"New Federalism" and the Domestic Technology of the 70's Guiding Concepts

Clearly it is not merely desirable but critical that the national strategy of the 1970's, designed to use the knowledge and resources of our post-industrial age to raise the quality of life for all Americans, be based on a dedicated Federal-

State alliance. Federal-State policies and programs relevant to the utilization of science in the service of society must strongly reinforce each other, in diverse regions and circumstances.

Patently, this requires close and continuing communication and sensitive coordination, beginning now. A partnership with a responsible for both the State and Federal Government, is surely the essence of "New Federalism."

Obviously, this requires sophistication and insight, at both ends of the exchange. Means must be found to promote sophistication and sensitive understanding where they are in short supply.

Earlier the urgent need in this Nation and its universities was greater depth in fundamental research in the basic scientific disciplines. This year Dr. duBridge has pointed to the present critical need in centers of interdisciplinary applied science capable of significant contributions to today's urban problems.

Today many well-staffed centers of research and development exist and means for production of products appear unlimited. The resources of the innovative genius and industrial insight of this Nation must be harnessed in new ways to new ends if the high domestic goals of 1970's are to be realized.

What is missing are the concepts, the motivated professionals, and the organizational concepts. We need sufficient numbers of our best young (and older) people, prepared with appropriate background, belief in the goals and concepts, and motivated to dedicate themselves to the new task. Our universities traditional role in our society, and opportunity, is to provide these in sufficient measure. Any strategy must surely be based on university leadership in promoting not less science but more application of science and engineering to today's special problems, not less depth in specialties for some, but more breadth for others. Not less dedication to the discovery of new knowledge, but surely as the university community grows, more dedication of larger numbers to the utilization of knowledge to serve man.

Clearly, applied research concepts directed at the physical structure of our communities and public facilities cannot be generated in isolation from those in authority who are responsible to their communities, nor removed from those with practical knowledge and responsibility for ultimate delivery of technology. Centers of excellence in conceptual pioneering applied research in our universities are essential, but only in strong communication and coupling with those responsible for acceptance, adaptation, and installation of the end product.

In short, industry must respond to the opportunity to provide efficiently the technology to rebuild our cities, to preserve the environment, to provide needed health services, and to make viable the communities in which they are located and limit or elevate the quantity of life characteristic of our technically advanced society.

States must be encouraged to develop strength and sophistication in marshalling their innovative technology-generating resources.

Federal agencies must initiate and coordinate the national effort while encouraging initiative and diversity in the individual States and regions.

Mechanisms for strong interaction of Federal-State policies and programs in on-going fashion are essential in disciplinary engineering and applied science on public problems, with a broad base, and a strong interaction with government and industry must be fostered.

APPENDIX V

Roles for Different Institutions

The functions of the university, government, and industry in finding effective routes to the use of new knowledge to solve our urban and environmental problems and the nature of the partnership among those which may be effective are, perhaps, illustrated by consideration of the several steps involved in new technological developments.

New knowledge.

New Technology and concepts.

New service to human needs.

These, and the relative involvements we may expect from elements of society may be visualized as follows:

	State of development of new solutions	Relative involvement client-sponsors		
		University	Community	Industry
Stage 1	Definition of problems	***	***	*
Stage 2	Innovative conceptual solutions	***	***	**
Stage 3	Explore and develop basic features of solutions.	***	*	**
Stage 4	Feasibility demonstration	*	**	**
Stage 5	Development		***	***
Stage 6	Installation		***	***
Stage 7	Use		***	***

The times demand major attention in the immediate future to stages 1, 2, and 3. What are the new innovative engineering-social concepts for marshaling our resources to provide more efficient and effective health care, environmental control, urban regeneration, transportation and the like? We must advance such new concepts, examine them critically and perfect them, and move to demonstration projects quickly. This requires intellectual leadership with university, industry, and governmental leaders and close collaboration among innovator, user, and ultimate supplier.

Zuni Comprehensive Development Plan

STATEMENT OF ROBERT E. LEWIS, GOVERNOR OF ZUNI PUEBLO

Mr. Evins. The committee has received a statement from Robert E. Lewis, governor of Zuni Pueblo, in support of the Zuni Comprehensive Development plan. The statement will be included in the record at this point.

(The statement follows:)

Zuni Comprehensive Development Plan

The Zuni Reservation was selected as a pilot project in the development of a comprehensive reservation planning technique. A prototype plan was designed to involve all public and private sources of funds in priority areas identified by the Zuni people.

The Zuni comprehensive development plan is as "people involved" as any plan can be. It is based on what the Zuni people want and need, stated in written comments made during a house-to-house, family-by-family survey taken in 1965.

When Zuni was selected to do the plan, the top priority projects that had been mentioned by the people, were selected by the Zuni Tribal Council, and with the assistance of technical people, the plan evolved. It contains 43 programs set up under the following major goals:

(1) Increase individual income.
(2) Enhance educational opportunities.
(3) Improve living conditions.

It is a multi-agency's plan, involving a number of Federal, State, and private agencies. These agencies have all been contacted at the local, the regional and the national levels. All have responded in a manner that has encouraged the Zuni Tribe greatly. This is a flexible plan structured within existing legislation and authority, and no new legislation is required.

The Bureau of Indian Affairs has endorsed the Zuni plan, and other Indian tribes are watching to see the results. Their reaction is dependent upon how successfully implementation is accomplished at Zuni.

The plan can be used as a guideline for planning by other tribes. Not only that, it can be used by non-Indian communities in poverty areas where there is potential for economic development.

Having in the long past experienced the piecemeal type of funding, which never has and never will fully accomplish those things that are vitally necessary on Zuni reservation, it is felt that this plan will focus the necessary funding and manpower in the major problem areas over a short period of time in order to make significant progress.

The additional investment requirements of the Zuni plan total $55 million spread over a 5 year period to fiscal year 1975. Of this amount, approximately $42 million is for capital investment. In short, it is a high impact "catch up" program designed to overcome the results of this piecemeal type of funding.

It is essential that all programs, Federal, State and tribal, be properly coordinated so that they complement and supplement each other to achieve the most effective utilization of funding.

Active Indian involvement was the most important aspect in the development of the Zuni plan. It assures that attention is being given to problems which are most important in the minds of the Zuni people. The next step is total involvement of the Zuni people in the implementation of their plan. The Zuni Pueblo, through its tribal council is presently negotiating with the BIA to assume the responsibility of supervision and administration of the programs of the BIA as well as those of the tribe. Accomplishment of this will assure complete Indian involvement and thus make BIA program money most responsive to stated needs of the Zuni people.

The Zuni people through their Tribal Council and governor, have committed their limited capital totally to the implementation of the Zuni comprehensive development plan. They appreciate this opportunity to make their wants known in this manner and vigorously solicit the support of the U.S. Congress in this undertaking.

WEDNESDAY, APRIL 22, 1970.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

APOLLO 13 FLIGHT

WITNESSES

DR. THOMAS O. PAINE, ADMINISTRATOR
DR. GEORGE M. LOW, DEPUTY ADMINISTRATOR
WILLIS H. SHAPLEY, ASSOCIATE DEPUTY ADMINISTRATOR
DR. WERNHER VON BRAUN, DEPUTY ASSOCIATE ADMINISTRATOR
WILLIAM E. LILLY, ASSISTANT ADMINISTRATOR FOR ADMINISTRATION
GERALD J. MOSSINGHOFF, ACTING ASSISTANT ADMINISTRATOR FOR LEGISLATIVE AFFAIRS
JOSEPH F. MALAGA, DIRECTOR, RESOURCES ANALYSIS DIVISION, OFFICE OF ADMINISTRATION

Mr. EVINS. The committee will come to order.

We have with us this afternoon Dr. Thomas O. Paine, the able Administrator of the National Aeronautics and Space Administration; Dr. George M. Low, the Deputy Administrator; Mr. Willis H. Shapley, Assistant Deputy Administrator; Dr. Wernher von Braun, Mr. William Lilly, Mr. Gerald Mossinghoff, and Mr. Malaga.

We are pleased to have you with us this afternoon.

APOLLO 13 ACCIDENT

Following our recent hearing, we have had one of the magnificent phenomena in the way of space shots, even though everything didn't go as planned. The members of the subcommittee wanted you to come and report to us on the most recent developments of the Apollo 13 accident. Congress and the entire country want to know the facts.

We want to congratulate you, Dr. Paine, the astronauts, and the entire space team on the safe return of these men from some 300,000 miles out in space. This has been a great achievement.

I want to read a few phrases here from an editorial that appeared in the Washington Daily News. I have watched the news reports in many of the newspapers, and this is one of the choice ones. The article says, "If ever there was a scientific marvel, this had to be it. Pick any word you like—incredible, inspiring, fantastic, sublime. The rescue of Apollo 13—by the grace of God and the ingenuity of man—was all of these and more."

The article goes on and on.

We want to commend you for the achievements. When the vehicle broke down, man took over. There has been some concern about the cost of the space program, the wisdom of going forward with it, and we wanted you to give us a report.

Dr. PAINE. Thank you, Mr. Chairman.

STATEMENT OF DR. THOMAS O. PAINE

We welcome this opportunity to discuss further with you the fiscal year 1971 program and financial requirements in the light of the events of last week.

As the whole world knows, the Apollo 13 lunar mission, after a successful launch on April 11, had an accident Monday night, April 13, when an oxygen bottle in the Service Module apparently ruptured. Contingency actions were promptly taken by the flight crew and ground controllers. The NASA team across the Nation worked around the clock for the next few days to guide the spacecraft home to a perfect splashdown in the Pacific, which took place as you know on Friday, April 17. In a moment, Dr. Low will describe these events to you in more detail and summarize briefly what we now believe to be the most probable causes of the failure in the Service Module oxygen system.

APOLLO 13 REVIEW BOARD

Immediately after splashdown, Dr. Low and I established an Apollo 13 Review Board to be chaired by Mr. Edgar M. Cortright, Director of Langley's Research Center. The full membership of the Board, announced yesterday evening, is:

Members: Mr. Edgar M. Cortright, Chairman, Director, Langley Research Center; Mr. Robert F. Allnutt, Assistant to the Administrator, NASA Headquarters; Mr. Neil Armstrong, Astronaut, Manned Spacecraft Center; Dr. John F. Clark, Director, Goddard Space Flight Center; Brig. Gen. Walter R. Hedrick, Jr., Director of Space, Office of the Deputy Chief of Staff for Research & Development, Headquarters, U.S. Air Force.

Mr. Vincent L. Johnson, Deputy Associate Administrator-Engineering, Office of Space Science and Applications; Mr. Milton Klein, Manager, AEC–NASA Space Nuclear Propulsion Office; Dr. Hans M. Mark, Director, Ames Research Center.

Counsel; Mr. George Malley, Chief Counsel, Langley Research Center.

OMSF Technical Support; Mr. Charles W. Mathews, Deputy Associate Administrator, Office of Manned Space Flight.

Observers; Mr. William A. Anders, Executive Secretary, National Aeronautics and Space Council; Dr. Charles D. Harrington, Chairman, NASA Aerospace Safety Advisory Panel; Mr. I. I. Pinkel, Director, Aerospace Safety Research and Data Institute, Lewis Research Center.

Congressional Liaison; Mr. Gerald J. Mossinghoff, Office of Legislative Affairs, NASA Headquarters.

Public Affairs Liaison; Mr. Brian Duff, Public Affairs Officer, Manned Spacecraft Center.

I also announced immediately after spashdown an assignment to our statutory Aerospace Safety Advisory Panel to review the procedures established by the Apollo 13 Review Board and its findings when they become available, and to submit an independent report to me and Dr. Low. A third assignment was made to Mr. Dale Myers, the Associate Administrator for Manned Space Flight, in two parts: first, his organization will provide all data and technical support required by the Review Board from OMSF Headquarters, the Manned Spacecraft Center at Houston, the Marshall Space Flight Center at Huntsville, and the Kennedy Space Center at Cape Kennedy. Secondly, his organization will move forward immediately with the studies, analyses, and other steps required to provide me and Dr. Low with plans and recommendations on how to eliminate the problem encountered in Apollo 13 and proceed with Apollo 14 and future manned space flight missions.

ESTABLISHING REVIEW BOARD

We have copies of the documents taking these actions for the subcommittee.

(The documents follow:)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION,
OFFICE OF THE ADMINISTRATOR,
Washington, D.C., April 17, 1970.

To: Mr. Edgar M. Cortright.
Subject: Establishment of Apollo 13 Review Board.
References: (a) NMI 8621.1, mission failure investigation policy and procedures.
(b) NMI 1156.14, Aerospace Safety Advisory Panel.

1. It is NASA policy as stated in reference (a) "to investigate and document the causes of all major mission failures which occur in the conduct of its space and aeronautical activities and to take appropriate corrective actions as a result of the findings and recommendations."

2. Because of the serious nature of the accident to the Apollo 13 spacecraft which jeopardized human life and caused failure of the Apollo 13 lunar mission, we hereby establish the Apollo 13 Review Board (hereinafter referred to as the Board) and appoint you Chairman. The members of the Board will be qualified senior individuals from NASA and other Government agencies. After consultation with you, we will:

(*a*) Appoint the members of the Board and make any subsequent changes necessary for the effective operation of the Board; and

(*b*) Arrange for timely release of information on the operations, findings, and recommendations of the Board to the Congress, and, through the NASA Office of Public Affairs, to the public. The Board will report its findings and recommendations directly to us.

3. The Board will:

(*a*) Review the circumstances surrounding the accident to the spacecraft which occurred during the flight of Apollo 13 and the subsequent flight and ground actions taken to recover, in order to establish the probable cause or causes of the accident and assess the effectiveness of the recovery actions.

(*b*) Review all factors relating to the accident and recovery actions the Board determines to be significant and relevant, including studies, findings, recommendations, and other actions that have been or may be undertaken by the program offices, field centers, and contractors involved.

(*c*) Direct such further specific investigations as may be necessary.

(*d*) Report as soon as possible its findings relating to the cause or causes of the accident and the effectiveness of the flight and ground recovery actions.

(*e*) Develop recommendations for corrective or other actions, based upon its findings and determinations or conclusions derived therefrom.

(*f*) Document its findings, determinations, and recommendations and submit a final report.

4. As chairman of the Board you are delegated the following powers:

(*a*) To establish such procedures for the organization and operation of the Board as you find most effective; such procedure shall be part of the Board's records. The procedures shall be furnished the Aerospace Safety Advisory Panel for its review and comment.

(*b*) To establish procedures to assure the execution of your responsibilities in your absence.

(*c*) To designate such representatives, consultants, experts, liaison officers, observers, or other individuals as required to support the activities of the Board. You shall define their duties and responsibilities as part of the Board's records.

(*d*) To keep us advised periodically concerning the organization, procedures, operations of the Board and its associated activities.

5. By separate action we are requesting the Aerospace Safety Advisory Panel established by referedce (*b*) to review both the procedures and findings of the Board and submit its independent report to us.

6. By separate action we are directing the Associate Administrator for Manned Space Flight to:

(*a*) Assure that all elements of the Office of Manned Space Flight cooperate fully with the Board and provide records, data, and technical support as requested.

(*b*) Undertake through the regular OMSF organization such reviews, studies, and supporting actions as are required to develop recommendations to us on corrective measures to be taken prior to the Apollo 14 mission with respect to hardware, operational procedures, and other aspects of the Apollo program.

7. All elements of NASA will cooperate with the Board and provide full support within their areas of responsibility.

T. O. PAINE,
Administrator.
GEORGE M. LOW,
Deputy Administrator.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION,
OFFICE OF THE ADMINISTRATOR,
Washington, D.C., April 20, 1970.

To: Dr. Charles D. Harrington, Chairman, Aerospace Safety Advisory Panel.
Subject: Review of Procedures and Findings of Apollo 13 Review Board.
Attachment: (*a*) Memorandum dated April 17, 1970, to Mr. Edgar M. Cortright, subject: Establishment of Apollo 13 Review Board.
References: (*a*) Section 6, National Aeronautics and Space Administration Authorization Act, 1968. (*b*) NMI 1156.14, Aerospace Safety Advisory Panel.

1. In accordance with references (*a*) and (*b*), the Aerospace Safety Advisory Panel (hereafter referred to as the Panel) is requested to review the procedures and findings of the Apollo 13 Review Board (hereafter referred to as the Board) established by attachement (a).

2. The procedures established by the Board will be made available to the Panel for review and comment as provided in paragraph 4(a) of attachment (*a*).

3. As Chairman of the Panel, you are designated an Observer on the Board. In this capacity, you, or another member of the Panel designated by you, are authorized to be present at those regular meetings of the Board you desire to attend. You are also authorized to receive oral progress reports from the Chairman of the Board or his designee from time to time to enable you to keep the Panel fully informed on the work of the Board.

4. The final report and any interim reports of the Board will me made available promptly to the Panel for its review.

5. The Panel is requested to report to us on the procedures and findings of the Board at such times and in such form as you consider appropriate, but no later than 10 days after the submission to us of the final report of the Board.

T. O. PAINE,
Administrator.
GEORGE M. LOW,
Deputy Administrator.

Enclosure.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION,
OFFICE OF THE ADMINISTRATOR,
Washington, D.C., April 20, 1970.

To: Mr. Dale D. Myers, Associate Administrator for Manned Space Flight.
Subject: Apollo 13 Review.
Reference: (a) Memorandum dated April 17, 1970, to Mr. Edgar M. Cortright, subject: Establishment of Apollo 13 Review Board. (b) Memorandum dated April 20, 1970, to Dr. Charles D. Harrington, subject: Review of Procedures and Findings of Apollo 13 Review Board.

1. As indicated in paragraph 6 of reference (a), you are directed to:
(*a*) Assure that all elements of the Office of Manned Space Flight cooperate fully with the Board in providing records, data, and technical support as requested.
(*b*) Undertake through the regular OMSF organization such reviews, studies and supporting actions as are required to develop timely recommendations to us on corrective measures to be taken prior to the Apollo 14 mission with respect to hardware, operational procedures, flight crews, and other aspects of the Apollo program.
2. The recommendations referred to in paragraph 1(b) above should be submitted to us in such form and at such time as you deem appropriate, but a report should be submitted no later than 10 days after the Apollo 13 Review Board submits its final report.
3. The assignments to the Apollo 13 Review Board and to the Aerospace Safety Advisory Panel by references (a) and (b), respectively, in no way relieve you of your continuing full responsibility for the conduct of the Apollo and other OMSF programs.

T. O. PAINE,
Administrator.
GEORGE M. LOW,
Deputy Administrator.

Dr. PAINE. Thus we will have findings and recommendations from three sources available to us shortly to help us make timely decisions on the corrective and other measures that should be taken prior to Apollo 14. Present indications are that the quantity and quality of telemetered data deceived from the spacecraft Odyssey at the time of the accident should permit a prompt and clear identification of the causes of the failure. The oxygen thermos flask believed to be involved is a relatively simple component and corrective action should not be a major task. If this proves to be the case, we anticipate that we will be able to move out promptly with the necessary alterations and proceed with Apollo 14 and subsequent flights on approximately the same schedule we have presented to you before.

I think it is very important that the subcommittee understand the view we in NASA take of the Apollo 13 accident. The Apollo 13 mission was a failure. We did not succeed in America's fifth flight to the moon and third lunar landing, nor were we able therefore to explore the Fra Mauro formation, which remains a high priority objective in our lunar program. It is too soon to say which of the remaining Apollo missions will now be sent there. Although the mission failed, we regard the recovery actions that followed the Apollo 13 ac-

cident as a very gratifying success which will contribute greatly to the Nation's space flight competence. The Apollo hardware, the contingency planning, the training of flight and ground crews, and the backup systems for emergency use appear to have demonstrated their flexibility and soundness. Our charge to the Apollo 13 Review Board, however, includes not only a critical review of the cause or causes of the accident, but also a critical assessment of the effectiveness of the recovery measures taken. We intend to learn everything possible from this real-time experience.

Finally, I should like to state our view as to how the Apollo 13 accident should affect the future of the space program. I see no reason why this setback should be—or should be made to be—the occasion for a major change in the course of the Nation's space program. We have clearly demonstrated the basic soundness of the Apollo system and of our operational procedures with the successful flights of Apollo's 7, 8, 9, 10, 11, and 12. Since the start of manned space flight, NASA's astronauts have safely flown a total of 68 million miles. From a technical standpoint, there is no question but that we are prepared to move forward with the space program for the next decade as we have outlined it to you in our previous appearances before you.

PRESIDENT'S VIEWS

I am happy to be able to report that the President fully shares this view. During our flight to Honolulu last Saturday to meet the astronauts, he expressed his strong support for a vigorous ongoing U.S. space program, particularly in manned space flight. He authorized me to make a statement communicating the views he expressed to me during the flight, which, with your permission, I will submit for the record.

Mr. EVINS. Without objection, it will be included in the record at this point.

(The statement follows:)

STATEMENT OF DR. THOMAS O. PAINE, NASA ADMINISTRATOR, APRIL 19, 1970

During the flight to Honolulu yesterday I had an opportunity to spend an hour and a half with President Nixon talking about the future of the U.S. space program. The President has authorized me to tell you about the conversation, and I would like to share a few of his thoughts with you tonight.

The President reiterated his strongest support for a vigorous, on-going program and particularly in manned space flight. We will press on, he said, in the exploration of the moon and eventually explore the planets.

There will be those, the President said, who will seize upon this accident as an opportunity to call for a slowdown or a turning back; but, he said, we are not the kind of people whose purpose is diverted by adversity or setback. We have set a good course, a forward course, he added, and we will not falter in our resolve.

During the past few months I have visited a number of countries on the President's behalf to express to scientific and space leaders the President's strong desire for all nations to share in the exploration of space. I briefed the President on my recent trips to Bonn, London, Ottawa, Canberra, and Tokyo, and he was pleased to hear that other nations were considering new ways to cooperate with us in very tangible ventures. He told me that we should continue these efforts and that he was particularly gratified by the messages of good will and support that he received from scores of nations during the Apollo 13 mission.

I told the President of our plans for a thorough review of the Apollo 13 accident. He once again expressed his confidence in, and his admiration for, the NASA

organization, and he said that these men and women, joining with our colleagues in other Government agencies, in industrial plants, and on college campuses would find a solution, fix the problem, and set forth again.

I told the President that I cannot yet set a firm schedule for the Apollo 14 mission and as soon as the Apollo 13 review board has completed its review of the accident and we know that we are ready to apply the lessons of Apollo 13 to the next mission, fix the equipment, and understand the procedures, we will announce the launch date for Apollo 14.

Finally, the President was pleased to see an enthusiastic flight crew in Hawaii, but they are tired, and he told me to go easy on the debriefings and to give Jim and Fred and Jack some well-deserved rest and relaxation. The President generously offered the use of Government facilities for this purpose, and I expressed my deep appreciation for his thoughfulness, and I have passed this on to the Apollo 13 crew.

We in NASA heartily agree they have earned all the vacation we can give them.

EDITORIAL COMMENTS ON FLIGHT

Dr. PAINE. All of us in NASA were also gratified that the leadership in Congress has taken the same view. The positive statements in the House Tuesday by Speaker McCormack and Minority Leader Ford are examples. Worldwide reaction has been the same; the great majority of editorial comments from coast to coast strongly support the position that the United States should not respond to this accident by cutting back or lowering its sights in space. We have assembled here a representative sample of editorial opinions for your inspection.

Mr. EVINS. Thank you. We will include a number of these in the record.

(The documents follow:)

[From the New York Daily News, Apr. 18, 1970]

FOR APOLLO 13—THANK GOD

Recovering from a jinxed moon stab that kept the world's teeth on edge and heart aflutter for days, U.S. spacecraft Apollo 13's command ship Odyssey splashed down yesterday afternoon in the Pacific with its three occupants alive and well. See the news columns for the marvelous details.

President Nixon has very fittingly proclaimed tomorrow a day of national thanksgiving.

And with that attended to, the U.S. space research and exploration program should proceed full speed ahead, with special reference to more manned moon shots, and the sooner the better. To falter or fail now would be, we think, as we've said before, unworthy of Americans and America.

[From the Christian Science Monitor, Apr. 18–20, 1970]

MANKIND'S VOYAGE

Never in recorded history has a journey of such peril been watched and waited out by almost the entire human race. Never, indeed, has the great heart of humanity beat in such unity of hope and helpfulness as attended the voyage of the crippled Apollo 13—with the Soviet Union, Britain, France, West Germany, Czechoslovakia, and many another country offering ships, radio silence—anything and everything to help bring the three astronauts back safely. This was mankind's as well as America's voyage.

Here was an epic beyond science fiction scenarios. Here was a test of man's fortitude and intelligence in reversing an unexpected dire disaster halfway to the moon. Here was a challenge to that remarkable teamwork of Manned Space Center scientists, electronic computers, way stations strung around the globe, and three superbly trained men—to ponder hundreds of rescue operation variables, concert action, avoid panic decisions and carry through calm procedures. There will be those who ascribe the rescue wholly to human skills and courage.

Others will see at work, affirmed in countless prayers, a power and providence which perceives "the path which no fowl knoweth." So be it. The hairbreadth plans succeeded, and the lonely voyagers are home safe from the solar seas.

At once, of course, comes the thought that the same dedication and devotion, applied to earthbound problems of city-core decay, pollution or racial strife, could bring swift amelioration. As a correspondent of this newspaper wrote from Houston: Here was "a model for intelligent action in time of seemingly unsurmountable difficulties."

The ordeal of Apollo 13 will leave its mark on the American space effort. The NASA team will probe the why of the explosion which put the fragile craft's main source of rocket power devastatingly out of action. Apollo 14, scheduled for October, may well be postponed. Public interest in moon flights is waning, NASA appropriations are down from a peak of $6 billion to $3.3 billion, and Congress will be asking anew "Are these many trips necessary?"

There will be need for serious conclusions. Has the margin of safety been too narrow? Now that the moon-landing goal set by President Kennedy has been truly achieved, what new space program will be worth the investment of billions annually, what will maintain the enthusiasm of the scientific community, what will best extend mankind's knowledge? Apollo 13 hoped to find moon rock in the lunar highlands which would determine how the moon—and perhaps the solar system—was formed.

Next on the Nixon space program, beyond lunar exploration, is the development of a rocket shuttle and a space station. There are plans to send an unmanned probe on a grand tour of the major planets between 1977 and 1979—and earlier in 1976, for a nunmanned probe for "life on Mars."

Today the world knows deep gratitude that the Apollo astronauts have had a safe splashdown. Tomorrow, America's space program must move forward again—doubtless at a more "deliberate" speed, warily watching for another Soviet space "spectacular," but deeply benefiting from the sober rethinking which Apollo 13 has forced upon the space community.

[From the Chicago Daily News, Apr. 18–19, 1970]

THE HAPPIEST LANDING

At the end, it was a normal, routine landing, or at least as normal and routine as a return from space can be at this stage. So the Apollo 13 flight ended as calmly as it began. But the world will not soon forget what came between—4 days of utter concentration on rescuing three men from a deadly danger never faced before.

The safe return of astronauts James Lovell, Fred Haise, and John Swigert marks a triumph for the space program, but of a far different sort than had been planned. And while there is disappointment that the moon expedition failed of its scientific purpose, the miraculous turnaround from disaster out weighs all else.

This was a brutal test of men and equipment, with both forced into roles unforeseen. Neither failed. The calm courage of the astronauts under extreme stress was matched by that of the men on the ground who devised the emergency procedures and made the intricate calculations vital to the rescue. The equipment, save for that still-unexplained blast in the service module, also came through. And the ungainly LM, the lunar module named Aquarius, proved to be the inanimate hero in its "lifeboat" role.

But most of all this was a human drama unique in the long history of the world. It can be truthfully pointed out that thousands of human beings died, many of them violently and most largely unnoticed, while the world spent its emotions on three men in space. The irony is self-evident, but it misses the point.

Surely the main point is that the space rescue became a larger than life symbol of the side of man's nature too seldom brought into sharp focus—his capacity for helping fellowmen in trouble. With so much of mankind engaged in quarreling and cheating and killing, here was an event crammed not only with suspense but with solid evidence that people can still care about each other, and will go to any lengths of sacrifice to lend a hand.

Around the world, millions were praying for the astronauts. Russia led the parade of nations offering aid in the recovery area. Briefly—all too briefly—there was a unity of spirit and purpose transcending all the divisive elements that mar normal life on earth.

The moment passed, and may not come again. Certainly we hope future moon missions do not bring a comparable brush with catastrophe. But in giving thanks for the safe return of the astronauts we should also savor the moment of unity, and hope some small residue of that feeling may survive to touch the other endeavors of the human family.

[From the New York Times, Apr. 19, 1970]

EARTH DAY AND SPACE DAY

As the disabled Apollo 13 rounded the moon and flew homeward again last week, there was passionate worldwide interest in its consumables. Was there enough oxygen and water left on their crippled craft to permit Lovell, Haise, and Swigert to make it back to earth? Would the available supply of lithium hydroxide suffice to clean their air of carbon dioxide and keep it breathable until splashdown? No great explanations were required to rouse such concern among ordinary citizens. It was self-evident that a small spaceship carries only finite, limited supplies of gases, fluids, food, and other life essentials, and that spacemen must return to earth before these resources are exhausted.

It is only recently, however, that many people have begun to realize that earth too is a sort of spaceship and that it too has only a limited supply of consumables. Even now, hundreds of millions of men and women still naively think that earth has what Kenneth Boulding has called a "cowboy economy," with resources as infinite and unending as the Great Plains must have seemed to those who herded cattle in the West a century ago. Every person understood last week that the scarce supplies on Apollo 13 had to be husbanded carefully, consumed economically, and recycled for reuse wherever possible. Earth Day next Wednesday aims above all to convince the American people that similar prudence is required on spaceship earth.

It is no mere coincidence that the great recent upsurge in ecology has coincided with the historic space triumphs at the end of the 1960's. An easily comprehended visual perspective of the earth's place in the universe was unobtainable until craft were available that could take cameras thousands of miles into deep space.

Not until Apollo 8 sent back earth's self-portrait were millions able to see and realize how "small and blue and beautiful" this planet is, and to understand—to quote Archibald MacLeish again—that earth is really a "tiny raft in the enormous, empty night.

On top of this new understanding came the evidence about the moon from Apollo 10 and Apollo 11, and about Mars from Mariner 6 and Mariner 7, the brutal testimony that earth is almost certainly unique in the solar system. Its "consumables," its water and oxygen and the abundant life they make possible exist here alone; they cannot be replenished from anywhere else if men exhaust them or befoul them into unusability.

In the wake of the emergency that threatened disaster for Apollo 13, many asked whether lunar exploration and space flight would continue after this vivid demonstration of the terrors of the cosmos. In the short run the answer is clear, for the lure of space and of the vistas it has opened is too great to be ended by one near-catastrophe. But for the longer run future, space exploration—like every other human activity—is contingent upon the health of this planet, upon the continued availability of the "consumables" for those who remain here and for those who rocket into the cosmos.

In that sense next Wednesday is Space Day as well as Earth Day; for unless this flowering home planet remains a haven of life the entire solar system may become as devoid of life as are now the mountains of the moon and the polar regions of Mars.

Dr. PAINE. Now, with your permission, I would like to ask Dr. Low to say a few words about what we now believe to be the most probable causes of the accident. Then we will undertake to answer any questions you may have about the accident, our actions to recover from it, the further steps we are taking to identify the causes and eliminate the problem for Apollo 14, and any impact this might have on our financial requirements for fiscal year 1971.

REVIEW BOARD MEMBERSHIP

Mr. JONAS. I want to preface this by saying that this inquiry is not based on any lack of confidence in the people you have appointed on this Review Board, but I do notice that all of them are connected directly or indirectly with NASA.

What would you say, for the record, as to the advisability of confining membership on these review boards to your own people, or the advisability of bringing in some outsiders to participate?

Dr. PAINE. Actually, Mr. Jonas, we have two people here of the total who are from outside NASA though one is only semioutside. We asked the Air Force for one of their top people to sit on the Review Board to give us an outside assessment.

Mr. JONAS. That is General Hedrick?

Dr. PAINE. That is right. Secretary Seamans, after consulting with various people, picked General Hedrick for that.

We also have Mr. Milton Klein, who is with the Space Nuclear Propulsion Office, a combination of Atomic Energy Commission and NASA; he brings a very separate and independent view from that quarter.

We felt we should have two of the seven people from outside and we thought that the five NASA people should indeed be the best people we could find in the country, the people most familiar with the systems, but people without any direct responsibility for the Apollo 13 mission and our manned space flight activity, so within NASA they would be independent. We do not have the manned space flight people investigating manned space flight activities.

Mr. JONAS. I just wanted to give you an opportunity to make a comment in this connection immediately following your prepared statement.

Dr. LOW. I wonder if I could add one word to that, Mr. Jonas? We also have the Aerospace Safety Advisory Panel which is referred to on page 3 of Dr. Paine's testimony. This is a panel established by the Congress and most of the membership is from outside NASA.

PREVIOUS REVIEW BOARD

Mr. TALCOTT. Could you compare this panel with the panel used after the other accident? How were those people chosen?

Dr. LOW. The NASA Review Board was chosen by the Administrator of NASA and included, again, all Government people. I don't recall exactly how many people were on it, but they were mostly NASA people with one member from the Air Force, and, I believe, one from the Civil Aeronautics Board.

Mr. SHAPLEY. It also included one fire expert from the Bureau of Mines.

Mr. TALCOTT. My recollection is that it was generally chosen in the same way, with the same composition, and with the same attitudes. I am wondering if there were any complaints about the selection of that Review Board and the conduct of their investigation or findings?

Dr. PAINE. I believe the general impression has been and remains that that Board did a very good job and that the corrective action that was taken has been proven by the long string of successful space flights since that time.

Mr. TALCOTT. I think Mr. Jonas and all of us are very anxious that this be a very thorough and complete investigation that will stand up anywhere before all the people.

Mr. EVINS. Dr. Low, do you have a statement in addition to that of Dr. Paine?

STATEMENT OF DR. GEORGE M. LOW

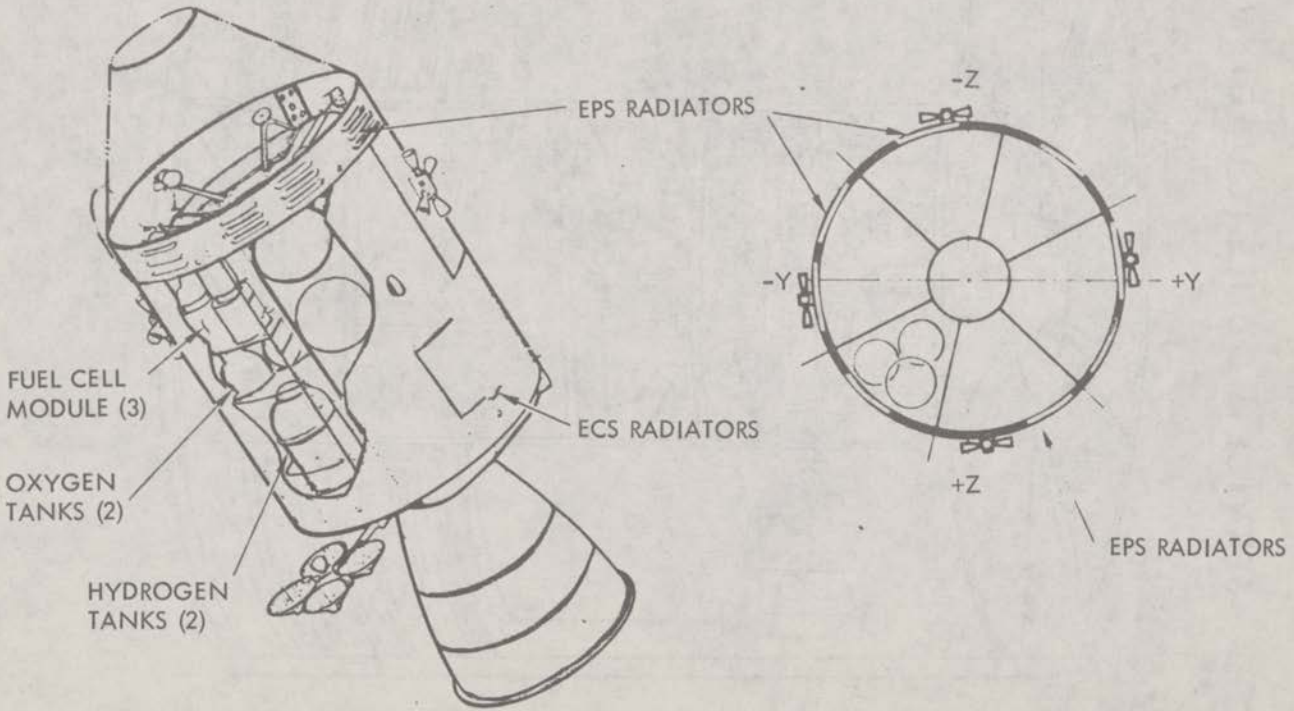
Dr. Low. Yes, Mr. Chairman. I have a few charts that should be in front of you and these will help me in explaining exactly what happened.

(The charts follows:)

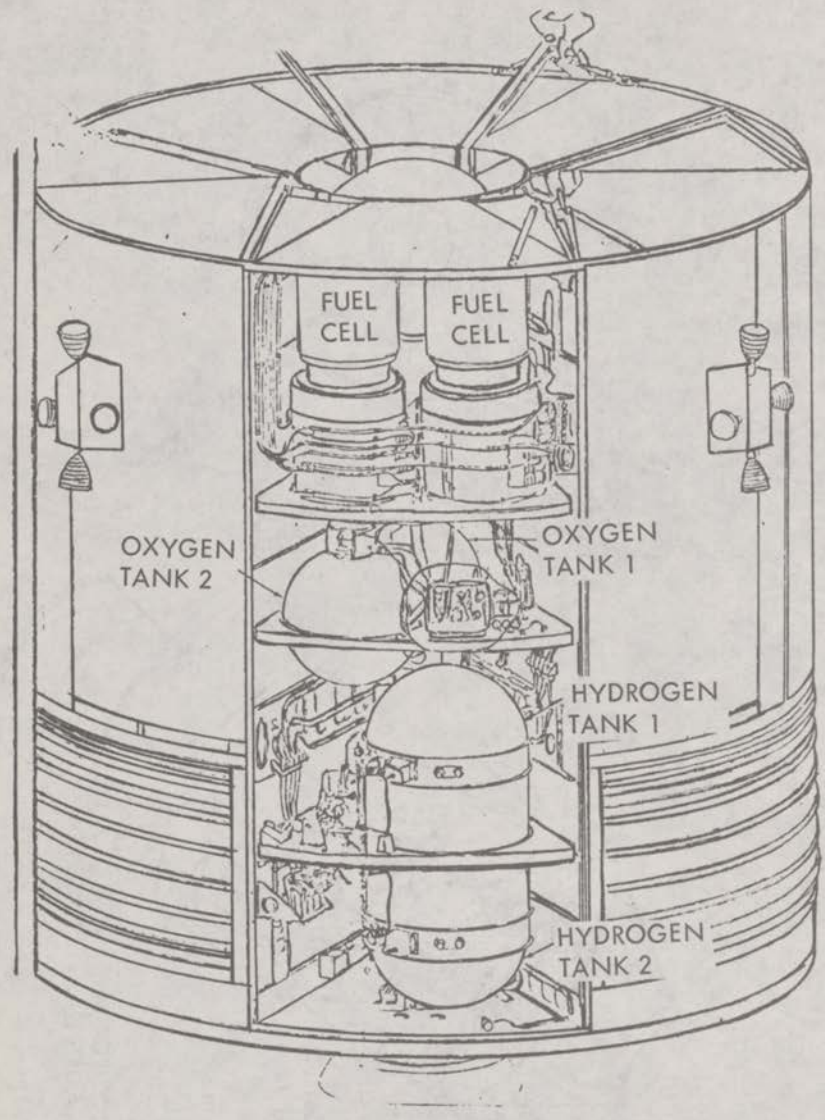
SEQUENCE OF EVENTS

GROUND ELAPSED TIME	EASTERN STANDARD TIME APRIL 13, PM	EVENT
55:53	10:06	OXYGEN TANK FANS TURNED ON
55:53:22	10:06:22	HIGH CURRENT SPIKE, FUEL CELL #3
55:53:36	10:06:36	OXYGEN TANK #2 PRESSURE RISE
55:53:38	10:06:38	9 VOLT TRANSIENT, AC BUS #2
55:53:41	10:06:41	HIGH CURRENT SPIKE, FUEL CELL #3
55:53:45	10:06:58	OXYGEN TANK #2 TEMPERATURE RISE
55:54:45	10:07:45	OXYGEN TANK #2 MAXIMUM RECORDED PRESSURE
55:54:53	10:07:53	LARGE SPACECRAFT MOTIONS
55:54:56	10:07:56	OXYGEN TANK #2 PRESSURE ZERO
55:55:20	10:08:20	LOVELL "I BELIEVE WE HAVE A PROBLEM HERE"

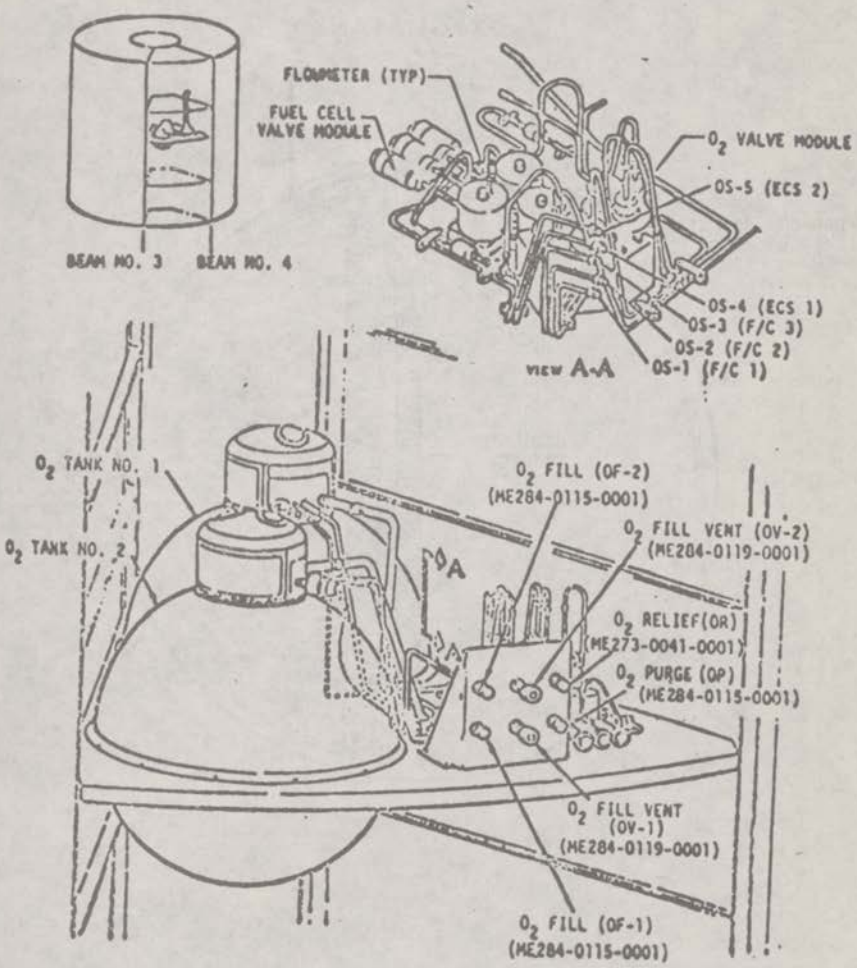
ELECTRICAL POWER SYSTEM



SERVICE MODULE (QUAD) IV)

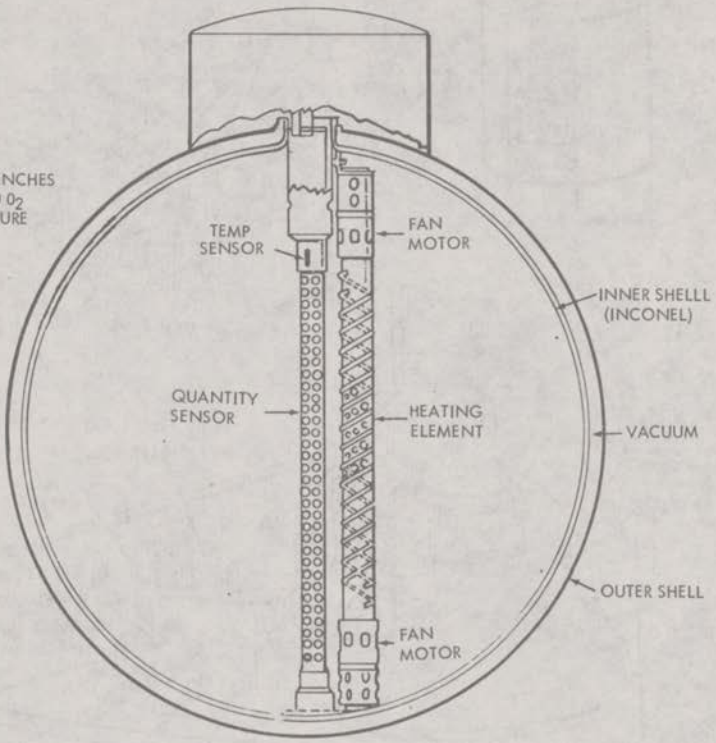


OXYGEN SUBSYSTEM SHELF MODULE



OXYGEN TANK

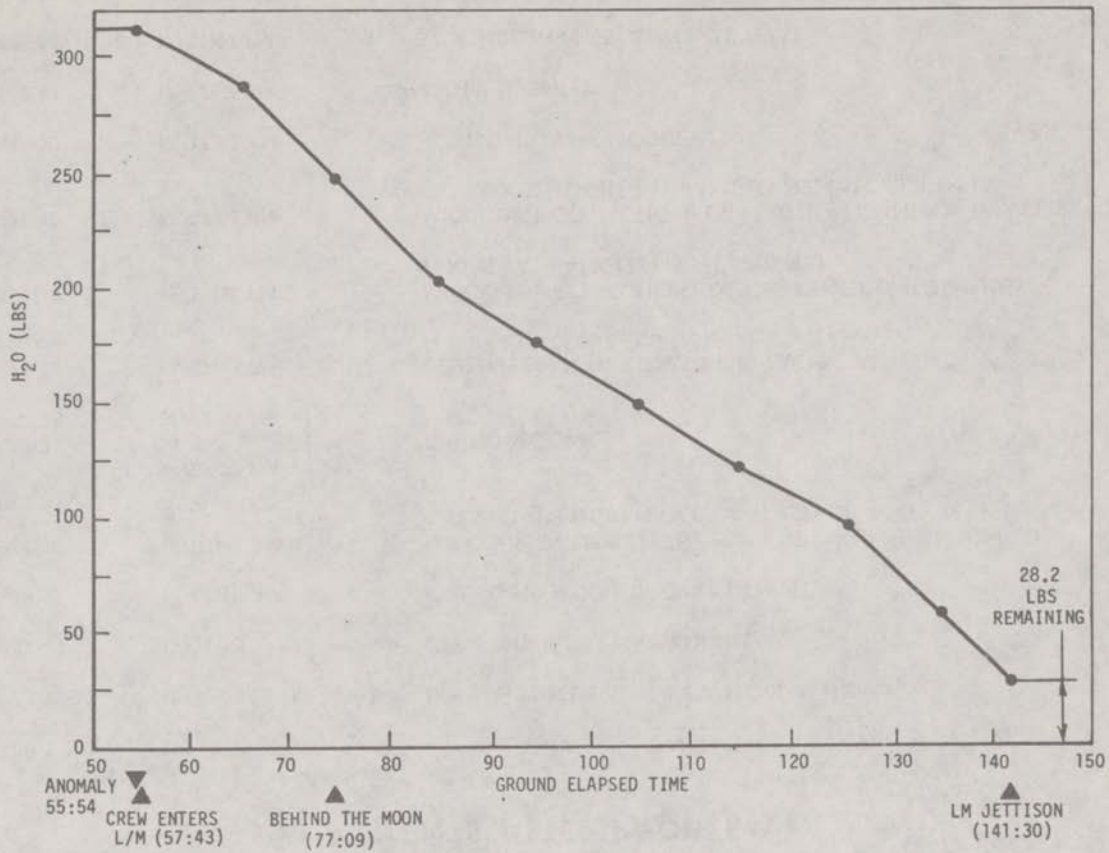
DIAMETER -25 INCHES
CAPACITY -330 0_2
NORMAL PRESSURE
870 -930 PSI



KEY EVENTS AFTER PROBLEM

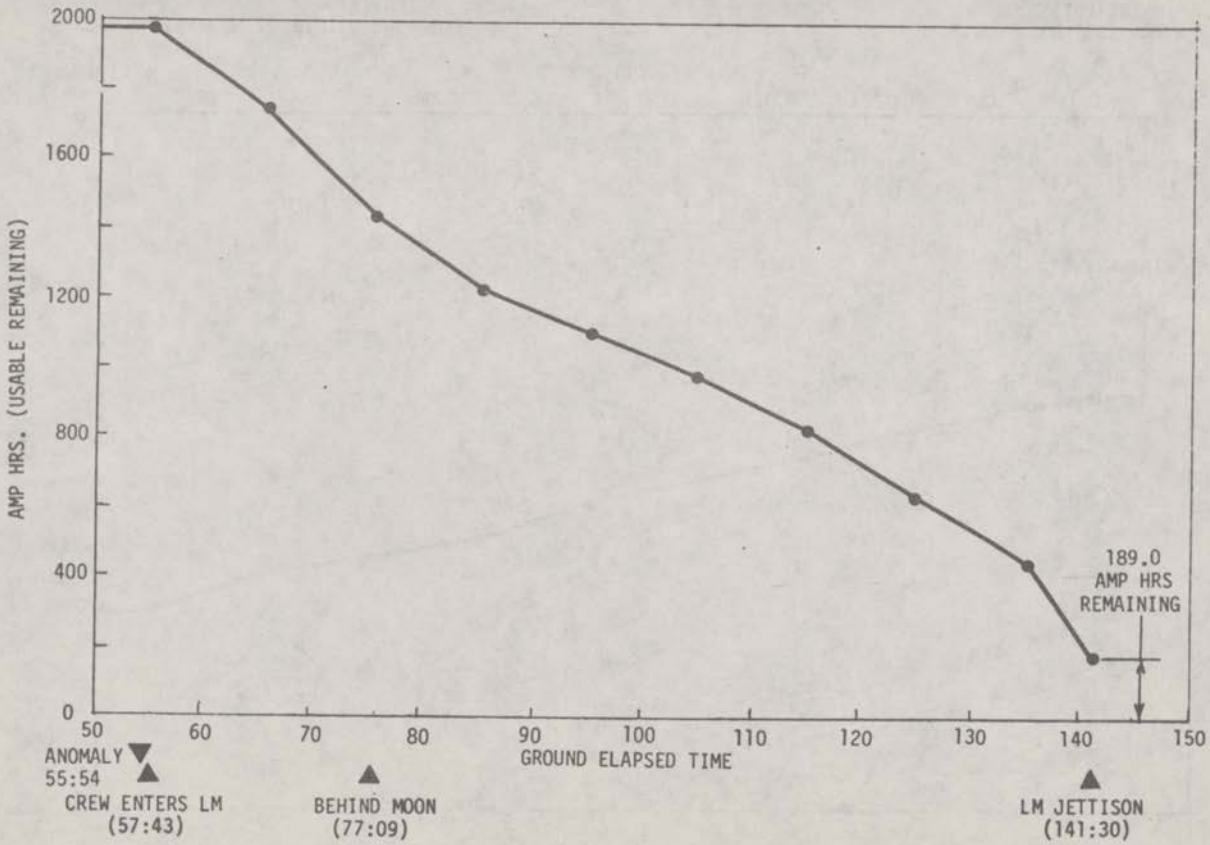
GET	EST	EVENT
55:55:20	13/10:08:20 PM	LOVELL: "I BELIEVE WE'VE A PROBLEM HERE."
57:43	13/11:56	CREW ENTERED LUNAR MODULE
58:57	14/01:10 AM	COMMAND MODULE POWER DOWN
61:30	14/03:43 AM	MIDCOURSE CORRECTION, DESCENT ENGINE, (RETURN TO FREE RETURN: INDIAN OCEAN AT 152) (30.7 SEC; 38 FPS)
77:09 TO 77:38	14/07:22 PM TO 14/07:51 PM	BEHIND MOON
79:28	14/09:41 PM	DESCENT BURN (RETURN TO MID PACIFIC AT 142:47) (4 MIN 23.4 SEC; 860.5 FPS)
105:19	15/11:32 PM	MIDCOURSE CORRECTION, DESCENT ENGINE (TO ADJUST FLIGHT PATH ANGLE) (15 SEC; 7.8 FPS)
137:40	17/07:53 AM	MIDCOURSE CORRECTION; LM REACTION CONTROL THRUSTERS (TO ADJUST FLIGHT PATH ANGLE) (22.4 SEC; 3.1 FPS)
141:30	17/11:43 AM	JETTISON LUNAR MODULE
142:41	17/12:54 PM	BEGIN RE-ENTRY
142:54	17/01:07 PM	SPLASHDOWN (165° 22'W X 21° 39'S)
143:40	17/01:53 PM	CREW ONBOARD SHIP

USABLE REMAINING WATER



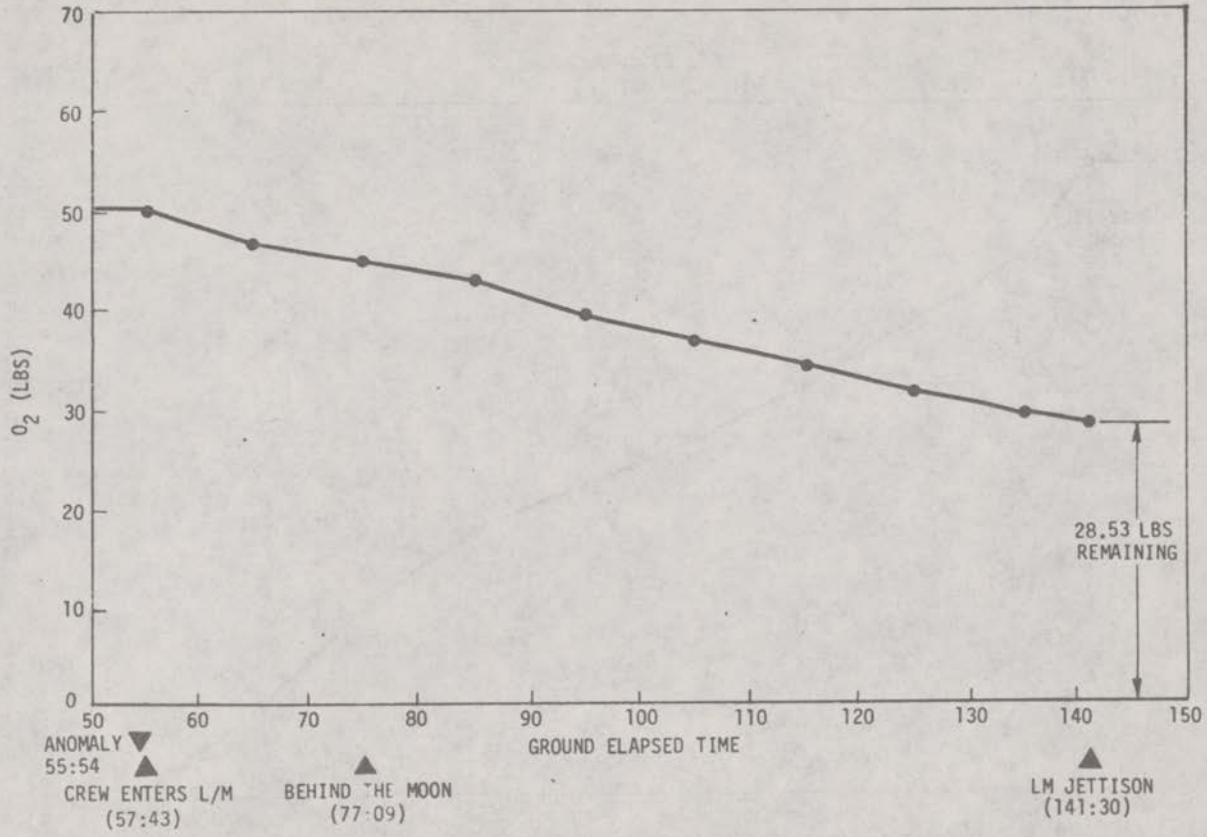
4091

ELECTRICAL POWER SYSTEM CONSUMABLES STATUS



4091

USABLE REMAINING OXYGEN



4091

CO_2 REMOVAL BY LITHIUM HYDROXIDE

REQUIRED	-	85 HOURS
AVAILABLE IN LM	-	53 HOURS
AVAILABLE IN CM	-	182 HOURS

CM CANISTERS USED IN LM THROUGH USE OF "JURY-RIGGED" CONNECTION.

Mr. TALCOTT. Have you met with the Review Board?

Dr. LOW. I have not met with the Review Board, but I have talked with the chairman. What I will be able to talk about this afternoon is a preliminary view of what we know today in NASA of what occurred and what the causes might have been.

Dr. PAINE. This is to bring you up to where we are today, but obviously the investigation has to still be made.

SEQUENCE OF EVENTS

Dr. LOW. On my first chart entitled "Sequence of Events," I have shown the events that occurred during the minute or 2 preceding the explosion in the oxygen tank in the spacecraft.

The first event of interest occurred at 10:06 p.m. eastern standard time on April 13, which was 55 hours and 53 minutes into the flight. At that time the oxygen fans—these are small fans located inside an oxygen tank—and I will show you a picture of that later—were turned on by the flight crew on request from the ground. This was a normal procedure.

Within 22 seconds after that, we noticed some problems on the electrical system. I should point out these were not noticed at the time because they occurred so quickly; they were on data collected in our tracking stations but did not appear directly in the Mission Control Center.

Mr. JONAS. You turn those fans on to distribute the oxygen?

Dr. LOW. To distribute the oxygen within the tank. The tank contains oxygen in a state that is partly a gas and partly a liquid. Periodically these fans are turned on to mix the liquid and the gas within the tank.

Dr. PAINE. The tank itself is about 25 inches around. We have two little fans inside the tank to mix the oxygen.

Dr. LOW. Twenty-two seconds later there was an excursion of the current measured on fuel cell 3; this was something like a short circuit which was measurable by our seeing an increase in current momentarily. Thirty-six seconds after the fans were turned on, we noticed that the pressure inside this oxygen tank, this 25-inch sphere, started increasing. Two seconds later we noticed another excursion in the current; another indication of a short circuit, 3 seconds later. Then we noticed a temperature increase in the tank. A minute after the temperature increase, we noticed that the pressure had reached the maximum that we could read on our gages. Our gages were not intended to measure a pressure rise to the point where the oxygen tank would burst. They were used for measuring the pressure at lower levels only so the gages reached maximum pressure.

Immediately after that, 8 seconds later, we noticed some motions on the spacecraft which were an indication to us later and to the crew at the time that something happened in the service module area. Something was venting that caused the spacecraft to move.

ZERO PRESSURE IN OXYGEN TANK NO. 2

Two or three seconds later the pressure in oxygen tank 2 dropped all the way to zero and it wasn't until 30 seconds after that that Lovell reported, "I believe we have a problem here."

The main point is that these events took place over a period of approximately 2 minutes. In terms of problems we have seen in the spacecraft, this is a long period of time and therefore the analysis of these events is considerably easier than some things we have seen in the past that occurred in milliseconds or microseconds; just fractions of a second.

Mr. JONAS. Did you record these events in Houston?

Dr. LOW. These were all recorded either in Houston or at tracking stations around the world, but the information is now available in Houston.

Mr. JONAS. These specific changes were transmitted out of the spacecraft?

Dr. LOW. They were transmitted out of the spacecraft; that is correct.

Mr. JONAS. Automatically?

Dr. LOW. Yes, sir.

ASTRONAUTS KNOWLEDGE OF PROBLEMS

Mr. BOLAND. Were they available to any of the crew? Would the crew have known what was going on?

Dr. LOW. The crew would not normally, all the time, look at the gages that are available to them to get some of this information. However, once they noticed they had problems they would turn switches to turn on certain gages. They saw some of these indications but not until a minute or so later.

Mr. TALCOTT. Which ones were recorded in Houston that you knew about right at the time? You knew that the fan was turned on because you did that in Houston, didn't you?

Dr. LOW. We asked the crew to turn it on from Houston.

Mr. TALCOTT. What did you notice between then and the time Lovell said "I believe we have a problem here"?

Dr. LOW. I don't have that information reconstructed. I don't know how much of this information was available before Lovell reported and how much of it appeared only on tapes that had to be analyzed after the fact. This, of course, the Review Board will determine.

Mr. EVINS. Are you telling the committee they knew the problem in Houston before the astronauts knew it in the spacecraft?

Dr. LOW. No, sir; I did not make that clear. This is the sequence of events that led up to the trouble. This is a reconstruction.

Mr. EVINS. I have an impression that the astronauts knew it first. At 10:08 p.m., when Lovell said, "I believe we have a problem here," Houston then became aware of it.

Dr. LOW. I believe the Review Board will have to determine what the exact sequence of events was and whether some of the flight controls in Houston knew about it before it was reported.

Dr. PAINE. In any event, it wouldn't have been more than 2 minutes before it was reported.

Dr. LOW. We have several models on my left. I brought along sketches to show the equipment I was talking about.

Perhaps Dr. von Braun could point at the small blue bottles in the cutaway model. Those are the two oxygen tanks. Above them the three

yellow items are the fuel cells. Below them, the red tank, is the hydrogen tank.

The blue oxygen bottle closest to the outside skin is the one in which we observed the temperature and pressure increases and the sudden stop in pressure, and that is the tank that is presumed to have exploded.

The figure shows this but not as well as the model; the figure shows the location of these tanks and the fuel cells, but the model shows this better.

This photograph is a picture taken by the astronauts after they have separated the service module just before coming back into the earth's atmosphere. Although it is not a very good photograph you can see along here (indicating) the entire panel—this is a 5 x 13 foot panel—blown away by the explosion inside there. It is in the area of the antenna.

I have two color photographs which show it a little more clearly. This is a panel that is not designed to withstand pressure. Its purpose is to cover the outside skin, but given an explosion inside that area, that panel could blow out and apparently it did.

OXYGEN TANK

The next figure shows the 25-inch diameter thermos bottle in which the oxygen is stored. As I mentioned, the oxygen is part gas, part liquid. It is normally at a pressure of almost 1,000 pounds per square inch, 870 to 930 pounds per square inch. It is stored at very low temperature. Inside the tank is a gage to measure the quantity of oxygen remaining. It is called "quantity sensor" on this figure. A temperature gage and two small fan motors—and I referred to these before—these are the fans that were turned on and they are submerged in the oxygen. They were turned on just before the sequence of events occurred.

KEY EVENTS FOLLOWING EXPLOSION

On the next chart I have indicated the events that took place following the explosion. I have started with the same call by Lovell, "I believe we have a problem here." Shortly thereafter, we lost two of three fuel cells. We lost these because the oxygen pressure explosion apparently shocked valves to these fuel cells and turned them off.

The third fuel cell was then powered by the second oxygen tank, oxygen tank No. 1, sitting behind the other one. Apparently, however, the explosion caused a very small leak in that tank, or in the plumbing leading to that tank, so we also lost oxygen pressure in that second tank, and over a period of 2 to 3 hours we lost all of the oxygen which, together with the hydrogen, is used to generate electricity in the fuel cells.

Dr. PAINE. I believe if you would like to go back to "Oxygen Subsystem Shelf Module" you can see the problem area where these valves are located. The thing to recall here is that the oxygen bottle nearest you, oxygen bottle No. 2, is the one that ruptured, and in this valve assembly, which is shown in the upper right-hand part of the page, you can see the fuel cell valve modules, the three cells side by side. The oxygen valve modules in the upper right-hand corner of the page and

the associated valve assemblies, in the course of the explosion, were shocked sufficiently to shut off oxygen to the other fuel cells, and leakage somewhere in this plumbing caused the pressure from oxygen bottle No. 1 to be slowly bled off.

Dr. Low. And the leakage was caused by a small crack in the tubing or a small opening in a joint in the tubing. It was a very small leak that caused this.

As soon as both the ground and astronauts became aware we were losing all power and all oxygen in the command and service modules, they moved to the lunar module in a maneuver that had been thought out in advance and simulated in advance for just this kind of an eventuality.

They moved to the lunar module and used this from then on as a lifeboat. You can see again on the big model that the astronauts were in the command module, which is the silver cone-shaped device on top. The explosion occurred below there in the service module. They climbed through a tunnel into the lunar module, which was docked and attached to the command module.

The lunar module, of course, has its own power, its own oxygen, its own supplies for the lunar landing. But, instead of using these now for the lunar landing and on the lunar surface, they were used as a lifeboat.

Dr. Paine. This is the entire assembly here which is the lunar module. This is the ascent stage and this is the cabin area to which the astronauts moved.

This part is the descent stage which is normally left on the surface of the moon although it was this engine up here (the descent propulsion system) that was used to move the whole combination back to earth.

Mr. McDade. The bottom engine has 100 pounds thrust?

Dr. Low. That engine has 10,500 pounds thrust.

Mr. McDade. How about the engine closer to the cabin?

Dr. Low. That has 3,500 pounds thrust.

Dr. Paine. This was not used during Apollo 13, although it was always available. If we had to, we could have gotten rid of the whole descent stage and used the ascent engine.

ASCENT STAGE OF LM

Mr. McDade. In your judgment you could have effectively performed the maneuvers with the ascent stage of the LM as well as with the descent stage?

Dr. Low. We could have performed the necessary propulsion maneuvers but the ascent stage of the LM did not have enough water and oxygen to support the entire mission. Most of the consumables, as I will point out in a moment, were in the descent stage.

Dr. Paine. The descent stage has heavy batteries which are normally left on the lunar surface, which we used on the way back.

Mr. Jonas. It would have been left on the lunar surface if this hadn't happened?

Dr. Paine. Normally it would be left, but we brought it back in this case.

This whole eventuality had been planned for early in the program and the first mission in which we flew astronauts in orbit around the

earth with the command service module and the LM was Apollo 9, which came immediately after our trip around the moon. At that time, in one of the maneuvers we carried out, we simulated this lifeboat maneuver, and we actually fired the descent engine with the command service module attached so we could satisfy ourselves in the event of some emergency that this engine did have a capability and there was enough structural strength. We particularly wanted to understand the vibrations and flexures which might occur in these complex systems when we fired this engine with this combination.

So this is not the first time we have ever done this.

Dr. Low. And in preparing for the Apollo 13 mission, Astronaut Lovell and his team had simulated or practiced this same kind of maneuver.

EARTHWARD MANEUVERS NEEDED

Now, at the time that the accident occurred, the spacecraft was on a trajectory that would have carried it around the moon and back toward the earth, but it would have missed the earth. So the first thing that we did, the first maneuver which the crew made which occurred 61 hours and 30 minutes into the flight, or at 3:43 a.m., Tuesday, April 14, was a midcourse maneuver to put them back on the trajectory to land somewhere on earth. That trajectory would have brought them back down in the Indian Ocean at 152 hours from the beginning of the mission. From then on if we had made no maneuvers, at least we had a trajectory to bring the crew back and the lunar module and the command module back to the earth, but not in the planned recovery area.

Later on at 77 hours into the flight we passed behind the moon and 2 hours later in another maneuver that had been preplanned and exercised before the flight, they made another burn with that descent engine on the lunar module to return to the normal recovery area in the mid-Pacific and to return almost 10 hours earlier.

Now, it was important to get back as quickly as possible because the available water, and the available battery power in the lunar module was just barely enough to get them back.

Mr. Jonas. The first correction of the trajectory was made before you got to the moon?

Dr. Low. That is correct.

Mr. Jonas. Was this a planned deviation?

Dr. Low. That was a planned deviation early in the flight, about a day into the flight. We made a maneuver with the big engine on the service module that is at the bottom of that model, to put us on a course that would put us in the best position for the landing on the moon. That course is one that would not intersect the earth if we went around the moon without landing on the moon. That was planned; that was well known in advance. It was the same maneuver we made on Apollo 12 at about the same time.

Knowing, however, we would not land on the moon as soon as we had lost power in the command module, we then decided the best move to make quickly was to make the burn to put us back on a trajectory that intersects the earth in the event we could not make any later burns for some unknown reason.

Later on in the flight, the next day, we made another small midcourse correction. It was again made with that big engine, but it could have been made with the smaller engine, to put us in a proper position for a good reentry into the earth's atmosphere and another midcourse correction another day later.

SERVICE MODULE JETTISON

About 5 hours before entering the earth's atmosphere—and this is not listed on the chart—we jettisoned the service module which was no longer doing us any good, but it was brought back this far so it would keep the spacecraft in the same configuration in which we had flown it before. In effect, the service module, the white module at the bottom there, served also to protect the heat shield which is at the bottom of the silver conical module to protect it during the remaining flight. It was let go about 5 hours before entry and at that time the pictures I have just shown were taken.

Mr. TALCOTT. What would you be protecting the heat shield from?

Dr. LOW. From getting too cold.

Dr. PAINE. We brought the module back as a thermal insulator.

Dr. LOW. This is the way we had tested in the past and this is where we had the most experience.

Dr. PAINE. This was one of the decisions we had to make. Actually, had we chosen to get rid of the entire service module out near the moon, we would then have had much less weight, and it would have been possible for us to come home and cut even another 10 hours or so off the trip. But we were concerned about the thermal problems and we really didn't have enough data to satisfy ourselves that the command module would be all right without the service module attached for that length of time.

Mr. TALCOTT. Was there any possibility that the astronauts might have frozen to death?

Dr. PAINE. No; we were concerned about the possibility of some of the water and some of the fuel in the RCS engines in the module perhaps being slushy or frozen. We were concerned about the possibility that when we got down to the temperature—a very low temperature away from the sun in space—that we might have a bad effect on the heat shield material itself. It might come unbonded.

After the engineers have now had a chance to look at it, the chances are that this would not happen, but we didn't feel we were justified in taking the risk.

Mr. JONAS. You would have taken that risk if your water had been lower?

Dr. PAINE. If we had less consumables, we would have done that.

Dr. LOW. If that was the only way to come home, we would have done it, but it was a little more risk than we were taking without jettisoning.

Dr. PAINE. We felt taking a little more time was the lowest risk way to come home.

PRECISE SPLASHDOWN

Dr. LOW. About 2 hours before reentry all crew members got back in the command module. One of the crew members had been in it for an

hour or so before that and had started powering it up. All three of them then got in, closed the hatch, jettisoned the lunar module, Aquarius, and reentered what was by then a normal configuration for reentry; the command module alone, into the atmosphere. And we had a very, very precise landing, as I think we all witnessed on television very close to the recovery ship. Again a precise landing gives great credit to the crew for having alined their guidance systems so very well that they could make this maneuver.

Dr. PAINE. We asked to have that guidance system shut down during the powered-down portion of the flight so they had to start up the guidance system a little while before the reentry.

Mr. JONAS. Was this adjustment done manually?

Dr. LOW. The adjustment of starting up the guidance system and the alinement has to be done manually. There is onboard the spacecraft a sextant which is a device they use to line up against the earth, the sun, the moon and the stars, to aline the system in space so that they then have a reference for the guidance toward reentry.

Mr. JONAS. That is normal?

Dr. LOW. Yes, but it is not normal to shut the guidance system down. We did this this time because we had no power in the command module except batteries needed for reentry. We had to shut the system down for about 80 hours of flight and then start it up again and do a complete alinement. Normally they only have to adjust the alinement a small amount as they navigate to the moon and back.

ACCURATE GUIDANCE SYSTEM

Dr. PAINE. We actually had taken a system identical to this to MIT where this guidance system was developed. We gave it the same cold treatment it would receive when it was turned off and checked it out before this was done and assured ourselves the guidance system could come back up.

Mr. EVINS. Gentlemen, when you think of the vastness of space and then you think of the veterans of the ocean and to bring this crippled spacecraft down within a few miles of the carrier, it is absolutely a marvelous achievement.

Dr. LOW. They flew 300,000 miles after the explosion.

Mr. EVINS. This is even closer to the carrier than in some of the earlier successful flights.

Dr. LOW. That is correct.

Mr. EVINS. How many miles after explosion?

Dr. LOW. 300,000.

As Dr. Paine pointed out, our major concern during the flight was for the consumables. How much water did we have left? how much electrical power? how much oxygen did we have left?

The water was used for cooling the lunar module and all of the equipment in it. As you can see above, the lunar module starts out with a little more than 300 pounds of water and the water was managed throughout the flight both by the crew and what we told them from the ground, so that at the time of splashdown we had 28 pounds of water remaining.

Mr. EVINS. When they reached splashdown, they had plenty of water, is that correct?

Dr. LOW. Yes, sir.

Mr. CLAWSON. What do you mean by usable remaining water?

LOW ON WATER

Dr. LOW. The other remaining water is what might be in the plumbing or the pipes that we can't get out.

Dr. PAINE. It is a good question though because we did have some other reserves besides this which if we had to we could have probably put into the tank. We had some water in the suits and so forth so this does not take into account the little bit we had in our pocket.

Mr. JONAS. What was the rate of water consumption per thousand miles?

Dr. PAINE. 300 pounds for 300,000 miles, so we get about a thousand miles per pound.

Mr. JONAS. You had 20,000 miles left, approximately?

Dr. PAINE. Another way to put it—Dr. Low mentioned the first burn we made was one that would have brought us in 152 hours. We made another burn to speed that up. You see, the 152 hours would have been very close on water. In fact, we might have had to put some of this other reserve in if we planned to go to 152 hours in the Indian Ocean. We did have four destroyers standing by at the Indian Ocean landing point, but we decided to speed it up to the 142 and to use our original site.

Dr. LOW. The battery power in the lunar module was also quite critical. We started out with 2,000 ampere hours and we had less than 200 remaining at the time we jettisoned the lunar module.

There was more than enough oxygen, however.

Mr. EVINS. The failure to use the battery is what caused the astronauts to be chilled, isn't that right?

Dr. LOW. That is correct, Mr. Chairman. If we had used more power, they would have been warmer, but we would have run out of power before they got home.

BREATHING OXYGEN

As I pointed out, there was more than enough oxygen. Out of the 50 pounds available, we only used about 20 pounds.

An interesting point was the availability of lithium hydroxide on the next figure. This was used to remove the carbon dioxide. Once we had entered the LM we needed enough lithium hydroxide to take carbon dioxide out of the air for 85 hours. Normally this lithium hydroxide is part of the environmental control system inside the lunar module. It is a can that has a chemical in it and as the oxygen passes through it removes the carbon dioxide. However, the available lithium hydroxide in the lunar module was only enough for 53 hours and we had 85 hours to go. This is one place where the team on the ground really came up with a very fine solution. They said, "Look, we have lots of lithium hydroxide in cans, in cannisters, in the command module. How could we use it?"

They made up on the ground, with cards out of their flight plan and plastic bags and equipment that we knew the crew had along, a

device that looks about like you see on the next page. You see here the lithium hydroxide can and it is taped to a hose which is also normally in the spacecraft. We tried this on the ground. We even had another man on the ground listen to the first one on the telephone so we could demonstrate that this information on how to build this could be passed along over the telephone. Once we found out we could do this, we told the crew how to make this device and how to use the carbon dioxide-removal cans. They did this and built two of these in the lunar module and immediately brought the carbon dioxide content down again.

Mr. TALCOTT. What is the purpose of the hose attached to the lithium hydroxide can?

Dr. LOW. They are the normal hoses connected to the pressure suit which we weren't wearing at the time, so they were available in the spacecraft. Everything we used to do this on the ground we knew was available in the spacecraft. It was tried on the ground and then passed up to them and they did it.

This is a photograph of the lunar module in flight where you see Swigert, I guess it is on the left, with the canister sitting right in front of him and the hose leading down to the environmental control system below him.

Dr. PAINE. You can compare the one in the previous picture to the ones the astronauts made, which is a photograph.

Mr. TALCOTT. How long does one of these canisters last?

Dr. LOW. In the command module each canister lasts 12 hours. In the lunar module I think they are 20-hour canisters. So they had to do this several times. They used a total of four canisters which gave them 48 hours on top of the 53 they had, so that gave them more than 100 hours and they needed 85.

Mr. TALCOTT. What is this mechanism they are working with?

Dr. LOW. The mechanism in the foreground is a device they hooked up to store the urine from the bag in which they collect it into another bag which was onboard for another purpose.

Dr. PAINE. We didn't want to dump it overboard because they were afraid that the slight impetus given the spacecraft from the dump might alter their course somewhat.

TENTATIVE CONCLUSIONS

Dr. LOW. Our tentative conclusion then to date is that some electrical short cricuit or something like a short circuit occurred inside oxygen tank No. 2, that it caused a reaction in there which caused the tank to explode and that all of the events that followed, the shutdown of the fuel cells and the loss of the second oxygen tank, were all a result of the explosion of that tank.

Mr. JONAS. You have excluded all possibility of an external force?

Dr. LOW. We have tentatively excluded that. We cannot make that a firm conclusion yet but the probability of a meteorite impact puncturing the tank is probably less than one in a million. There is a very low probability. Since we have all of the electrical events that took place within the tank, and we have made measurements of pressure, temperature, and electrical voltage and current, we believe that the accident occurred as a result of something inside the tank.

Mr. JONAS. There is no possibility of salvaging anything out of the sea?

Dr. LOW. No, sir. The service module landed in a very deep part of the ocean and would have partially burned up as it entered the atomphere. What would be left would be mostly burned fragments.

Mr. CLAWSON. Is the low probability of the damage coming from an extenal force because it is remote that something might hit the spacecraft or because the spacecraft could withstand it?

Dr. LOW. It is a combination. The possibility of any part of a spacecraft being damaged by a micrometeorite depends on the design, the skin thickness, and on the probability of a meteorite large enough existing. So the thicker the skin, the larger a meteorite that would be needed before it could puncture; and the larger ones, based on measurements from our unmanned satellites, the larger meteorites are very scarce, very rare. So the probability of encountering one in 55 hours of flight before the event, one of the larger ones, is less than one in a million.

Mr. TALCOTT. What yould have been the consequences when the pressure in oxygen tank No. 2 was rising, if you had just turned off this fan, could you have accomplished the mission without using oxygen tank No. 2?

Dr. LOW. Yes, we could have accomplished the mission without using that tank because either one of the tanks would perform the entire mission. But even if we did notice exactly at the time it occurred that the pressure was rising and then turned the fan off, I would presume it would have been too late. Whatever reaction started in the tank was already well underway by the time we noticed the pressure was increasing and then we presume it would have been too late to cutoff power at that time.

CONFIDENCE IN RECOVERY

Mr. BOLAND. At what point in time did those at Mission Control feel that, providing nothing else happened, you were going to get them back? You felt this almost from the time, I suppose, the crew entered the lunar module—if the lunar module was going to operate all right—you were going to get them back.

The headlines were a lot more scary and a lot less reliable than what you people really knew. Is that a fair assumption?

Dr. PAINE. I think it is fair to say that some of the headlines and some of the TV commentators were somewhat more alarmist than perhaps we in Mission Control felt, but at the same time, Mr. Boland, we were not sure we were going to get them back until they were on the deck of the carrier because we had eliminated our backup systems. As long as we have the alternatives then we always feel, "Well, if something fails, we will still get them back; we will do it this way."

Now, with this massive failure we were down to the point where every system had to perform and, furthermore, it had to perform right up to snuff. All that water had to be there and we had to be able to have the batteries charged where they should have been and the charge had to come out properly and all be there.

Mr. TALCOTT. How soon after splashdown did you know whether the astronauts were in good condition?

Dr. PAINE. Immediately. In fact, they talked on the radio system to one of the helicopter pilots and said, "The crew's in good condition."

RESCUE CAPABILITY

Mr. CLAWSON. If you had not been successful and the astronauts were left out in space, either through our program or any Russian program, would it have been possible to go out and attempt to rescue them?

Dr. PAINE. That is a very interesting question because what we have before us is the possibility that we should be developing a rescue capability. In the era of the space shuttle, which is still 5 or more years ahead of us, if we decide to proceed with that program, we will begin to have the kind of capability to go out.

Looking at this particular accident, it seems clear to us if we had had another Saturn V on the pad with a crew ready to go and we pushed the button the minute this happened, there would have been no way of effecting any sort of a rendezvous and helping them in any way. This, I think, is another example of the fact that in spacecraft, as in submarines and in commercial airliners, in order to save the people, you have to save the device. If a wing falls off an airliner and you are unable for any reason to land the airliner, you will lose all the passengers; you don't have parachutes. In the case of a submarine, you have to bring the submarine up to the surface or close to the surface in order to save the crew. So, it is with the spacecraft. We have to find a way to bring the spacecraft back. We can't go and get them.

Now, in the earth orbital area there might be times when someone who was in earth orbit and unable to deorbit—where it might be possible to rendezvous, dock, and remove him, but on trips to the moon this is highly unlikely.

Dr. LOW. I would like to make one final point. We have this time far more information because the event took place over the period of a minute or two—we have far more information than we very often in the past have had about any kind of a failure in our spacecraft.

Because of this and because of the very massive effort we set up with the Review Board and the various teams down in Houston, and because the tank and the devices in the tank are fairly simple devices, I am quite confident that we will find a solution and understand a solution of what really happened here much quicker than we often have in the past. I am also quite confident that whatever fix has to be applied will probably be a relatively simple fix, again because the tank and the motors in it and heaters in it are small, relatively small, simple devices. It only takes a day or two or three to change a tank at the Cape for example.

Mr. EVINS. You have three oxygen tanks. According to your tentative findings, one exploded and another one was lost because of the explosion. What happened to the third one?

Dr. LOW. The third one, Mr. Chairman, is a very small tank inside the command module and it is used only for the last hour or two of reentry. It was used for breathing oxygen only. It is not used for powering the fuel cells.

REVIEW BOARD'S TASK

Mr. MARSH. The scope of the investigation you are now having in relation to the accident, as I gather the scope of that investigation really goes to the malfunction of the part in question, or the capabilities of the spaceship and its ability, if corrected, to engage in the future Apollo shots more than it does to the broader question of policy of future lunar landings in light of this accident?

Dr. PAINE. The charge which has been given to the Board is to investigate the accident to determine its cause and to recommend the corrective action that should be taken and also to examine all of the ensuing recovery activities that were carried out to make sure that if there was anything in our back-up systems and our recovery that should be changed, that we also learn from that portion of the incident.

Now, in connection with this, Mr. Cortright will look broadly at policy questions or the design philosophy; for example, should we locate the two oxygen cells so closely together. As a result of what has happened here, we should be taking into account, both in future designs, any modifications we should make to the existing tank.

Mr. MARSH. Actually the report then will not go to that broader question that has been raised in many areas of our country as to the feasibility or scope of future Apollo shots in light of the accident that we have had?

Dr. PAINE. I am not sure I quite understand the point.

Mr. MARSH. The point is this, Doctor: I think the Apollo 13 shot has raised a question in the country as to what extent we want to continue with these shots. How many of these types of shots do we want to continue making? Let's say we are programed now for six more. I think that many people are saying, "Look, we have done it. Let's not go forward with any more shots."

I don't happen to share that view, but the question is raised. In the light of this accident, what will we do about our future shots?

Presently, I, for one, would be in favor of continuing, but I also want first to clearly establish in light of Apollo 13 whether or not we should , and need, to make all of these future moon shots.

Dr. PAINE. Mr. Cortright's board will get into this to the extent that if, in his review of the accident that happened, and if in his review of other activities in connection with this, he feels that this system should be radically redesigned or should not fly again, he is perfectly free to come to whatever conclusions he would like and he will so recommend to us. To that extent, he would get into this, but we have not asked him to review the broad question of the U.S. policy with respect to manned space flight or U.S. policy in respect to lunar trips using our Apollo Saturn system.

DIRECTIVES TO REVIEW BOARD

Mr. EVINS. I will make a quick rundown on the directives to the Review board: "To appoint members." This has been done. "Arrange for timely release of information." That will be done. Then the Board will,

"(a) Review the circumstances surrounding the accident to the spacecraft which occurred during the flight of Apollo 13 and the subsequent flight and ground actions taken to recover, in order to establish the probable cause or causes of the accident. (b) Review all factors relating to the accident and recovery action. (c) Direct such further specific investigations as may be necessary. (d) Report as soon as possible." Do you have any idea when this will probably be? 60 days, 90 days, a year? Are you going to give us any time?

Dr. PAINE. We have given the Review Board themselves the responsibility for telling us how long it will take to conduct——

Mr. EVINS. "Report as soon as possible." We have no definition for "as soon as possible."

Let me read the rest of these:

(*e*) Develop recommendations for corrective or other actions, based upon its findings and determinations or conclusions derived therefrom.

(*f*) Document its findings, determinations, and recommendations and submit a final report.

4. As Chairman of the Board you are delegated the following powers:

(*a*) To establish such procedures for the organization and operation of the Board as you find most effective; such procedures shall be part of the Board's records. The procedures shall be furnished the Aerospace Safety Advisory Panel for its review and comment.

(*b*) To establish procedures to assure the execution of your responsibilities in your absence.

(*c*) To designate such representatives, consultants, experts, liaison officers, observers, or other individuals as required to support the activities of the Board. You shall define their duties and responsibilities as part of the Board's records.

(*d*) To keep us advised periodically concerning the organization, procedures, operations of the Board and its associated activities.

5. By separate action we are requesting the Aerospace Safety Advisory Panel established by reference (*b*) to review both the procedures and findings of the Board and submit its independent report to us.

6. By separate action we are directing the Associate Administrator for Manned Space Flight to:

(*a*) Assure that all elements of the Office of Manned Space Flight cooperate fully with the Board and provide records, data and technical support as requested.

(*b*) Undertake through the regular OMSF organization such reviews, studies, and supporting actions as are required to develop recommendations to us on corrective measures to be taken prior to the Apollo 14 mission with respect to hardware, operational procedures, and other aspects of the Apollo program.

This merely gives a directive to conduct corrective measures prior to Apollo 14. It is assumed that Apollo 14 will go, but you don't know whether it will go on schedule.

Could the Administrator comment upon this at this time?

Dr. PAINE. Mr. Chairman, we will furnish the committee promptly the alterations we plan to make in the Apollo 14 schedule once they are known. At the present time it is too early to say whether there will be a delay and if so, how long a delay.

Mr. EVINS. You alluded to that on television and then we heard one of your men from Houston state there is no reason why, by October 14, that the regular scheduled flight should not go forward. The review would be so prompt that it would be over by then.

NEXT MISSION NOT YET SCHEDULED

Dr. PAINE. That, Mr. Chairman, is not his decision to make, I assure you. I don't know who that was, but I can assure you that we have no schedule at the present time to fly Apollo 14 in October and we will not reach a decision on a schedule for the flight until we are satisfied that the investigation has really uncovered——

Mr. EVINS. In other words, the prior scheduling of Apollo 14 in October is now under consideration and announcement will be made later as to when it will be scheduled?

Dr. PAINE. Precisely.

We have suspended judgment on it until we have had a chance to conduct this investigation.

Mr. JONAS. Mr. Chairman, this has been very interesting. We couldn't possibly have had a hearing without discussing the accident, but that really was not the purpose of the meeting. It was suggested we ought to have a review of exactly the financial situation because, as the gentleman from Virginia says, whether we agree or not, there is a body of opinion both in and out of Congress that we shouldn't take any more chances with the lives of people for awhile. When we have this bill on the floor we will have to have answers to some questions that although I am sure we could dig out of the previous hearings, I think we ought to start right now and have you all tell us again exactly what money is involved; what this hardware costs that you have on hand; and what it will cost to warehouse it.

What does each one of these shots cost? I hear various different theories about that.

COST OF APOLLO 13

Mr. EVINS. We want to ask the Administrator to supply for the record the cost of the Apollo 13 flight, the general breakdown to include the costs of (1) the hardware, (2) the launch, (3) the tracking, and (4) other data on the cost of the Apollo 13.

(The information follows:)

Cost of Apollo 13 (Dollars in Millions)

Total	$375.0
CSM–109	[1] 55.0
LM–7	[1] 40.0
SAT V–508	[1] 185.0
Launch and flight operations	[2] 70.0
MSF	60.0
OTDA	10.0
Science payloads	[3] 25.0
ALSEP	10.5
Radioactive power source	2.0
Seismometer	2.5
Charged particle/lunar environment	2.0
Lunar heat flow	5.0
Drill	2.5
Other (cameras, etc.)	.5

[1] Average unit costs of Apollo buy.
[2] Delta cost to basic capabilities.
[3] Includes developments costs—cost to replace—about $12,000,000.

Mr. JONAS. When you talk about cost, are you talking about research and development and all background costs or are you talking about new money? What did Apollo 13 cost in brandnew money? Also identify what it costs to build one of these complete units.

Dr. PAINE. We can give you all of these numbers, Mr. Jonas.

Mr. EVINS. The public report is that this shot cost approximately $350 million.

Mr. JONAS. What did Apollo 13 cost?

Dr. PAINE. I will ask Mr. Lilly to try to put this in the most lucid number of terms, not only dollars, but what it represents.

Mr. BOLAND. It might be good information if we can have it today because the authorization bill is on the floor tomorrow and it may very well be some of us could use it. There are many of us on this committee who believe in this program and if we have these answers it might be very helpful.

Mr. LILLY. In trying to arrive at the total cost, one has to use averaging techniques. The technique we have used is to take the average cost of production for each of the elements, that is the average cost based on a total of 15. These costs vary slightly between missions depending on the mission you are flying, the tracking that is required, and the scientific equipment that you are carrying.

On two flights previous, the cost, you might remember, was $350 million. On this flight we said it was $375 million. That is, the average cost of command and service module is $55 million. On the lunar module, $40 million. On the Saturn V, all stages, $185 million. The launch and flight operations to carry out that flight, $70 million. (That, incidentally, includes the tracking and data. The $60 million of launch and flight operations and $10 million of tracking data, for a total of $70.) The science payloads on this particular shot, were $25 million. That is made up of a number of items such as the ALSEP, costing $10 million, the radioactive power source, $2 million, the seismometer, $2.5 million, and going on down through other smaller items such as cameras.

VALUE AMERICANS PLACE ON LIFE

Mr. EVINS. I want to make a couple of observations. One is that the detailing of these figures show the value which Americans place on the lives of an individual. Some nations don't put a very high value on the life of an individual, but we brought these individuals back safely. The interests and the prayers of the world were with us. I believe, for a moment, the country was united in this and I believe that probably the technical achievement of bringing a crippled spacecraft back safely created more interest, more universal hope, than the landing of the man on the moon itself.

Mr. JONAS. Is it safe to say each one of the remaining six shots will cost an equivalent amount?

Mr. LILLY. That is approximately correct. However, if one were to run into trouble and then decide to stretch the schedule a year, it would cost considerably more. I assume the schedule we have now——

Mr. JONAS. Assume for the purpose of discussion that each of the remaining shots will cost about the same.

Mr. LILLY. That is right, and you would have to say that part of the costs I have given you have already been paid for in past times.

Mr. JONAS. The last one of the Saturn V's you plan to use not for lunar landing, but for orbital missions?

Dr. PAINE. That is correct.

Mr. JONAS. So that leaves six additional manned flights to the moon you plan, is that correct?

Mr. LILLY. Mr. Jonas, I believe I have provided a handout which gives not only a summary of dollars in the budget for the total manned space flight program, but also the complete hardware schedule.

Dr. PAINE. This is a complex schedule.

Mr. JONAS. I don't want to have to analyze all these figures. That is why I asked you whether you planned six more manned flights to the moon.

Dr. VON BRAUN. We have six more flights.

Mr. LILLY. What he says is correct. In the current schedule there are seven Saturn V's left. One will be used for the Skylab 1 leaving six for the lunar mission. We did mention in previous hearings that it is always possible—to use one of the last vehicles for a second Skylab, but right now it is scheduled for a lunar mission.

Mr. JONAS. We talked about converting some of this hardware in previous hearings. Exactly what hardware do we have? Do we have only the boosters or do we have the complete modules; do we have seven of them in the warehouse, in storage? Exactly what have we already purchased of this equipment?

Mr. LILLY. The remaining seven are all included in the same contract which bought the total of 15.

Mr. JONAS. But they haven't been completed?

Mr. LILLY. They have not all been delivered.

Mr. JONAS. Some of them are in the pipeline?

APOLLO HARDWARE STATUS

Mr. LILLY. Let me give you the status of the major elements broken down by vehicle, command and service module, and lunar module.

(The information follows:)

APOLLO HARDWARE STATUS

	Saturn vehicles		CSM		LM	
	No.	Status	No.	Status	No.	Status
Apollo (1)=Saturn I–B	201		009	Launched, Feb. 26, 1966		
Apollo (2)=Saturn I–B	203			Launched, July 5, 1966		
Apollo (3)=Saturn I–B	202		011	Launched, Aug. 25, 1966		
Apollo (4)	501		017	Launched, Nov. 9, 1967	LTA 10R	
Apollo (5)=Saturn I–B	204			Launched, Jan. 22, 1968	LM 1	
Apollo (6)	502		020	Launched, Apr. 4, 1968	LTA 2R	
Apollo (7)-Saturn I–B	205		101	Launched, Oct. 11, 1968		
Apollo (8)	503		103	Launched, Dec. 21, 1968		
Apollo (9)	504		104	Launched, Mar. 3, 1969	LM 3	
Apollo (10)	505		106	Launched, May 18, 1969	LM 4	
Apollo (11)	506		107	Launched, July 16, 1969	LM 5	
Apollo (12)	507		108	Launched, Nov. 14, 1969	LM 6	
Apollo (13)	508		109	Launched, Apr. 11, 1970	LM 7	
Apollo (14)	509	At KSC, in checkout	110	Completed, at KSC	LM 8	Completed, at KSC. June 1970.
Apollo (15)	510	SIC, SIVB, IU, storage; SII post static c/o	111	Completed, to KSC June 1970	LM 9	Completed, in factory checkout, to KSC June 1970.
Apollo (16)	511	SIC refurb; SII and SIVB storage; IU assembly.	112	In mod. for extended staytime	LM 10	Plant c/o of ascent and descent stage.
Apollo (17)	512	SIC, SII, SIVB storage; IU fabrication	113	do	LM 11	Final assembly of ascent and descent stage.
Skylab	513	SIC storage; SII at MTF; IU, component procurement.				
Apollo (18)	514	SIC accept test; SII plant c/o; SIVB storage; IU fabrication.	114	Structurally complete, in storage	LM 12	In fabrication and structural assembly.
Apollo (19)	515	SIC assembly; SII system installation; SIVB system c/o; IU component buildup.	115	do	LM 13	Do.

Mr. LILLY. The next planned flight was Apollo 14. That vehicle is at KSC, in checkout.

The command and service module and the lunar module are completed and are also at KSC.

For Apollo 15, the first stage of the vehicle, the third stage, and the instrument unit are in storage. The second stage is in poststatic checkout.

Dr. LOW. "In storage" means the stages have been completed and are ready to go to the Cape for launch.

Mr. LILLY. The command and service module is completed and is due to be shipped to the Kennedy Space Center in June of this year. The lunar module is completed and is in factory checkout now and will go to Kennedy in June of this year.

For the next vehicle, as you can see, all three stages are in storage and the instrument unit is in assembly.

The command module of that one is in-plant at North American and is undergoing some modification to provide extended lunar stay time.

The lunar module is in checkout at Grumman and they are doing the final checkout of the ascent and descent stages.

For the next vehicle, 512, all three stages are completed and in storage and the instrument unit is in fabrication.

The command and service module is again being modified for extended lunar stay time and the lunar module is in final assembly.

The next vehicle, 513, will be used for the Skylab program in 1972. For that vehicle, the first stage is in storage. The second stage is at the test facility and the instrument has some component procurement going on for it for final completion. That vehicle, as you might notice, does not have a third stage since the third stage is the Skylab.

For the next one, Apollo 18, or 514, the first stage of the vehicle is in acceptance test. The second stage is in plant checkout. The third stage is completed and in storage and the instrument unit is in fabrication.

The command and service module, 114, that goes with that has been fabricated and is in storage. The lunar module is in fabrication and final structural assembly.

For the last one, Apollo 19 or vehicle, 515, the first stage is in assembly. The second stage is in systems installation and the third stage is in systems checkout. The instrument unit is in what we call component buildup.

The command and service module is complete and is in storage. The lunar module is in fabrication and structural assembly at this point. That is the status of each of the items.

Now, in addition to that, Mr. Jonas, you might remember there are four command and service modules that were procured under the Apollo program that will be used in the Apollo Applications or Skylab program. I believe all of them are structurally complete and are having the necessary modifications put on them for use in the Skylab or Apollo Applications program. The launch occurs in late 1972 with revisits in 1973.

CONTRACTS FOR APOLLO PROGRAM

Mr. JONAS. Are definite binding contracts executed for all of this procurement?

Mr. LILLY. These contracts have all been awarded, Mr. Jonas. As you know, the money is provided in annual increments and we do not get full funding at the time of contract award. In all contracts of this nature there is provision for limitation of Government liability which limits the Government's liability to that amount of money which is currently on contract and for any termination costs that could be involved.

Mr. JONAS. Termination costs would have to be the subject of negotiation.

Mr. LILLY. That is right and audit and things of that kind.

As you can see, all of the Saturn V's will be completed, delivered, and tested in about October of this year and basically this is true of most of the other hardware except certain command modules and LM modules that are scheduled modifications at a later point in time. As a generalization you could say that it would cost more to pay the termination than it would to go ahead and complete it.

MODIFICATION OF SKYLAB WORKSHOP

Mr. JONAS. What will be the difference in cost to modify this hardware for use in other than moon-landing flights? How many can be modified and how many have gone beyond the stage where modification would be feasible?

Mr. LILLY. If you flew the same configuration as we are planning for Skylab 1, you would have to say that none have reached that point. There are certain elements you may have to take out and change in the third stage, but they are all susceptible to that use at this point.

Mr. JONAS. Are you sure you want to answer that way? Do you mean all of them or the six that are left? How about No. 14, isn't it pretty well complete?

Mr. LILLY. Yes, sir.

Dr. PAINE. There may be a little misunderstanding here. I think Mr. Lilly is only talking about the first two stages of the Saturn V. Of course, the lunar module is only used for lunar landing and you wouldn't modify it for anything. It is not useful for anything else.

The first two stages of the Saturn V are basically just a booster and they could be used to boost any large payload into orbit.

Mr. JONAS. How about the manned modules?

Mr. LILLY. They would have to be modified. There is a considerable cost for the Skylab which uses the third stage of the Saturn V and is under modifications for making it into the Skylab at this point. Some of the major costs involved in this kind of earth orbital program are for scientific payloads. If we count just what we now have to complete—Skylab I and experiment—it would be about $500 million.

NASA'S VIEW OF SKYLAB PROGRAM

Dr. PAINE. Our feeling on the Skylab program is that we certainly want to try one of them. We may decide to pull one more lunar flight back and fly a second Skylab although there are many people who

think this would be a terrible waste of our national capability. I doubt very much that we would want to do it again. One or two times is a good experiment. I don't believe there would be much point in doing a third one.

Mr. McDade. Why is that?

Dr. Paine. Because we will be able to put this experimental space station up into an orbit that will cover all of the earth 50 degrees north latitude and 50 degrees south latitude. It will remain up for a year and in the course of a year we will be able to revisit it three times with three astronauts on each visit so we will have nine astronauts up there. We will be able to carry out all the experiments that we can envision as being useful to carry out with this kind of equipment in that area of the first year with Skylab 1 and then if we fly a Skylab 2 the additional things we would do in Skylab 2 would pretty much finish up the experiments it would be useful to do with this class of equipment.

The next step beyond that would not be a Skylab 3, but would probably be the first prototype of a more permanent space station of some kind.

Mr. McDade. That is when you are getting into the space shuttle.

Dr. Paine. That is right. You are out in about the 1977 period of time.

Mr. Jonas. As I understand this chart, you have two of the lunar modules completed. One is ready to be launched and the other is in factory checkout, virtually completed. The third one is in the plant checkout. What does that mean?

Dr. Low. That means that this hardware, the stages are completed, and they are now being checked.

Mr. Jonas. They haven't been assembled?

FACTORY CHECKOUT OF EQUIPMENT

Dr. Low. Yes, sir, they have been completely assembled. The checkout period lasts 2 to 3 months in the factory to be sure the equipment works exactly as designed.

Dr. Paine. Final inspection you might call it.

Mr. Jonas. How about 17, final assembly of ascent and descent stages?

Dr. Low. That means that the outer shell, the plumbing and the wiring and all of that has been completed and that the various subsystems are now being bolted in and installed.

Mr. Jonas. Using 100 percent as a point, what figures up to 100 have you completed?

Dr. von Braun. Eighty.

Mr. Jonas. Roughly 80 percent of the cost has already occurred?

Dr. von Braun. Yes.

Dr. Low. It is like the case of an automobile that doesn't have the engine installed, or the seats and the steering wheel.

Mr. Jonas. In all of these you are at least 50 percent complete?

Dr. Paine. Yes, sir; and of course, on the actual Saturn V rocket the final test of the final Saturn V rocket component will be made before the end of this year and after which they will all be put in storage.

Mr. JONAS. Did Mr. Lilly break out the costs and refer only to the lunar module costs? What is that cost per unit?

Mr. LILLY. About $40 million, sir.

Mr. JONAS. For each one?

Mr. LILLY. Yes, sir.

Mr. CLAWSON. Did you indicate earlier that it would cost more now to terminate these than it would to go on through to completion?

Mr. LILLY. I was referring to the Saturn V vehicles at this point. It depends upon what state of fabrication and development you are in and how much the contractor has already bought. As you can see on the schedule for the lunar module, we are not as far ahead as we are on the vehicles.

Mr. MCDADE. I would just like to go back with you for a moment and clarify in my own mind the difference between the figure of $375 million and $70 million or $75 million. The figure that we hear about. I have heard it said in the hearings that the hardware is bought and paid for, is that right?

Mr. LILLY. I am sorry, I didn't hear all of your question.

Mr. MCDADE. I am back to trying to get more enlightenment on the difference between $375 million and $70 million, which is a figure that is listed as launch and flight operations, $70 million.

I have heard in these hearings that most of the hardware is paid for. Is that correct?

Mr. LILLY. That is correct.

HARDWARE NEARLY READY TO FLY

Mr. MCDADE. We heard testimony, I believe, from Dr. Paine, that you can't store this equipment; that the best thing to do with it now is to utilize it and try to get as much scientific payoff from it, having paid for it, as we possibly can. Is that statement correct?

Dr. PAINE. That is correct. As you know, this has been a program, a roughly——

Mr. EVINS. The $375 million is not new money at all. Most of that $375 million has already been expended, the equipment has been bought and paid for. Is that correct?

Mr. LILLY. That is correct.

Dr. PAINE. That is correct. And we have not included the termination costs, of course, which would use up a lot of anything left.

TERMINATION COSTS

Mr. EVINS. Can you give me an estimate on termination costs?

Mr. LILLY. Well, for most government contracts I have looked at, you can generally assume that termination will cost you anywhere up to 2 to 3 months of effort plus your inventories. In other words, if the inventory or the parts and pieces are already bought and paid for——

Mr. MCDADE. Which is the case here, is it not?

Mr. LILLY. It is the case here. The costs vary according to the status of the contract, but generally you can figure it costs an ongoing program something like 2 to 3 months to terminate.

Mr. MCDADE. Can you translate that into a dollar figure?

Mr. LILLY. Say if I have a contractor running $20 million a month at the time we terminated, you can generally estimate it will cost you between $40 and $60 million in termination costs.

COST OF CONTINUING PROGRAM

Mr. BOLAND. Would it be fair to say then that really the only costs that are now involved in these launches are the $70 million for flight and launch operations and $25 million in science payload?

Mr. LILLY. There are some modification costs that occur, and, as you can see, there is some final checkout and a few items are still in final assembly.

Let me give you an example. In your 1971 budget for the Apollo program, the dollar amount you see on the table for the Apollo program is $956.5 million.

Mr. JONAS. Is that new obligational authority or outlay?

Mr. LILLY. That is new obligation authority.

If you take that and break it out into what part goes to major hardware and production support, there are $376 million that go into production and hardware support. In addition to that, there are $67.2 million in the experiments, space suits, and supporting elements for the astronauts.

There are $95.2 million in what we call launch, or mission operations costs, or mission-recurring costs. These, to give you an example, are the costs of the space operations, recovery operations and things of this nature as well as the systems engineering, which goes along with it. Then you have what is called the base support, or institutional costs. The technical base support that is required just to run our centers and to carry out the engineering that is necessary accounts for about $405 million.

So, of the $956 million that we have in Apollo, there is $376 million going into either fabrication, checkout for that equipment, and we generally link it as hardware related. So you can say about one-third of the $956 million is in hardware, in the checkout, and the supporting engineering required for it.

APOLLO PROGRAM IN FINAL STAGES

Dr. PAINE. We are talking here about a program that is in its final stages. This is a program in which every month we are taking large numbers of production workers out of the system. So it is in a sharp phase-down program and has been in a sharp phase-down for about the last 18 months or so. It is always more difficult under those circumstances to effect large economies because we have already made very substantial cuts in this program.

Mr. JONAS. Two of these launches aren't planned until 1974.

Dr. PAINE. That is correct. The last two.

Mr. JONAS. Is that because they won't be complete until then?

Dr. PAINE. Really, they won't be completed until then because we don't intend to launch them. We are making these launches now at a rate of two a year, which is the one-shift level down at Cape Kennedy, a convenient pace for us, keeping up all of the quality checks and the skills of the crew but still going at the lowest rate that a one-shift operation will allow.

Mr. JONAS. In the 1971 budget time frame you plan two launches?

Dr. PAINE. That is correct.

Mr. JONAS. That would be twice $375 million out of a $3 billion budget.

Mr. LILLY. No, sir, not out of that.

Mr. JONAS. Why not?

Mr. LILLY. Because much of that 375 that you talked about has already previously been paid for.

Mr. JONAS. When will the outlays come for the remaining $2,250 million for these six shots?

1971 APOLLO PROGRAM COSTS

Mr. LILLY. The total program, as laid out, is $956 million in the 1971 fiscal budget. For next year, I can't give you a precise figure but it will drop to about $800 million and will continue to drop gradually in succeeding years to about $300 million, as I recall.

Mr. JONAS. It is not accurate to say there will be no dollar savings if we shut this program down tomorrow?

Mr. LILLY. If you decided you wanted no manned space flight and say "Close your centers, close your contracts et cetera," there certainly would be dollars that would not be spent.

Mr. TALCOTT. The savings would be about $100 million per unit, would it not, and there are six units, so we would save at least $600 million.

Mr. LILLY. The answer to what you could save or not spend depends basically upon what decision is made. If one says, "We want the capability to fly and we want to be able to pick up in some form but we don't want to fly in 1971," that gives me one answer as to what could be saved in 1971.

On that basis I can tell you that if we say, "No, I don't want to close out and fire all the people at Kennedy and at Houston and Marshall. I want to go ahead and preserve this hardware, keep my teams able to launch them and fly them, but don't launch for a year," the only variable cost you have in the 1971 budget is the figure I gave you for the recurring costs of about $95 million.

Dr. PAINE. You wouldn't save much in the scenario Mr. Lilly just painted because all you would save is the cost of the fuel you put in the tanks. You would still be doing all the things. We want to be as responsive and give you precisely the numbers you want, but we have to have the precise situation so we can cost it.

Mr. LILLY. Another example. Take our basic launch costs. Our launch crews at the Cape, have come down now to essentially a one-crew operation. It is a rate that one crew can handle, two launches a year on a fairly continuous basis. (Actually, they can handle maybe two and a half, but we have them down to two.) If you say launch one, all we save is the cost of propellants, because we still have to keep the same people. We can't hire and fire them every 6 months.

If you say "I am not going to fire any this year but I will next year," we still couldn't fire the people, because we would need that much lead-time or more to build up and train the people to do it the following year.

SHOULD MANNED FLIGHTS CONTINUE?

Mr. JONAS. I don't hear anybody argue that we ought to close down and discontinue space exploration. I do hear some people question the wisdom of continuing to try to land men on the moon. There is a body of opinion—I don't know how strong it is in the country—that argues we have now landed on the moon twice and there is no point in risking lives to just repeat that effort. We ought to devote our attention to the utilization of instruments and quit trying to land men on the moon.

Dr. PAINE. This opinion is sometimes expressed, and there are people apparently who are very sincere about holding it, Mr. Jonas. I think it is not a view which the United States should adopt. I think it would be a disaster for the United States to turn over this entire business of flying above the atmosphere to the Soviet Union. It would be a disaster to stop space flight and not move it ahead and go on as we are doing in this program.

Mr. JONAS. Is there not anything more we can do in earth orbital operations?

Dr. PAINE. We will continue that in the 1972–73 period of time but at the moment the amount we are learning from space flights to the moon is really tremendous and even though Apollo 13 was not a success, from the standpoint of actually being able to accomplish our mission objectives, we have learned very much, just as in the early days of aviation when carburetors failed due to icing and people developed nonicing carburetors and so forth.

The only way you can learn to fly in space is by flying in space and perfecting your systems which is, of course, what we are doing here.

Mr. JONAS. Isn't there a difference between flying in space and flying to the moon?

Dr. PAINE. Well, the moon was selected, I think, in a very wise way as being an excellent place for us to develop the capability to leave the near space of earth orbit, to fly to another body, to find out how to land on it, find out how to get out and conduct useful experimentation and exploration; the ability to do useful activities, collect samples, emplace instrumentation; the ability to return to the vehicle and return to earth—this is the essence, essentially, of space flight, and are using the moon as a place where we are learning how in this Nation to be able to do this.

Apollo represents a system which we have developed over the last 8 years. We have made many successful flights with it. It is the system which will be superseded with another generation on out in the later 1970's, but which at the moment is teaching us an enormous amount about both the heavens around us in the scientific sense and equally important, how man, indeed, will fly through space and carry out operations of this sort.

NEW GENERATION OF SPACE FLIGHT

Mr. MCDADE. That second generation you refer to is the space shuttle?

Dr. PAINE. The space shuttle, the space station and very likely the nuclear space tug.

Mr. McDade. As you are presently programed, you will begin phasing out of this system, as you have indicated, with the lack of flights, the cutback in contractors and all the rest of it, at the time when you are prepared to move into the space shuttle, a new generation of spaceflight, typlified by the space shuttle?

Dr. Paine. That is correct. Now, we have not yet come before this committee and asked permission to proceed with the space shuttle because we are going to wait until the 1972 hearings.

Mr. McDade. You have money in the 1971 budget for it, do you not?

Dr. Paine. For studies, but we have no commitment as yet to proceed with the shuttle.

Mr. McDade. You are putting up proposals to contractors requesting proposals?

Dr. Paine. Yes, but these are for the phase B studies and not for the actual development, so we can tell you how much it will cost, what the characteristics will be, and so we can satisfy ourselves that we are ready to proceed.

Mr. McDade. One of the points you are making is now, between now and the time when you might get to a new generation of flight, the only vehicle you have to test in terms of spaceflight is the vehicle we are using now?

Dr. Paine. Exactly. This is where we are learning, all the United States, is now learning about space travel.

Mr. McDade. How much more, in your judgment, will the continued exercise of this program contribute to the next generation of spaceflight? How much more do you think you will learn, assuming you go through all these flights when you get to the point where you do decide, yes or no, on a space system, a space shuttle system, or whatever it might be?

Dr. Paine. We will learn a great deal. In fact, I think it is perfectly correct to say and state very emphatically that Apollo 13 has taught us some very important lessons that will be reflected in space shuttle designs, for example for space rescue. This mission has taught us a great deal even though we are only starting our investigations.

Mr. McDade. Many people have the impression we have learned everything there is to know in terms of spaceflight in this type of operation.

Dr. Paine. We have had too many successful flights; I am afraid you are right. The general public doesn't understand the complexity. I think on this committee you do.

LESSONS LEARNED

Mr. McDade. Perhaps you could amplify for the record some of the things you are learning or may still be learning when you face into the next part of the effort.

(The information follows:)

The lessons learned as a result of the Apollo 13 accident, even at this early date, are many. They apply both to spaceship design and to spaceflight operations.

In the area of spaceship design, we have learned that the separation of different spacecraft functions into separate spacecraft modules is indeed important. In Apollo, a decision was made in 1962 to separate the reentry function from the lunar landing function. With this separation, then, the Appollo spaceship

consists of both a command module and a lunar module. In Apollo 13, when the command module systems failed, the lunar module was still available to act as a lifeboat to bring the astronaut back home. One could have decided at the beginning of the Apollo program to combine both the earth reentry function and the lunar landing function into a single spaceship. Had that decision been made, no lifeboat would have been available to rescue the crew of Apollo 13. Now, as we face the design decisions for the manned spaceships of the future, we will take a hard look at the design principles employed in Apollo and, wherever possible, apply these again in consideration of the Apollo 13 accident.

In the area of spaceflight operations, we learned that the many hours spent by our flight crews and by our ground operations personnel in simulating all possible emergency modes were indeed worthwhile. In training for any given lunar mission, only a very small percentage of the time is spent in preparing for the planned events. Our flight controllers spend the majority of their time (it has been estimated up to 80 percent of their time) on simulating every conceivable emergency situation. Because our flights prior to Apollo 13 were so very successful, we had begun to question seriously whether this use of time for planning for emergencies was indeed worthwhile. Had it not been for the Apollo 13 accident, we might have rescheduled our training time in the future because our experience prior to Apollo 13 indicated that this might be possible. Now, with Apollo 13 behind us, it is clear that the kind of operational training that we have used in the past should be continued into the future.

In other words, we learned a great deal in both the areas of design and operations from Apollo 13. These lessons are now being applied to the remainder of the Apollo flights and to the design of our manned spaceships of the future. And surely, just as we learned from the computer alarms during the critical lunar landing phase of Apollo 11, and from the lightening strike during the launch of Apollo 12, and now from the Apollo 13 accident, so will future Apollo flights continue to teach us how to operate in space—how to become and remain proficient in the exploration of space. In this way, America will remain preeminent among spacefaring nations.

MANNED SPACE STATION

Mr. CLAWSON. I address myself specifically to the manned space station. Are the trips to the moon essential now in order to provide the necessary information for the manned space station? Not the shuttle, but just the station?

Dr. PAINE. If we cut out the trips to the moon tomorrow, we could still proceed with the space station.

Mr. CLAWSON. You could still proceed with that?

Dr. PAINE. It isn't essential in that sense. We will have much more confidence if we continue to fly the Apollo system to the moon and continue to learn as we are doing about space flight but if the question is, could we do it, yes, we could do it.

Mr. EVINS. Mr. Boland.

Mr. BOLAND. I, for one, want to express my sincere regard for the performance of Dr. Paine, the astronauts, the flight operations, everyone connected with the Apollo program. This was a magnificent performance by the astronauts themselves, Lovell and Haise and Swigert, and really incredible performance of those on the ground at the Houston Manned Spacecraft Center. I just think that you, Director Paine, and all of the people at NASA have handled this extremely difficult problem in a highly commendable manner. You have a magnificent staff. I believe I express the opinion of all the members of this committee in commending what the space program shows in the way of technological competence and the high quality of all the people connected with the program. Please convey these thoughts to all of those connected with this magnificent effort.

Mr. MARSH. I would echo what Mr. Boland has said. I think that is one of the great things you have demonstrated in the past week.

Dr. PAINE. During the period in which we flew Apollo 13, we lost 140 people in Vietnam last week, we lost a thousand in automobile accidents. While we hazarded men in space, there were five, including one teenager, who died of narcotic abuse in New York City alone. People were lost for many things last week and I think the fact that the Nation was interested in this doesn't mean the Nation was not concerned about automobile accidents, narcotics addition, and losses in Vietnam. We are concerned about all these things.

Mr. MARSH. In reference to the future Apollo shots, the committee and the members individually wrestle with this problem of the future of the manned space flight program. I gather from your testimony, that it is your opinion that the remaining Apollo shots are absolutely essential to our manned space flight program in order to maintain it at the level you feel is consistent with the national priorities. To reduce the number of shots would damage to a great extent our capability in this particular field, is that correct?

USE OF CAPABILITIES

Dr. PAINE. I couldn't emphasize that more emphatically. I believe to turn aside and not use the capability we have built up would be a terrible waste of the taxpayers' money. I think it would be an act which would cause condemnation all around the country and, indeed, around the world. We operate more than the American space program; we are operating the space program of the free world. We operate everything that opposes the Soviets in this area. I don't want to wave the Russian flag on this thing, but I think it is extremely important.

Let me quote Mary Haise, the wife of one of the astronauts who, before the safe recovery when the issue was still in doubt, said that she certainly hoped that all she was going through was not going to lead to a situation which would cause any slowdown of the space program. Here is a brave wife 7 months pregnant waiting to see whether her husband is going to be alive or not and stating very emphatically this should not slow down the space program.

Mr. JONAS. Dr. Paine, would you make the same statement, that you think it is absolutely necessary to use the remaining vehicles, if we had landed on the moon with No. 8 instead of No. 11?

Dr. PAINE. I think I probably would. I think we ought to find out all that we can from the moon during this initial Apollo effort.

Dr. von Braun has likened this to the dogsled era of exploration of the Arctic, when we can just with some difficulty get there. But we learned a lot about the Antarctic and the Arctic in that initial era.

Later in the seventies and in the eighties we will move on to a decade when it will be much easier to travel to the moon at a much lower cost.

Mr. JONAS. That wasn't the reason we programed 15 of them to start with. We thought we would have to have them.

Dr. PAINE. We thought we would have to have them. The 15 vehicles were designed just to get us there once.

Mr. JONAS. We improved on our projections?

Dr. PAINE. Yes, sir.

Mr. JONAS. We got there sooner than we expected.

I agree with what Mr. Boland said. This flight, Apollo 13, turned out to be successful. To be stranded out there and sustain what most people thought was an accident from which we couldn't recover and to be able to bring these men back under these adverse conditions, is a tremendous accomplishment. But I must say that if we had not brought them back, if we had lost them, the space program would be in a lot of trouble today.

Dr. PAINE. I have no doubt of that, but at the same time I think we——

REASONS FOR CONTINUING LUNAR EXPLORATIONS

Mr. JONAS. Would you please give us some reason that we can use to convince our skeptical colleagues that we are not projecting the remaining six shots to the moon just because we have the hardware. I don't think that is a good enough reason.

Dr. PAINE. No, it is not a good reason and we wouldn't do it just because we had the hardware.

Mr. JONAS. I want you to say that as emphatically as you are willing to; that that excess hardware has not entered into your consideration.

Mr. EVINS. Dr. Paine, amplify for the record at this point if you will.

(The information follows:)

CONTINUED EXPLORATION OF THE MOON

Study of the moon has progressed through the centuries from naked-eye observations of primitive man, to telescopic study by scientists, through unmanned spacecraft of many varieties, to our present knowledge gained through the direct utilization of the eyes, hands, and minds of men on the lunar surface. The first two manned landings have been characterized recently by Dr. Gerald Wasserburg of the California Institute of Technology as having furthered our knowledge more than all of the previous study combined. Beyond the study of the moon itself, the information returned from these missions has opened new windows of knowledge on the earth and the entire solar system.

The Apollo lunar program holds out the promise of providing an understanding of the origin of the moon and earth. This would be a fundamental and major milestone in man's understanding of his physical world. How old is the earth; how did it form; how has it evolved; how will it evolve? Such an increased understanding will come from the unraveling of many new clues, some of which are now at hand. These demonstrate the great age of the lunar surface, perhaps as old as 4.5 billion years or more. We, therefore, have the possibility of reading the record back to the period of formation of the earth. The number of missions and time duration of a program of lunar exploration are obviously two important factors in insuring that we will obtain the desired, basic understanding. The first, if there are sufficient missions, insures that adequate data gathering can take place. The second allows conflicting, or supporting, theories to be tested and refined in the crucible of scientific examination tempered by the introduction of new facts and theories. This is the scientific process by which major discoveries, and in turn major advances in knowledge, are made.

We presently have the capability to send six more manned missions to the moon. This number is determined by the hardware on hand purchased in the course of insuring a successful manned landing. Is this enough—or too many? The Space Science Board of the National Academy of Sciences, meeting after the Apollo 11 landing, concluded that additional landings, beyond those presently planned, and extending into the 1975 time period, would be appropriate. This conclusion was reached after careful consideration of the moon's probable complexity and the risk of having very many clues after a few landings but still a great enigma at the program's end. Apollo 12 served to confirm this fear when we landed at a site we thought would be very similar to Apollo 11 and found a great many significant differences.

The Lunar and Planetary Missions Board, a group of prominent scientific advisers to the Agency, has stated that the probability is highest of making major discoveries on the later missions, and without these missions it may well be that a first order theory of the moon will be lacking. The ensuing uncertainty and controversy may raise doubts that any program of planetary exploration can lead to understanding, and thus undermine the future exploration of the planets.

The presently planned program of lunar exploration has been formulated with the assistance of many of our best scientific minds cooperating with the engineering and technical expertise gained thus far in our space program. It is predicated upon landings at diverse points on the lunar surface selected specifically to provide answers to pieces of the lunar puzzle whose absence obscures our total picture of this unique planetary body. If we are to understand the spectrum of characteristics of the moon, we need missions to the highlands, the craters, the unexplained river-like rilles and other unique features.

These diverse sites not only permit us to study and sample important lunar features that apparently differ, but they also permit us to deploy our scientific instruments in a meaningful network, best calculated to obtain data on processes effecting the whole moon. If it is remembered that the surface area of the subject under study is the same as that of North and South America combined, the magnitude of the problem is evident. It will only be through the most judicious use of the remaining missions that there is any hope that we will obtain the goal of this phase of the program.

In addition to studying the origin and history of the moon and its relationship to the earth, there are other important returns which we can anticipate from continuing missions. We expect to learn more about the beginning of life. Samples from below the surface of the moon, protected from the harsh space environment, may be important sources of information in this continuing study. We expect to obtain data on lunar resources and uses of the moon. The moon is in fact a space station in orbit about the earth with its own unique environment. We will want to know what types of research or technological applications are feasible. This in turn will indicate the progress we should make toward establishing a lunar base. Finally, the lunar program is an outstanding example of the way in which space programs can contribute to international scientific cooperation. Sixteen countries presently participate and more will undoubtedly join the effort.

PRIORITIES TO CONSUMER

Mr. TALCOTT. I agree with Mr. Boland and in the tribute he paid to NASA. However, the Science and Astronautics Committee is a proponent of NASA and I can understand that. However, we in this committee must consider many programs and assign priorities. I can understand Dr. von Braun's analogy with the dogsled, but we have a lot of other things that are coming up now and we have to balance out these priorities. We are getting some very strong demands from other areas and we have to consider those.

Now, one of them is that we built in a safety factor into NASA equipment, especially for the moon landing, redundancy after redundancy after redundancy for the safety of the men. I am pleased with that. I think Astronaut Sweigert made one of the best statements, that he considered the return of the crew a very important thing.

We have young fellows, officers, who are flying in Vietnam where there is no safety feature built into their equipment. Some people think that we ought to build in some safety equipment into the vehicles that they are flying. If we are concerned as much about their safety as we were about NASA's safety, there would be a great difference in our expenditures for the military. So we have that problem that we have to face up to. Then we have the problem of the environment. Everybody today is talking about spending billions of dollars on environmental problems and they think we can extend the space program some and get our priorities back in order.

I understand that a large amount of the hardware has already been paid for. Out of the $375 million, $55 million, $40 million, and $185 million is already bought and paid for and there is no way we could have any money there. In fact, we might incur more in debts if we tried to stop the program right now.

That leaves $95 million on each one of these space shots where it looks like we could save. I doubt that we could save all of that.

Dr. PAINE. Probably not.

Mr. TALCOTT. Probably only half of this could be saved because a lot of the launch equipment, the tracking and so forth, a lot of these things are all ready—we have some commitment there, even though it is not considered hardware.

The team you now have is the minimum team you can function with, as I understand it. Couldn't you run one launch a year instead of two a year in a more economical way?

MINIMUM LAUNCH RATE

Dr. PAINE. Not only economically but safely. We feel two a year is the minimum we would feel comfortable with.

Mr. TALCOTT. I have two more questions. When do we level off to the minimal operation? Is that going to be this year?

Dr. PAINE. We hope that the 1971 which we have laid before you will be the minimum in NASA. To go back over the record and refresh your memory, Mr. Talcott, we have gone from 420,000 people in the American space program down to a present level of about 185,000 and we will be by the end of 1971 down to about 145,000. It is our view this will be the leveling off. Many of these 45,000 people—in fact, a large majority of the 45,000 people are coming out of the Apollo program. This represents the completion of the equipment and the laying off of the people.

Mr. TALCOTT. There are six additional manned moon probes as I understand. Five if you use one more for a Skylab, but you have none programed after that?

Dr. PAINE. We have no manned space flight programs after that. That would be the end of manned space flight until the shuttle is flying if we decide to go ahead with the shuttle.

BIPARTISAN SUPPORT

Mr. EVINS. We have all heard the President's statements. The Vice President has decried those who would be against the program. The majority of the Space Committee has authorized it.

I read here a line from Speaker McCormack on the floor of the House. He said, "There may be a small minority who will urge that we pull back in our space efforts. This is not my position. Neither am I convinced will it be the view of the Congress or the overwhelming majority of the American people. This country has committed itself to exploration of space as one of the highest national priority. We have done so not as a matter of national chauvinism, but in the interests of all mankind. The space program which we have pursued during the past decade has been eminently successful in its ultimate rewards will be enjoyed by the entire world."

Jerry Ford said, "I share likewise the views of the distinguished Speaker in reference to the space program. It is one of the great achievements of our Nation."

So you have the Speaker and the minority leader. You have bipartisan support, as well as the backing of all the editorials by the American people, but I have heard a lot of others speaking otherwise.

This committee does have its responsibilities. We thank you for this review of the Apollo 13 accident.

COST EFFECTIVENESS OF SHUTTLE SYSTEM

One of our colleagues said he spoke to seven members of the authorizing committee and he quoted Dr. von Braun from the Aerospace Daily magazine. Maybe this is an excerpt from what he said. Certainly it has been cut short. Quoting from the Aerospace Daily, Thursday, April 2, 1970, it says, "Dr. von Braun questions the cost." That is the headline. "In his remarks today Von Braun said that it is questionable whether shuttle traffic in the next 10 or 15 years would justify an initial multibillion-dollar investment in a reusable booster or whether it would be smarter to stick to throw-away stages for a while. The shuttle task group report, however, said that studies consistently show that the fully reusable shuttle system is the most cost-effective system when any significant operational program is taken into account."

He is quoting Dr. von Braun as questioning whether we should go into this cost of the shuttle and the station. Is he quoting you correctly? Do you wish to amplify to the committee on what you said.

Dr. VON BRAUN. I haven't read the article from which you were quoting.

Mr. EVINS. It was added as exhibit B to the testimony of Congressman Karth.

Dr. VON BRAUN. Could I study this article?

Perhaps I can make a statement and amplify in the record. I think there is no question but the reusable vehicle is most cost effective, rather than the throw-away vehicle if you have enough traffic to fly things up there. You have, of course, the initial investment to develop such a system, and that initial investment must be amortized against a certain number of flights. So the whole question of where you break even hinges on the number of flights that you have.

I think if we believe, as we do, that we will have an energetic program of space flights including manned space flights, in the future, then the reusable launch vehicle is, of course, the answer, and all of our studies support that.

Mr. EVINS. The reusable ones would be the more economical?

Dr. VON BRAUN. This statement that a throw-away vehicle could be superior applies only if you assume that there will not be enough traffic, so that you don't get your initial development investment back.

Mr. BOLAND. What you are saying is if there is not enough traffic then a throw-away vehicle is the vehicle to use. This is where the difference comes in between what Aerospace Daily says or whatever the task force says. They say we ought to use reusable vehicles, as I understand it.

Dr. VON BRAUN. The reusable vehicle presupposes you will have a continued energetic space flight program in orbit that will warrant the initial investment. If you don't have the faith in that, or if you say we will have a continued small program, then it may not be wise to spend many billions of dollars developing a reusable system.

It is pretty much like the situation in the airlines. If you believe that you have a route structure that you must service and there will be enough traffic, then it is worthwhile or cost effective to develop airlines to serve that structure. If you see the situation as going down and there will be less and less traffic, you don't need it.

Mr. EVINS. In your 1971 budget you have funds for project definition of the space shuttle and the space station. What part of the estimate is for hardware?

Dr. PAINE. There is no hardware per se. There is only money for testing critical components to help us get the answers as to how complex the job is going to be.

Mr. EVINS. You are going to be before this and other committees before you launch out on to the space station and space shuttle in another year.

Dr. PAINE. Exactly.

Mr. LILLY. We will be buying parts and components and testing this kind of hardware. There is no flight hardware.

Mr. EVINS. The 1971 program is project definition and research and development?

Dr. PAINE. Precisely.

ADDITIONAL COMMENTS OF DR. VON BRAUN

Mr. EVINS. Dr. von Braun, you may elaborate on this if you wish to for the record.

Dr. VON BRAUN. It says "von Braun said it is questionable." I think we could say the question depends on whether you believe in this amount of traffic.

(The statement follows:)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION,
Washington, D.C., April 22, 1970.

Hon. JOE L. EVINS,
House of Representatives,
Washington, D.C.

DEAR MR. CHAIRMAN: In further response to your question during today's hearing of the Independent Offices Subcommittee of the Appropriations Committee concerning the design of the space shuttle, I would like to offer the following observations.

Our present thinking is that the space shuttle should be a two-stage, fully reusable vehicle. This means that each stage, the booster and the orbiter, will have the capability to fly back to earth and land at an airport just like an airplane. This conclusion is based on feasibility studies conducted during the past year by NASA, by the Air Force, and by industry. The studies indicated that a fully reusable system would be by far the most economical approach to a space transportation system.

With the funding requested for fiscal year 1971, we would therefore proceed with a shuttle design and definition effort by two or three industrial teams that concentrate on the two-stage, fully reusable concept. This definition and design effort does not yet commit us to proceed with the development of the space shuttle. However, it will provide us with detailed information concerning the technical problems with the space shuttle together with the projected schedule and costs. A decision for a go-ahead to develop the space shuttle would only be made during the fiscal year 1972 budget cycle and would, of course, be subject to approval by your committee, as well as other committees of the Congress.

The major effort during fiscal year 1971 will be on the design and definition studies of the fully reusable system that I have just discussed. These are the so-called phase B studies. During the same period of time, however, we want to be doubly sure that we do not overlook any other approaches to the space shuttle that might be promising. For this reason, we may also undertake several other studies, but at a much lower scale than the phase B studies for the fully reusable system. These studies will encompass all possible approaches, including a single stage, fully reusable shuttle vehicle and a two-stage system in which the booster stage is expendable and only the orbiter stage is reusable. I would like to emphasize, however, that these additional studies will be so-called phase A feasibility efforts and will involve far less work and money than the phase B studies. Of course, if the phase B studies indicate that another approach is more promising than the two-stage, fully reusable approach, we would, of course, redirect the phase B studies to incorporate this approach. However, such a redirection (which I now believe is unlikely) would also be fully reviewed in terms of the fiscal year 1972 budget process. It would not affect in any way our request for fiscal year 1971 budget.

I hope that this information explains and amplifies the statements I made before the committee earlier today.

Sincerely yours,

WERNHER VON BRAUN,
Deputy Associate Administrator.

Mr. EVINS. Unless there are further questions, we thank you for coming to give us a report on the Apollo 13 accident. Again we commend the great space team.

Mr. BOLAND. And applaud them.

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