REVIEW OF THE SPACE PROGRAM

HEARINGS

BEFORE THE

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

EIGHTY-SIXTH CONGRESS

SECOND SESSION

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REVIEW OF THE SPACE PROGRAM

TUESDAY, FEBRUARY 23, 1960

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND ASTRONAUTICS,
Washington, D.C.

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

The CHAIRMAN. The committee will please come to order.

This morning I might say to the members of the committee that we are pleased to have our newest member, Mr. Tom Morris of New Mexico, who has been selected to take the place on this committee and succeed our able colleague, Mr. Hall. So we welcome you this morning. We have a lot of work for you and all the members of the committee and hope you have a lot of time to put in and a lot of energy to put into the affairs of this committee.

If I were from California or Florida, which I am not, I would say this is the fastest growing committee in the Congress. But I still say it is a good committee and we are happy to have you.

Mr. MORRIS. Will the chairman yield?

The CHAIRMAN. Yes.

Mr. MORRIS. Mr. Chairman, I just want to say it is a real pleasure and an honor to be assigned to this committee and to be associated with the gentlemen who have worked so hard on this very important question that this committee has jurisdiction over.

It is a real pleasure for me to be here.

The CHAIRMAN. Thank you, Mr. Morris. The gentleman who just came in there and to your right is Mr. Roush. Well, we are happy to have you.

As we near the end of the general posture hearings on space and missiles, we are able to record that the committee has heard from most of the top officials, both civilian and in uniform, who carry responsibility for national progress in these fields. This has been useful to the committee for the report it will make to the Congress, in due course, and we believe it has been useful to the American public, with the help of the press representatives who have covered these hearings, and they have been unusually faithful in that respect.

This morning we are holding a session I view as an important addition to our consideration of these vital problems. The committee has invited the major technical societies and other groups concerned with space and missiles to present their views for the record. We hope at an appropriate time late to hear from industry as well as to round out these hearings in full.

The societies which are represented here today in combination have tens of thousands of members, resident in all the States of the Union.

Their members include close to 100 percent of all the technical talent in the Nation of those concerned with the space effort. Therefore, the views they are going to present to use deserve to be listened to with profound respect by the members of the committee.

My thought is that we will ask each witness to give an oral statement about 10 minutes in length, and to file any longer written statement for inclusion in the record. After this, the members of the committee may ask them questions, as a panel.

I say that because we do have Congress meeting at noon and we have our subcommittees, three subcommittees ready to report. We are going to take those reports up Thursday. We hope by that time that all four will be ready to report to the full committee. We will take those up Thursday. We will look them over in connection with the bill that we are writing.

So tomorrow we will meet at 9:30 in the morning to hear one additional witness who was invited for our posture hearings and who could only be here tomorrow morning. We are meeting early so as to give the morning to the subcommittees to finish up their work.

Mr. MILLER. Subcommittee No. 1, Mr. Chairman, must have an executive meeting. It finished all of its hearings and is ready to mark up the bill.

The CHAIRMAN. You can do that this afternoon or tomorrow. It will be all right.

Mr. MILLER. We have a meeting set for this afternoon at 2 o'clock in my office.

The CHAIRMAN. I want to commend the subcommittees for diligence. They have really gone to work earnestly, sincerely, and vigorously. As I just mentioned, three of them are about ready to report, and Mr. Sisk's subcommittee, I am sure, will be ready very soon thereafter.

Mr. FULTON. Mr. Chairman.

The CHAIRMAN. Mr. Fulton.

Mr. FULTON. May I say we are glad to have the societies represented here, but they are better than I expected. If, as the chairman said, they represent more than 100 percent of the technical people connected with the space program, they are doing very well.

The CHAIRMAN. I said close to 100 percent. [Laughter.]

Anyway, 100 percent is good enough.

Mr. FULTON. The other serious point I wanted to make, which is the reason I asked for the minute, I would like to ask Mr. Anfuso, and Mr. King, through the chairman of the committee, that the Science and Astronautics Committee ask the NASA people to come up with a statement of the use of scientific manpower in the agency; that is, whether they are adequately being used for scientific purposes; whether there might be a diversion of their use to management or to survey purposes; and whether there is any topheaviness in the executive end of the agency, so that there may be too many scientists or too many managers.

The CHAIRMAN. The Chair is going to rule that that is a subcommittee matter. Until the subcommittee reports, it will have to be handled by the subcommittee.

Mr. ANFUSO. This afternoon that will be taken up. I will discuss it with you later.

The CHAIRMAN. The first witness this morning is Dr. Howard S. Seifert, president of the American Rocket Society. His biography has been placed before each member. He is also a senior staff engineer of Space Technology Laboratories and is the editor of the outstanding book issued last year called "Space Technology." He will present the statement of the American Rocket Society.

Dr. Seifert, we are happy to have you this morning. If you will proceed for about 10 minutes orally, we will file your statement and be glad to have you.

[From "American Men of Science," vol. I]

BIOGRAPHY OF DR. HOWARD STANLEY SEIFERT

SEIFERT, DR. HOWARD STANLEY, 382 S. Grand Oaks Ave., Pasadena 10, Calif. Physics: Reynoldsville, Pa., Feb. 17, 11; m. 33; c.3. B.S. Carnegie Inst. Tech, 32, M.S. 34; fellow, Calif. Inst. Tech. 34–37, Ph.D (physics), 38. Teacher, high sch, Pa, 32–34; asst. prof. physics, Kalamazoo Col, 34–40; research physicist, Westinghouse Elec. & Mfg. Co, 40–42; asst. proj. engineer and later chief liquid rocket sect, jet propulsion lab, Calif. Inst. Tech, 42–46, chief applied physics div, 46–51, staff engineer, 51–54; mem. research staff, Ramo Wooldridge Co, 54–[1]. Lecturer, Carnegie Inst. Tech, 42; U.S. Army Air Force premeterol. sch, Pomona Col, 43; Calif. Inst. Tech, 45–48. Tech. specialist, rocket ord. to Mil. Attache, London, 44. Asn. Physics Teachers; Rocket Soc. (assoc. ed, 'Jour,' 51–54). Liquid rocket motor design; missile systems.

(The statement referred to is as follows:)

TEXT OF STATEMENT ON AMERICAN ROCKET SOCIETY VIEWS OF U.S. NATIONAL SPACE PROGRAM

Made by Dr. Howard S. Seifert, president, American Rocket Society, before the House Committee on Science and Astronautics, February 23, 1960

I. THE AMERICAN ROCKET SOCIETY

Founded 30 years ago, the American Rocket Society is a professional society of approximately 15,000 engineers and scientists organized in 53 sections throughout the Nation. Its objectives are to foster and encourage the development of those sciences which relate to travel through interplanetary space; i.e., astronautics.

The areas of interest of the society are indicated by the following grouping of its 22 technical committees:

A. Flight Dynamics and Control:
   1. Astrodynamics.
   2. Guidance and Navigation.
   3. Communications.

B. Vehicle Design and Operation:
   4. Missiles and Space Vehicles.
   5. Structures and Materials.
   6. Power Systems.
   7. Test Facilities and Support Equipment.
   8. Logistics and Operations.
   9. Instrumentation and Control.

C. Propulsion:
   10. Propellants and Combustion.
   11. Liquid Rockets.
   12. Solid Rockets.
   13. Nuclear Propulsion.
   14. Ion and Plasma Propulsion.
   15. Ramjets.
   16. Underwater Propulsion.

[1] Now Senior Staff Engineer, Space Technology Laboratories.

COMMITTEE NOTE.—Dr. Seifert is President of the American Rocket Society, 500 Fifth Ave., New York 36, N.Y.

D. Fundamental Science:
   17. Physics of Atmosphere and Space.
   18. Hypersonics.
   19. Magnetohydrodynamics.
E. General:
   20. Education.
   21. Human Factors and Bioastronautics.
   22. Space Law and Sociology.

The name of the official society magazine was Astronautics during the 13 years from 1932 to 1945, and was changed to "Journal of the American Rocket Society" for most of the ensuing 15 years. At present two magazines are published, an archive-type Journal of the American Rocket Society and a semitechnical monthly called Astronautics.

The objectives of the society are accomplished by publication of these journals and by the conduct of numerous general and specialized meetings as well as by a number of other activities. For example, in 1957, prior to Sputnik, the society tendered a resolution to the President, urging the acceleration of space research. During the year 1960, approximately 10 general and specialist meetings will be held in addition to nearly 400 local section meetings.

The officers of the society consist of a president, vice president, permanent secretariat, and a 15-man board of directors, among whom are numbered many prominent contributors to the field of astronautics. The officers and directors comprise seven research directors, five vice presidents, and five engineering professors, all from major corporations or universities. Several of these men have testified or will testify before this committee as individuals. The officers and directors with their titles and affiliations are listed below:

Dr. Howard S. Seifert, president, ARS, special assistant to the executive vice president; professional development; Space Technology Laboratories, Inc.; visiting professor of engineering, UCLA.
Dr. Harold W. Ritchey, vice president, ARS, vice president, Rocket Division, Thiokol Chemical Corp.
Mr. James J. Harford, executive secretary, American Rocket Society.
Mr. Irwin Hersey, director of publications, American Rocket Society.
Dr. Ali Bulent Cambel, professor and chairman, Gas Dynamics Laboratory, Northwestern University.
Mr. Richard B. Canright, chief, Research Section, Douglas Aircraft Co.
Mr. James R. Dempsey, vice president and manager, Convair-Astronautics.
Dr. Herbert Friedman, Superintendent, Atmosphere and Astro Division, U.S. Naval Research Laboratory.
Dr. Robert A. Gross, Physics Department, University of California (formerly, chief research engineer, Fairchild Engineering Corp.)
Mr. Samuel K. Hoffman, vice president and general manager, Rocketdyne, a division of North American Aviation, Inc.
Dr. A. K. Oppenheim, professor of aeronautical science, University of California.
Dr. William H. Pickering, director, Jet Propulsion Laboratory.
Dr. Simon Ramo, executive vice president, Thompson Ramo Wooldridge, Inc.
Mr. William L. Rogers, vice president, Azusa Operations, Aerojet-General Corp.
Lt. Col. David G. Simons, chief, Department of Bioastronautics, School of Aviation Medicine, U.S. Air Force.
Mr. John L. Sloop, Chief, Rocket Systems Branch, National Aeronautics and Space Administration.
Dr. Martin L. Summerfield, editor, ARS Journal, Department of Aeronautical Engineering, Princeton University.
Dr. Wernher von Braun, Director, Development Operations Division, Army Ballistic Missile Agency.
Dr. Maurice J. Zucrow, professor of gas turbines and jet propulsion, Purdue University.

The immediate past president of the American Rocket Society was Col. John P. Stapp, chief, Aero Medical Laboratory, Wright-Patterson Air Force Base; his predecessor was Mr. George P. Sutton, presently chief scientist of ARPA and formerly Hunsaker professor of aeronautics at Massachusetts Institute of Technology.

II. THE SOCIETY'S VIEWS

In response to a request by the House Committee on Science and Astronautics to the president of the American Rocket Society, the members of the American Rocket Society's board of directors (listed above) were polled for their views on the adequacy of America's current space program. Two members abstained. A summary of the views received was made. The president assumes the responsibility for making this summary, since there was insufficient time for it to be reviewed by the board prior to this hearing. While the summary is representative in the sense that it records the majority view in a given issue, it is important to note that a spectrum of opinion exists on some matters. In order to remain as objective as possible and to present the committee with a source of authoritative opinion, there is appended a selection of quotations, categorized by subject matter, from the statements of the board. Those desiring a more detailed sampling of opinion than the summary can give may refer to this appendix.

In general, the board of directors seems to feel that three aspects of America's space program need discussion and examination—its planning, its funding, and its technical goals. The following is a résumé of their views on these matters:

1. Planning

The members of the board of directors feel that the present planning for the American space program could be improved. Its weakness lies in the absence of a clearly defined national policy on space. One day space is regarded as the key to the Nation's survival, the next as an expensive gamble which is largely irrelevant to our national destinies. Achievements in space are considered to be a revealing index of a country's technology and hence its position in the world; but they are also deprecated as mere propaganda, valuable only for swaying the have-not nations. The planning and funding of space projects are affected critically by these oscillations of opinion, often in a damaging fashion.

We as a Nation should decide, first of all, how important we feel space to be, and then be prepared act upon the consequences of our decision.

The American Rocket Society would like to make its position clear in this matter. It believes that the exploration of space is and will be of central national importance, and that the welfare of this country depends in large part upon the extent to which it is willing to accept the challenge of this new frontier. It believes this attitude practical, not romantic, for it sees space technology as a fruitful area for research. Space technology requires the solution of new problems in metallurgy, physics, mathematics, information theory and communications, fabrication techniques, nuclear power, and much more. These are matters which the American Rocket Society directors feel should not be neglected.

Once we have decided that space is important we should set a series of long-range goals for ourselves. This is essential, for the space race is a costly one to enter as a competitor and only countries who plan wisely will win. We need to appreciate the fact that space age leadtimes are longer than those of the pre-Sputnik tank or jetplane. For example, if we envision interplanetary travel as part of our national capability in 25 years, a substantial amount of time should be devoted now to nuclear propulsion and recoverable boosters. If we take a long-range view we shall also see that education is a most important commodity, and thus begin now to set up scholarship programs. We might also set up national laboratories in conjunction with our leading universities so that we can utilize their resources and enhance the education of scientists. If we want to compete 25 years hence, these things should be done now.

Once we have defined our aims for the space program, we shall be able to establish a series of logical steps by which to achieve them. We shall also have a series of meaningful criteria for assigning priorities to programs, rather than day-to-day switches of opinion that are costly in money and development time. We shall have, in short, a unified development plan which will be an expression of national purpose. This step must be taken before an integrated research and development program is possible.

These recommendations do not necessarily imply reorganizing the administration of our space program. While a few members of the board feel that all space and military efforts should be gathered under a single officer of Cabinet rank, most seem to think our present administrative setup will be adequate if it is properly used. Reorganization can markedly reduce the effectiveness of

groups, and it is often as much as a year before a reorganized group regains its efficiency. We are too far behind as it is, they feel, to permit such delays. What we need is clearly defined goals, not reshuffling.

2. Funding

The area in which the lack of organized purpose is perhaps most clearly in evidence is funding. Like our planning, funding should be geared to a series of long-range purposes based on a realistic appraisal of our national resources. Yet too often it is a series of catch-as-catch-can policies. The board of directors feels that funding should be allocated for at least 5 years in advance, preferably longer. The funding for initial phases of a project should be firm, for latter periods flexible enough to account for possible developments.

Funding of this sort would give a continuity to the efforts of both planners and doers. As things presently stand, budgetary oscillations sometimes wreck technological effort. At great expense a group of experts is gathered, organized, made efficient by experience, and then, just as it is beginning to function productively, suddenly disbanded because of a budgetary cutback. We must prevent such situations. They waste time and money, and they can force some of our better men out of defense projects, where we urgently need them, into more stable occupations. We must fund, in short, in such a way as to permit the continued effort of experienced groups.

The board feels that funding has been conspicuously deficient in the field of basic research. More funds are badly needed in this area. Furthermore, a short-term funding structure is incongruous with the nature of fundamental research. The length of the funding should be determined by the nature of the project, not by arbitrary fiscal dates.

The board urges that unless we take a long-range view of these matters, the bill for the conquest of space will be unnecessarily high.

3. Technical goals

While the general feeling of the board is that we should explore as many aspects of space as possible, several projects were called out for special attention. First, emphasis should be given to those high-performance vehicles and powerplants which require 5- to 10-year leadtime and without which major exploratory work cannot be done. These include million-pound class recoverable boosters, medium scale rockets using new energetic propellants, nuclear rockets of 100,000 pounds thrust and up, and electrical propulsion rockets of the order of one-tenth pound thrust. The board suggests increased studies in bioastronautics, astronomy, astrophysics, metallurgy, and solid state physics. As a means of gathering data for these studies, they suggest an integrated orbital system consisting in part of satellites used as engineering laboratories. Such a system could include provision for global communications and weather prediction in addition to basic research. Several feel that a program to take instrumented vehicles near and to the Moon should be pursued. The vehicles would be used to study the moon, and determine the feasibility of its use as a base or station for interplanetary explorations.

Some members point out that military and political pressures are exerted by a country's technical and scientific achievements. They hold that we must not force an artificial separation between the scientific and military potential of space, and that we must be fully aware of possible military aspects of space if we are to assure ourselves of an opportunity to explore space peacefully.

APPENDIX

QUOTATIONS FROM THE LETTERS AND TELEPHONE CONVERSATIONS

The following quotations, listed under a series of representative topics, are taken from the letters and phone calls of the members of the board of directors.

The topics covered are:

Planning
Funding
Objectives of space program
Important research areas
Basic research
Military aspects of space
Education
Administration of space program

PLANNING

"Our present program of basic research in space science is operated on a 'catch-as-catch-can' basis. Scientists have been funded to produce all the various payload packages without preassignment of vehicles or dates. Because of the limited number of vehicles available, payloads have been integrated with groups of incompatible experiments in order to give everybody a chance. The end result, however, is never entirely satisfactory to any of the parties involved."

"We must recognize the need for a sound space science program apart from the need for propaganda 'spectaculars.' If the political need demands the spectacular achievement, we should evaluate the present Russian lead and not dissipate our efforts in the preparation of missions in which there is little chance of our being first."

"In contrast to the urgency being expressed in the booster program * * * there seems to be little emphasis on planning the missions. For example, plans have been discussed with respect to a soft lunar landing of an automated tractor-type laboratory, capable of performing a variety of experiments such as X-ray fluorescence analysis of the lunar surface, measurement of its radioactivity, and the taking and analysis of core samples. To my knowledge, no firm decisions have been taken to develop the payload in spite of the fact that several years of intensive effort are hardly adequate to perfect such instrumentation. It seems likely that we shall have the boosters but would have to wait for the payloads."

"I believe that one of the most desirable combinations of the 'spectacular' with highly scientific objectives is a space observatory to extend astronomy into the ultraviolet and X-ray wavelengths and long wavelength radio spectrum beyond the ionospheric cutoff. On the assumption that we can look forward to boosters capable of placing several-ton payloads in very high orbits by the middle 1960's, we barely have the time to perfect the necessary instrumentation for a space observatory even on a crash basis. Plans for ultimately instrumenting such an observatory have been tentatively formulated but it will require an intensive program, starting with rocket astronomy in its present primitive state and advancing through a series of developmental payloads and broad sky surveys in order to achieve the 'know-how' for the final package. For lack of adequate support and emphasis, these steps are progressing so slowly at this time that I see little hope of effecting the ultimate payload in time to match the vehicular development."

"It is suggested that 10-year programs should be established by both the military and the civilian space organizations. The first year's programs should be in considerable detail, with each succeeding year requiring less specific program targets. Also, duplicate approaches and backup programs should be permissible in the early, less expensive years."

"General approval should be expressed for the NASA 10-year program of space exploration, as recently announced in the press. However, NASA should be urged by Congress to make use of American private industry wherever possible to develop its overall vehicles and launching systems and stop trying to do it all in its own house."

"If we are going to think of interstellar travel, even in the far distant future, it is well to undertake some research programs now that will eventually lead to the possibility."

"It is highly desirable that any research program be planned in logical steps, so that the next generation may continue it without serious loss of time that could be attributed to initial misdirection or initial lack of foresight."

FUNDING

"The subject of funding should certainly be considered. A congressional plan of budgeting the space program on a 5-year basis with a firm 1-year program and planning for the additional 4 years would be highly desirable. This would allow a continuity and planning that would benefit both the doing and the funding organizations."

"With reference to the funding, in my opinion the problem is more in the incorrect handling than the money available. The structure of short-term contracts for fundamental research is essentially paradoxical. The funding of a research program on the basis of an artificial period of a fiscal year is basically untenable."

OBJECTIVES OF SPACE PROGRAM

"The objectives of the U.S. space program should be the exploration of space, its use, and exploitation of its resources for both civilian and military purposes."

"From the scientific viewpoint, the intermediate objectives would involve a thorough geodesian mapping of the Earth, the complete description of geomagnetic field, aurora, particle trapping, airglow, particle interaction, and ionospheric phenomena, and a more complete grasp of meteorology than available at present. The emphasis in the exploration of the planetary system would be in natural and life sciences, chemistry of interplanetary space, meteorites, cosmic rays, magnetohydrodynamic phenomena, as well as providing opportunities for tests of general field theory, relativity, etc."

"There are three major areas which the U.S. space program should include: These are:

"1. Integrated orbital system: The system should be controlled or coordinated by a single agency. It should include subsystems such as communications satellites, meteorological satellites, instrumented and manned research vehicles, and manned space research laboratories.

"Objectives:

"(*a*) Provide research capabilities for medicine and other basic sciences.

"(*b*) Provide common services such as communications and weather prediction.

"(*c*) Explore potential uses and benefits of orbital environments and applications of orbital operations.

"(*d*) Ascertain possible military exploitation of space.

"2. Lunar exploration. The program should include instrumented vehicles to and near the Moon, manned lunar circumnavigation, and manned landings.

"Objectives:

"(*a*) Provide basic research information about the Moon and its environment.

"(*b*) Determine desirability and feasibility of establishing manned lunar base and its functions.

"3. Planetary and interplanetary exploration. The program should include instrumented probes to and near planets, later instrumented landings, and manned planetary exploration if determined to be desirable.

"Objectives:

"(*a*) To provide basic information about other planets of the solar system and the environment of interplanetary space.

"(*b*) To determine desirability and feasibility of manned planetary exploration."

IMPORTANT RESEARCH AREAS

"The large chemical boosters of 1 million to 1,500,000 pound thrust should be continued with improvements incorporated as technology permits. Clustering of the engines should be considered to increase the overall thrust level available for ambitious missions."

"The high energy (LOX-hydrogen) engine field should be expanded to incorporate the presently planned 200,000 pound thrust engine size. A 3 year review of the high energy program should be made to determine if the requirement exists for the next larger engines, possible 500,000-pound thrust (LOX-hydrogen)."

"An immediate start should be made in the nuclear engine field. A thrust of 75,000- to 90,000-pound size (to fit present reactor design) would seem to be a first logical step. Such an engine should be ready for flight about 1965. A review of the nuclear program in about 3 years should be made to determine the feasibility and requirements for a larger thrust nuclear rocket engine."

"The electrical propulsion field could be enhanced by the initiation of a 0.1-pound thrust engine at this time. Such an engine could be ready for flight in 1964 to 1965. A review of the electrical propulsion progress should be made in 1962 to determine the requirements for a larger engine—probably of the 1- to 10-pound thrust size."

"Engineering design data are needed in order to exploit most economically and efficiently our new space frontier. Several engineering laboratories (initially unmanned, of course) should be put into space to gather the needed information."

"The experimental and development work leading to a nuclear rocket engine should be expedited, so that the only presently known type of high-thrust, high-specific impulse rocket powerplant can be available sooner, to economize on the total bill for space exploration. Concurrently with the increase of emphasis should come design and experimental studies leading to an engine of a thrust size ($\geq$300K) useful for space exploration, together with initiation of design studies of the optimum (costwise) airframe into which this powerplant can be integrated."

"Serious studies should be stepped up in bioastronautics, a man's survival in space and on other planets. This might include research into closed ecological systems, food cycles, biological cycles, resynthesis, respiratory quotient, and use of algae."

"More research in the area of astronomy and astrophysics should be initiated."

BASIC RESEARCH

"We cannot recommend too strongly the need for more adequate funding in basic research, particularly in the materials areas of metallurgy and solid state. A higher level of basic research support is also definitely called for in those types of space science based on ground level observations. In this latter category our national radio astronomy effort is sadly neglected."

"Basic research should be taken out of the hands of the Department of Defense and the AEC (the two Government agencies that spend most of the Federal funds in this area) and put into the hands of a civilian agency staffed by professional scientists, and the amount of Federal support in this field should be sharply increased."

"Basic research in the space field should be provided with long-range funding rather than the present annual budget. The length of the funding should be dependent upon the nature of the project."

"More Government support should be given to long-range fundamental research so that the researchers can serenely concentrate on their work rather than coming out with inconsequential results to satisfy quarterly or yearly nontechnical contractual requirements. Fundamental research studies should not be governed by development and production divisions."

"We should have a number of national laboratories for basic studies. Whenever possible these laboratories should be located in close proximity to universities to utilize buried talent to a maximum and to maximize the education of many more scientists."

MILITARY ASPECTS OF SPACE

"Ballistic missiles now are needed to complement long-range manned bombers in an overall deterrent force. Similarly, military space vehicles will be needed to complement the ballistic missile force. These military space vehciles will be for reconnaissance, early warning, communications, weather, and navigation purposes."

"The military must support and is supporting President Eisenhower's policy that space is for peace. But, in order to ensure that it is only used for peace by all who might enter it, we have to explore space thoroughly and determine the military potential. Once we learn what is possible militarily, we will have to exploit this potential and provide in space the deterrent force that is necessary there. In order to determine the military potential, many scientific experiments will have to be conducted, but if we make only scientific explorations of space, then we take a big chance in falling behind militarily as I am sure the Russians will utilize anything that they can in a military way in order to achieve a military superiority."

"We may not know the nature of an effective military space force now, but when we do identify it and implement it, we will find that a strong deterrent space force is the best way to ensure 'Space is for Peace.' "

"It is not nearly so important at the present stage of international affairs to win the scientific race into space as to win the ICBM missile race and to win the overall race for retaliatory power. If the financial choice must be made between speeding up Saturn and, say, an airborne alert, actual civil defense, a reactivation of the B–70 program, or a missile speedup, then the latter projects should be voted. A year's delay in Saturn will not endanger the nation; an inadequate retaliatory power will."

"Military space systems offer hope for removing the H-bomb threat from civilian populations."

"The United States should not sign any pact agreeing only to the peaceful exploitation of space (compare use of the ocean, in peace and in war)."

EDUCATION

"One area that needs heroic measures is education. Another is the support of basic research. Proper education is costly and large amounts of Federal tax money will be required to do the job. This is especially true in the field of higher education."

ADMINISTRATION OF SPACE PROGRAM

"Combine the present military and civilian space programs under one central agency. Under a single civilian leader this agency should be charged with our space responsibilities and governed by a primarily technical group."

"The present industrial competitive bid system for Federal space projects is obsolete and should be abolished. Rather, a system (of which there have been several suggested) should be installed which permits the continued efforts of experienced, successful groups, without major influence of budget oscillations."

"It is more important to maintain the integrity of existing R. & D. laboratory groups than to establish new agencies. Every reorganization destroys the efficiency of the groups being reorganized for a period of at least a year and perhaps 2 years. The R. & D. competence and logistics experience of military laboratories ought to be coordinated with the operations of the civilian organizations to fully utilize all the facilities in the country and to make the fullest use of all the available trained manpower."

(Paraphrase of telephone conversation:) "I am not satisfied with the way NASA chooses its projects. I fear that too many nontechnical considerations enter its thinking. Moreover, they are inadequately funded to keep up with the Russian effort. The NASA administrators were told by the budget directors what dollars were available rather than asked what dollars were needed. I believe that 1 percent of the gross national income should go into the effort. There is some question whether the NASA organization is able to handle projects of this magnitude and 'think big,' as the military are accustomed to doing. I believe the NASA group are using military hardware and 'drying up' the available military program without being able to replenish it with an aggressive long-range, large-scale booster program."

(Paraphrase of telephone conversation:) "We should emphasize the urgency of a unified program, and not dissipate energy between competing agencies. It is too costly in dollars, men, and especially facilities, to spread our efforts between NASA and the Air Force. I do not, at this time, claim to have answers as to how to accomplish unification.

"Since this is a cold war and not a hot war, the space program should emphasize scientific and exploratory needs rather than military 'requirements.' This does not mean that ballistic missile programs should be neglected; in fact, the military would do well to concentrate on a really good ICBM.

"Military control of the entire space program might lead to an expensive satellite armament race, divert limited funds from a proper basic scientific program, and produce an impression of U.S. militarism on the world. I recommend civilian, presumably NASA, control and not yet another organizational structure over both NASA and the Air Force."

(Paraphrase of telephone conversation:) "I believe our primary need is to support the importance of the space program. This was stated very well by George Allen of the U.S. Information Service in a Time article a few weeks ago. This importance justifies a 50- to 100-percent higher budget than is now allotted, to go mainly toward items such as nuclear propulsion and manned space laboratories.

"We are too far committed to the present (NASA-Air Force) organization to change again. Let's give it a chance to work. I believe NASA should operate in the spirit of the old NACA and do more fundamental supporting research and less operational big booster development."

"Perhaps the major factor in determining the space program of this Nation is our military requirements. Man is headed now for exploration of space, and some of our future space programs can properly be labeled as nonmilitary or pure research. However, this research is very expensive. Meanwhile, the military requirements include heavy expenditures to provide the big boosters to get us into space, the complex electronics apparatus for guidance and control of and communication with spacecraft, and the facilities for launching, maintenance, and handling of data. It will shortly become clear, if it is not clear today, that the way to accomplish the most research and exploration for each dollar is to have close ties with the military."

"Wisdom must accompany imagination. Our chance for survival depends on making better choices than any potential enemy nation of all the possible things we can do.

"If we are tired of cheap predicting and promoting, we are tired also of the argument that we must do various things because the Russians might do them first. We want to choose to do what we think makes the most sense for us as a nation, and not be influenced to do other things in a misguided effort to accomplish the impossible; namely, to be first in everything that can be achieved in space. That would be the same as allowing the Soviet Union to determine our defense and research programs."

THE AMERICAN ROCKET SOCIETY, 1930–60

The American Rocket Society is the largest professional society in the world devoted solely to the advancement of the field of astronautics and related sciences. ARS now numbers over 15,000 members, a growth of more than fivefold in 5 years, making it one of the most rapidly growing professional engineering organizations in the United States.

In accordance with the society's purpose to promote the field of astronautics, it has in its 30-year history been a leader in the effort to obtain for this country a superior space program. In two instances in particular ARS programs led directly to action by the Government in the space field.

In November 1954 the ARS Space Flight Committee, headed by Milton Rosen, presented a proposal to the National Science Foundation calling for sponsorship of a study of the utility of an unmanned Earth-satellite vehicle. This proposal was one of the factors which led to the announcement by President Eisenhower in July 1955, that the United States would launch a satellite in the course of the International Geophysical Year.

In October 1957 ARS submitted to President Eisenhower a full-scale report calling for immediate initiation of a long-term national space flight program to be administered by a new independent Government agency with broad powers in this area. The report, drawn up before the Sputnik I launching by the ARS Space Flight Committee, headed by Krafft A. Ehricke of Convair-Astronautics, and including many of this country's top astronautical engineers and scientists was one of the considerations which led to the establishment of the National Aeronautics and Space Administration.

The society, which is comprised of and dedicated to astronautical scientists and engineers, carries out its objectives principally through the dissemination of information in its two publications, Astronautics and ARS Journal, and through its technical meetings, numbering over 500 per year on both a local and national level.

PUBLICATIONS

Astronautics covers topics of broad interest to the field, written to keep the specialist in one area abreast of developments in other areas that affect his specialty. It also carries general news of the field including contract awards, personnel news, patents, and new product announcements.

ARS Journal is an archive publication covering in detail research and development work of particular interest to the specialist in such fields as astrodynamics, propellants, combustion, hypersonics, physics of space, liquid and solid rockets, and others. In the fall of 1959, ARS, under the sponsorship of the National Science Foundation, began publishing a quarterly supplement to ARS Journal of translations of articles on astronautics or related subjects appearing in Russian technical journals.

MEETINGS

The society holds two major meetings a year, the annual and semiannual meetings. At these two, all the astronautics disciplines are represented so that at one meeting, the scientist and engineer can hear not only of late developments in his particular area, but also acquaint himself with the state of the art of allied fields.

In addition to these two meetings, smaller specialist conferences are held which devote themselves to more exhaustive studies of specialized segments of astronautics.

Examples of current specialist conferences are:

January 28–29, 1960: Solid Propellant Rocket Research Conference, Princeton University, Princeton, N.J.

February 17–19, 1960: Ballistic Missile Defense Conference (secret), cosponsored by ARPA, College of William and Mary, Williamsburg, Va.

March 23–25, 1960: Ground Support Equipment Conference, Detroit, Mich.

April 6–8, 1960: Structural Design of Space Vehicles Conference, Santa Barbara, Calif.

Behind the program of these meetings and contributing to the quality of material carried by the two publications are 22 technical committees which solicit, screen, and program material for presentation. These technical committees, covering specialties from astrodynamics to underwater propulsion, are headed by scientists and engineers prominent in the specialty and supported by committee members also distinguished in the field, providing the highest quality panel for selecting material most appropriate for presentation to the membership.

AWARDS

The society makes seven awards annually to people who have distinguished themselves in various fields of astronautics. These awards are the Robert H. Goddard Memorial Award for outstanding work in liquid rockets, C. N. Hickman Award for outstanding work in solid rockets, G. Edward Pendray Award for outstanding contribution to the rocket and astronautical literature, ARS Astronautics Award for outstanding contribution to the advancement of space flight, James H. Wyld Memorial Award for outstanding application of rocket power, and the ARS Chrysler Corp. and Thiokol Chemical Corp. student awards, the former for undergraduate, the latter for graduate students.

SECTIONS AND STUDENT CHAPTERS

The nationwide membership is organized into 52 sections, which meet on the average of once a month. These meetings give members a chance to hear outstanding lecturers in their fields and to get together on a social basis to exchange views and ideas.

Similarly, the society has 46 student chapters formed at universities and colleges throughout the country which encourage engineering and science students to augment their work and to give them contact with professionals working in the field.

HISTORICAL BACKGROUND

Though most recognition has been given to the society in the post-Sputnik era, it was organized on April 4, 1930, by a group of 11 men and 1 woman, primarily science fiction writers, for the purpose of promoting interest in space flight. Of the original dozen only one man, Dr. G. Edward Pendray, is still a member of the society, but the organization spawned by this group has continued to grow.

The founders originally named the group the American Interplanetary Society but changed its name to the present one in 1934 because, as the editor of Astronautics explained at the time, "In the opinion of many members, adoption of the more conservative name, while in no way implying that we have abandoned the interplanetary idea, will attract able members repelled by the present name."

In June of 1930, the group printed its first publication, at first in mimeograph form, titled, the Bulletin, and subsequently retitled Astronautics, then the Journal of the American Rocket Society, Jet Propulsion and now ARS Journal. In August 1957, the society began publication of its second magazine, Astronautics.

In 1931, inspired by a trip by Dr. Pendray to Europe on which he talked with leading European scientists working with rockets, the society formed an experimental committee with Dr. Pendray as chairman. This group designed the first ARS rocket, consisting of two parallel cylindrical tanks of standard aluminum piping, each 5½ feet long and 2 inches in diameter. They were held at the top by a frame piece which supported the motor and its cooling jacket, turn-on valves that could be operated electrically from a distance, and a cone-shaped nose piece containing a parachute. At the rear of the rocket were large sheet-aluminum fixed vanes for guiding in vertical flight. The fuels were gasoline and liquid oxygen.

The rocket received its first burning test on November 12, 1932, on a farm near Stockton, N.J., and though it performed as desired it was accidently damaged in testing and therefore never flight tested.

A streamlined version of the rocket, dubbed ARS rocket No. 2, was shot in a field at Marine Park, Great Kills, Staten Island, N.Y. on May 14, 1933. It reached an altitude of about 250 feet, after firing about two seconds and was still going when a stuck valve caused the oxygen tank to explode. This firing was followed by two subsequent ones in September of 1934.

The society then began a series of proving stand tests, which though clogged with difficulties, resulted in the development by James Wyld of his regenerative motor which subsequently was the basis for the organization of Reaction Motors, Inc., in New Jersey in 1941.

Membership in the society during this period included mostly experimenters since there was no rocket profession to speak of. Dr. Robert H. Goddard, the father of American rocketry, is one of the few ARS members who could have been considered a working professional then since his New Mexico developments were being subsidized by the Guggenheim Foundation. Dr. Goddard was an ARS director in the early 1940's.

A 1946 roster lists only 120 members. At about this time, however, the society expanded nationwide when a number of engineers and scientists from Aerojet Engineering Co., the first western rocket enterprise, and from the Jet Propulsion Laboratory at California Tech., joined. From then on growth was much more rapid.

It is interesting to call attention to some of the ARS members in the early 1950's and contrast their responsibilities then with those of today:

	Responsibility in early 1950's	Responsibility in 1960
J. V. Charyk	Associate professor, Princeton University.	Under Secretary of the Air Force.
James R. Dempsey	Program manager MX-1593 (early name for Atlas).	Vice president, Convair-Astronautics.
Krafft Ehricke	Preliminary design engineer, Bell Aircraft.	Program manager, Centaur, Convair-Astronautics.
Richard W. Porter	Manager, Hermes project, General Electric Co.	Vice chairman, COSPAR.
George P. Sutton	Engineer, Aerojet Engineering Co	Chief Scientist, ARPA.
Wernher von Braun	Chief, Guided Missile Branch, Redstone Arsenal.	Director, Development Operations Division, ABMA.

INTERNATIONAL RELATIONS

ARS is the American voting member of the 21-nation International Astronautical Federation. The IAF meets each year for scientific and plenary sessions. Last year the meeting was held in London and was attended by some 500 scientists and engineers. More than half of the papers presented were by ARS members. A delegation from the House Committee on Science and Astronautics participated.

The 1960 IAF Congress will be held at the Royal Technical Institute in Stockholm, August 15–20. President of the IAF this year is Academician Leonid I. Sedov of the U.S.S.R. Col. John P. Stapp of ARS is one of the vice presidents. Two ARS members have held the IAF presidency: Frederick C. Durant III and Andrew G. Haley.

At the ARS 14th annual meting in Washington, November 16–20, 1950, Professor Sedov headed a five-man delegation from the U.S.S.R. which presented important new material on the U.S.S.R. sputnik and cosmic rocket orbits and

their findings. Abe Silverstein, Director of Space Sciences for NASA, was chairman of the session at which these papers were presented and described them as having "presented information which gave one an overall impression of the space program in the Soviet Union. This effort appears to show a carefully directed, intense program which is soundly based and is being carried out on a long-range basis. The Soviet scientists were friendly, cooperative, and were willing to exchange views and some ideas, and to answer most of the scientific questions which were presented to them. Further contacts of this nature are certainly valuable, as they improve communications between the scientific and technological communities of the U.S.S.R. and this country."

In August or September 1961, ARS is scheduled to be host to the IAF Congress in New York. The gathering is expected to bring some 500 space authorities from all over the world.

ARS YOUTH PROGRAM

Because of the high incidence of accidents involving amateur rocket experiments, the society issued last year a 76-page report analyzing the problem and is widely publicizing its conclusion that it is "unalterably opposed to amateur rocket experimentation with explosive propellants of any kind regardless of supervision."

The society's education committee, headed by Prof. Irving Michelson of Pennsylvania State University, is developing a positive program of study and nonhazardous experiments for would be space scientists in cooperation with such organizations as Civil Air Patrol, the Boy Scouts of America, and other qualified groups.

THE COMING YEARS

The society regards its mission in the 1960's particularly urgent for the engineers and scientists it serves, for the astronautics field and for the Nation.

Its responsibilities are summarized in these excerpts from the objectives which President Howard Seifert outlined to the ARS Board of Directors at its meeting on January 27, 1960, in New York:

To manifest leadership in improving the quality of professional communications media in the astronautics field.

To make a conscientious effort to create new media for communicating the significance of the achievements and potential of astronautics to the Nation at large.

STATEMENT OF DR. HOWARD S. SEIFERT, PRESIDENT, AMERICAN ROCKET SOCIETY; ACCOMPANIED BY DR. MARTIN SUMMERFIELD, EDITOR, ARS JOURNAL, MEMBER OF BOARD OF DIRECTORS; AND JAMES J. HARFORD, EXECUTIVE SECRETARY, AMERICAN ROCKET SOCIETY

Dr. SEIFERT. Thank you, Mr. Chairman. I would like briefly to identify the American Rocket Society. It was founded about 30 years ago. It has about 15,000 engineers and scientists as members and its objectives are to foster and develop those sciences that are related to interplanetary travel. This is defined in Webster as "astronautics."

I would like to point out the membership of the board of directors. We include among our 15 directors some names whom you may recognize: Dr. William Pickering of the Jet Propulsion Laboratory, Dr. Simon Ramo of the Thompson Ramo Wooldridge Corp., Dr. von Braun of ABMA, Mr. Jim Dempsey of Convair, and Mr. Samuel K. Hoffman of Rocketdyne, as well as Dr. Martin Summerfield who is professor at Princeton and editor of our ARS Journal.

The rest of the board is of a similar high caliber, but these gentlemen may be known to you.

I polled this group by wire and I have attempted to make a summary of their views. However, I must take the responsibility for

this summary since I did not have time to review it with them prior to the committee hearing.

The board seems to feel that there are three aspects of the space program that would bear discussion—the planning, the funding and the technical goals. Some of these goals are, in fact, being implemented.

First, the planning. The members of the board feel that the present planning has a weakness, in that there is not a clearly defined national policy. One day space is regarded as the key to the Nation's survival and the next day as an expensive gamble which is largely irrelevant to our national destiny. The planning and funding of space projects is affected critically by these oscillations of opinion, often in a damaging fashion. We feel then as a Nation we should decide how important we feel space to be.

The Rocket Society would like to make its position clear. It believes that the exploration of space is of central national importance and that the long-range welfare of the country depends on the extent to which we are willing to accept the challenge. It is a fruitful area for research, particularly in such subjects as physics, mathematics, and communications.

Once we have decided that space is important, we should set a series of long-range goals. For example, if we envisage interplanetary travel as part of our national capability in 25 years from now, a substantial amount of time should be devoted now to nuclear propulsion, recoverable boosters, and the like. Similarly, if we take a long-range view, we see that education is a very important commodity and we should begin now to set up such things as scholarship programs and national laboratories in conjunction with the leading universities.

Once the aims for the space program are defined, we shall be able to establish a series of logical steps by which to achieve them and have a series of criteria for assigning priorities to programs. In short, we will have a unified development plan.

These recommendations do not necessarily imply reorganizing the administration of the space program. Some members of the board felt that perhaps a single officer of Cabinet rank should have authority over these matters, but most seem to feel that the present administrative setup will be adequate and, in fact, that reorganization would markedly reduce the effectiveness of groups.

In other words, what we need is clearly defined goals and not reshuffling.

Item 2 for discussion is funding.

The board feels that the area where the lack of organized goals is most clearly in evidence is in the funding. It should be geared to a series of long-range purposes; and yet, too often, it has a somewhat catch-as-catch-can character. The board of directors feel that the funding should be allocated for at least 5 years in advance, and preferably longer, with the initial phases firm and later periods funded in a flexible manner to allow for developments.

This would assure continuity of effort. As things presently stand, budgetary oscillations sometimes wreck technological effort.

A group of experts is brought together and made efficient and then just as it begins to function, it is disbanded because of budgetary cutback. We must fund, in short, in such way as to permit the continued effort of an experienced group.

The board feels particularly strongly that the funding has been deficient in the field of basic research. A short-term funding structure is incompatible with the nature of basic research. The length of the funding should be determined by the nature of the project, not by arbitrary fiscal dates.

I might add that no comment on the quantity of funding is indicated here except that it should be continuous.

Finally, the technical goals—and this concludes my statement: The general feeling of the board is that while we should cover as many subjects as possible, there are certain projects they call out for special attention.

First, the emphasis to those high performance vehicles which require 5 to 10 years' leadtime and without which major exploratory work cannot be done, such as million-pound class recoverable boosters, medium-scale rockets with the new energetic propellants, nuclear rockets of 100,000-pound-thrust up, and electrical propulsion systems.

The board suggests that satelliteborne studies of such matters as astronomy, bioastronautics, and metallurgy be carried forth by means of an integrated system consisting of satellites used as engineering laboratories.

Such a system might also provide for global communications and weather prediction in addition to these engineering research programs.

Finally, some members point out that military and political pressures are often exerted by a country's technical and scientific achievements. Therefore, they hold that we must not force an artificial separation between the scientific and the military potential of space and that we must be fully aware of the possible military aspects of space if we are to assure ourselves of an opportunity to explore space peacefully.

This concludes my statement. There are attached to the formal statement a series of direct quotations from the members of the board for those who would like more detailed survey of opinion. Thank you.

The CHAIRMAN. Thank you very much, Dr. Seifert. We appreciate very much your statement.

Now, the second witness is Dr. George R. Arthur, president of the American Astronautical Society. His biography has been placed before each member of this committee. He is also systems projects engineer, Missile and Space Vehicle Department of the General Electric Co. He will present the statement of the American Astronautical Society.

(The biography follows:)

BIOGRAPHY OF DR. GEORGE R. ARTHUR

Dr. Arthur received his education at Yale University, graduating with high honors in 1948 with a bachelor of science degree. In 1949 he received his masters degree, and in 1952 a Ph. D. in mathematics and engineering. While at Yale he was a Thomas Edison fellow in 1949. From 1949 to 1952 he was an instructor in electrical engineering and a research fellow.

From 1952 to 1956 Dr. Arthur was employed by Sperry Gyroscope as a section head in charge of missile guidance systems and automatic pilots.

From 1956 to 1959 he was manager of design engineering at the RCA Airborne Systems Facility, specializing in television, infrared, and special missile systems. He recently joined the General Electric Missile and Space Vehicle Department and is associated with the advance space vehicle engineering operation.

Dr. Arthur is a consulting editor for Automatic Control magazine, a fellow of the American Association for the Advancement of Science, and president of the American Astronautical Society. He is a senior member of the IRE and a member of Tau Beta Pi and Sigma Xi. His articles have been published in the Journal of Applied Physics, the IRE Proceedings, the British IRE Journal, Television Engineering, and Automatic Control magazine.

The CHAIRMAN. Now, Dr. Arthur, Dr. Seifert, we are going to need all of you in front for the question. However, if you will proceed, Dr. Arthur, we would appreciate it.

STATEMENT OF DR. GEORGE R. ARTHUR, PRESIDENT, AMERICAN ASTRONAUTICAL SOCIETY, INC.

Dr. ARTHUR. Thank you, Mr. Chairman.

I should like to express my thanks to the chairman and to the committee members for inviting me here and giving me this opportunity to present the views of the society on this vital subject. I am here in my capacity as president of the American Astronautical Society and I am trying to present substantially the society's views, although it is somewhat difficult to keep personal reflections from creeping in and I shall attempt to identify them.

This statement has been prepared through discussions with the majority of our board members and with the board of directors of several of the regional sections of the society.

The best point of departure for this statement is to outline briefly the broad objectives of the American Astronautical Society and then to relate this position of the society to the space flight programs and philosophy in the United States today. More particularly, it will relate to some of the specific programs in space technology.

The American Astronautical Society is composed of scientists and engineers in the astronautical sciences. We are a national scientific organization dedicated to the advancement of the astronautical sciences. The society considers manned interplanetary space flight a logical progression from today's high performance research aircraft, guided missiles, and Earth-satellite operations.

I shall attempt to hit the high spots of four major areas: The present approach to the space program, public information programs, organization, and education.

How does this relate to the present situation? As noted above, the society believes that manned space flight and all it implies is a logical progression from today's technology. We believe that this is a natural evolution of mankind and that mankind can benefit greatly by the step into space. These benefits have been included and described in detail by other speakers before this committee and include such things as communications satellites, navigation satellites, meteorological satellites, and similar items. Are we doing all we can to reap these benefits?

As far as the U.S. program is concerned, the following comments can be made.

The field appears to divide into two major areas: (1) Scientific exploration, and (2) applications of systems.

Sputnik, Vanguard, the Explorers all have been in the first category. The manned systems cover both areas.

It appears that the U.S. program in the area of exploration by Earth-satellite operations is reasonably well in hand. This scientific exploration program has dealt largely with unmanned vehicles.

The one area of exploration where a more rapid rate of development appears warranted and very useful as an aid to applications is the planetary probe.

We now see in retrospect that the program for manned space flight probably got off to a late start, and is now proceeding at only a modest pace. Although some advance planning is in progress at the present time in the manned satellite field, it is felt that the lack of strong support for a substantial follow-in program to Project Mercury is a definite gap in our present space program.

It must be noted that the sixties will be an era of technology and engineering and this is the area where our path is difficult. By technology and engineering, I mean the process of physically realizing in equipment many of the concepts and approaches that have been known for years. These concepts have received much study effort in the past few years and are now on the verge of fruition due to our great strides in propulsion and other technologies which have occurred since World War II.

In essence what I am trying to say is that this is the decade of reducing to practice the goals proven feasible in the past. This is where the U.S.S.R. appears to have stolen a march on us.

In the applications area, the U.S.S.R. has no known work but much is suspected. They have an extremely high capability due to the size of their boosters and to the state of their technology in instrumentation and guidance as demonstrated by their lunar shots.

The United States has several programs in the applications area but there is some question whether our work in this field has clearly established long-term goals.

Some applications programs seem to sit on a single approach and refuse to budge until forced. Others proceed in sort of a herky-jerky fashion by jumping to another approach too quickly.

To summarize this point, it appears the U.S. program is a conservative one as there are many areas where we could be bolder, specifically in application areas such as the meteorological satellites, communications satellites, and navigation satellites. We must remember that programs of this type have tremendous potential and we would be in favor of accelerating this type of program independently of any Russian accomplishments.

In the area of public information, it is respectfully suggested that Congress seriously consider some kind of formal program in the space field for the following reasons. There is a tendency today through the medium of the Sunday supplements and other information media such as TV to engage in what might be called space charletanism. The public is constantly besieged by all sorts of predictions, stories, pictures, artists' conceptions, and the like about space flight in the future. Now we all know that much of this may come to pass someday and some of this material is necessary. However, the effect of this present situation on the public is to give them a rather jaded outlook toward space technology. They get the feeling things are easy, things have been achieved that are still many years away. Thus,

if we ever go to the people with pleas for more sacrifice, more taxes, and a bigger effort, and I feel this we must do, then reaction may very well be dubious, in that they feel much of what we want to do is already done.

The National Aeronautics and Space Administration, the Department of Defense, and the other agencies engaged in space flight programs should be encouraged to make better known to the general lay public the implications and serious problems of space technology and space flight. In addition, the impact of a bigger and bolder program in space on the public in terms of the financial support and technical manpower that must be given to these programs should be emphasized now. There must be a correlation between what we predict, what we plan, and what we can do. In other words, the picture must make sense to the layman. The public must be aware of this correlation.

In the area of organization one of the questions being considered today is how best to organize our space effort. There are several ways to do this, such as assigning it all to the military or all to the civilian or a civilian-type agency in the Department of Defense and so one.

The society takes no position as to whether the military or the civilian should control completely the space programs. We feel that it is a mutual problem. It is apparent that there is much scientific knowledge and much scientific utility to be gained from space flight, both manned and unmanned. We do feel, however, that there are definite military implications to this new field.

In addition it must be recognized that military programs have always been better supported financially and received wider public acceptance in all technical areas than strictly civilian programs. Thus a military basis for space technology is a definite advantage.

Any of the several plans for achieving space flight and advancing space technology can be realized provided we have strong technically enlightened leadership in high places and a streamlining of our decision making and planning. This is our biggest problem in this regard.

An excellent approach to this problem is characterized in a report on military research policies by the Rand Corp.

I would like to quote:

[Report R–333, December 4, 1958]

A good development policy will insure that those in technical charge of a program have the authority to take quick advantage of new information gained during development. Such a policy will guard against the tendency for technical decisions to be made at the upper echelons of the military services, or higher. Technically trained contractor and service personnel who are in close touch with a program are in the best position to translate new knowledge into concrete plans for the next stage of development.

In closing, we would like to digress slightly to one area which is often overlooked in its relation to our space program although it has gotten some attention since Sputnik. This area is education. It has been said by several people of high esteem that entirely new types of vehicles may be built and assembled in space. A new technology may arise unrelated to the extrapolated experience with missiles and aircraft. By the same token, much of the predictions for space technology are in the future. We talk of programs in the next 5 years, in the next 10 years, in the next 20. This all presupposes that we are able to maintain a continuous flow of trained, capable technical and

scientific manpower. The boys, and girls for that matter, that we are educating in our elementary schools today are those who will be the young scientists and engineers in the space flight field of the 1970's. I think therefore we need to take a long-term look at education methods and philosophy in order to face the future with confidence.

Considerable criticism has been leveled upon our colleges and school systems. Much of it is well founded. It seems certain that we will not be able to develop and supply the space scientists and engineers of the future unless we have a school system which offers curriculums firmly grounded to fundamentals, a system which teaches orderly thought processes, a system which disciplines the mind for scientific knowledge. Many present elementary and high school systems are not doing this now.

We must start planning and acting now to correct this or there will be no strong leaders in sufficient supply in the coming years to realize the full potential of the space age.

Therefore, it is suggested that this committee should consider, in conjunction with other appropriate committees, the implication of the U.S. educational program on the future of space technology. As I noted before, the United States has tremendous scientific and technical potential. We feel far in excess of the U.S.S.R. However, this potential is constantly being diminished by our conservative approach, by our squabbling over who does what, by our poor utilization of manpower, and over the long pull, by what appears to be a serious deterioration of quality in our educational system. In this diminishing of our potential, we may be like other great world powers before us, sowing the seeds of our own destruction.

Thank you, Mr. Chairman.

The CHAIRMAN. Dr. Arthur, we appreciate very much your statement. You have put your finger on a number of very touchy spots and we will question you about those matters just a little later.

(Dr. Arthur's prepared statement is as follows:)

STATEMENT OF DR. GEORGE R. ARTHUR, PRESIDENT, AMERICAN ASTRONAUTICAL SOCIETY

I should like to express my thanks to the chairman and to the committee members for inviting me here and giving me this opportunity to present the views of the society on this vital subject. I am here in my capacity as president of the American Astronautical Society and although I am trying to present substantially the society's views, it is difficult to keep some of my personal opinions from creeping in. I shall attempt to identify these.

General

I think the best point of departure for this statement is to outline briefly the broad objectives and tenets of the American Astronautical Society, and then to relate this position of the society to the space flight programs and philosophy in the United States today. More particularly, I will relate it to some of the specific programs in space technology.

The American Astronautical Society is composed of scientists and engineers in the astronautical sciences. We are a national scientific organization dedicated to the advancement of the astronautical sciences. The society considers manned interplanetary space flight a logical progression from today's high performance research aircraft, guided missiles, and Earth-satellite operations. The scope of the society is illustrated by the fact that we are interested in all of the scientific disciplines of astronautics and space technology with emphasis on applications.

The aims of the society are to encourage scientific research in all of the fields related to astronautics and to propagate knowledge of current advances. The

society promotes astronautics in this way largely through its program of technical meetings and publications.

Present approach

How then does this relate to the present situation? As noted above, the society believes that manned space flight and all it implies is a logical progression from today's technology. We believe that this is a natural evolution of mankind and that mankind can benefit greatly by the step into space. These benefits have been included and described in detail by other speakers before this committee and include such things as communication satellites, navigation satellites, meterological satellites, and similar items. Are we doing all we can to reap these benefits?

As far as the U.S. program is concerned, the following comments can be made. The field appears to divide into two major areas:

1. Scientific exploration.
2. Applications of systems.

Sputnik, Vanguard, the Explorers all have been in the first category. The manned systems cover both areas.

It appears that the U.S. program in the area of exploratory by Earth satellite operations is reasonably well in hand. This scientific exploration program has dealt largely with unmanned vehicles.

The one area of exploration where a more rapid rate of development appears warranted and very useful as an aid to applications is the planetary probe.

We now see in retrospect that the program for manned space flight probably got off to a late start, and is now proceeding at only a modest pace. Although some advance planning is in progress at the present time in the manned satellite field, it is felt that the lack of strong support for a substantial follow-on program to Project Mercury is a definite gap in our present space program.

It must be noted that the sixties will be an era of technology and engineering and this is the area where our path is difficult. By technology and engineering, I mean the process of physically realizing in equipment many of the concepts and approaches that have been known for years. These concepts have received much study effort in the past few years and are now on the verge of fruition due to our great strides in propulsion and other technologies which have occurred since World War II. For example, in the area of radiation protection, we are in the process of obtaining much fine scientific information on radiation characteristics. However, if we find it necessary to reduce this to a practical situation by building radiation protection equipment, we find that we are not in very good shape because we have not instituted a comprehensive measuring program on physical damage, due to radiation. In essence, what I am trying to say is that this is the decade of reducing to practice the goals proven feasible in the past. This is where the U.S.S.R. appears to have stolen a march on us.

In the applications area, the U.S.S.R. has no known work but much is suspected. They have an extremely high capability due to the size of their boosters and to the state of their technology in instrumentation and guidance as demonstrated by their lunar shots.

The United States has several programs in the applications area but there is some question whether our work in this field has clearly established long-term goals.

Some applications programs seem to sit on a single approach and refuse to budge until forced. Others proceed in sort of a herky-jerky fashion by jumping to another approach too quickly.

To summarize this point, it appears the U.S. program is a conservative one as there are many areas where we could be bolder, specifically in application areas such as the meteorological satellites, communication satellites, and navigation satellites. We must remember that programs of this type have tremendous potential and we would be in favor of accelerating this type of program independently of any Russian accomplishments.

Information programs

The AAS, as I noted above, also tries to be a technical forum. Anything that can be done to increase the ease of flow of technical information among workers in the field will be an aid. It may be possible in a revised Space Act to implement an easier method of communication between engineers and scientists in the field. If this is done, it will be an aid because it will permit less duplication of effort, which can occur due to ignorance of other work that may be going on.

We recognize, of course, the proprietary information problem and the security problem, but it seems that these are sometimes overworked.

In addition, it would be suggested that the Congress seriously consider some kind of a formal public information program in the space field for the following reasons.

There is a tendency today through the medium of the Sunday supplements and other information media such as TV to engage in what might be called "space charlatanism." The public is constantly besieged by all sorts of predictions, stories, pictures, artists' conceptions and the like about space flight in the future. Now, we all know that much of this may come to pass some day and some of this material is necessary. However, the effect of this present situation on the public is to give them a rather jaded outlook toward space technology. They get the feeling things are easy, things have been achieved that are still many years away. Thus, if we ever go to the people with pleas for more sacrifice, more taxes, and a bigger effort, and I feel this we must do, then reaction may very well be dubious, in that they feel much of what we want to do is already done.

The National Aeronautics and Space Administration, the Department of Defense, and the other agencies engaged in space flight programs should be encouraged to make better known to the general lay public the implications and serious problems of space technology and space flight. In addition, the impact of a bigger and bolder program in space on the public in terms of the financial support and technical manpower that must be given to these programs should be emphasized *now*. There must be a correlation between what we predict, what we plan, and what we can do. In other words, the picture must make sense to the layman. The public must be aware of this correlation.

Organization

One of the questions being considered today is how best to organize our space effort. There are several ways to do this, such as assigning it all to the military or all to the civilian or a civilian-type agency in the Department of Defense and so on.

The society takes no position as to whether the military or the civilian should control completely the space program. We feel that it is a mutual problem. It is apparent that there is much scientific knowledge and much scientific utility to be gained from space flight, both manned and unmanned. We do feel, however, that there are definite military implications to this new field.

In addition, it must be recognized that military programs have always been better supported financially and received wider public acceptance in all technical areas than strictly civilian programs. Thus a military basis for space technology is a definite advantage.

Any of the several plans for achieving space flight and advancing space technology can be realized provided we have strong technically enlightened leadership in high places and a streamlining of our decision making and planning. This is our biggest problem in this regard.

An excellent approach to this problem is characterized in "Report on Military Research Policies" by the Rand Corp.: [1]

"A good development policy will ensure that *those in technical charge of a program have the authority to take quick advantage of new information gained during development.* Such a policy will guard against the tendency for technical decisions to be made at the upper echelons of the military services, or higher. Technically trained contractor and service personnel who are in close touch with a program are in the best position to translate new knowedgle into concrete plans for the next stage of development."

To answer now the question of the military basis in space technology we know some people feel the military has no role in space. This is not the case. As to what are the military implications of space, actually these are relatively undefined at this point. However, there is no question that space is a military objective. Mainly for the following reason—if an area can be controlled, if only partially, by a power unfriendly or possibly unfriendly to the United States and controlled in such a fashion that it is dangerous to the United States, then this area immediately becomes a military objective or at least control of it does. In the simple sense then, the use of this area must be denied to the unfriendly power. No thought has been given to the method by which this denial can be

[1] Rept. R–333, Dec. 4, 1958.

achieved but it seems that this situation does exist and therefore space is in essence a military objective, in addition to a scientific frontier.

If you will permit me to add my voice to answering an overworked question: Why do we want to compete with the Soviet Union in this field? My answer is the same as that given by others. This is a situation in which we must face reality. Whether we like it or not, the United States must be in this race with the Soviet Union. We cannot afford to let this go by default. Our reputation and our political strength in the world are directly dependent on our achievements in scientific enterprises and especially in astronautics.

Education

In closing, I would like to digress slightly to one area which is often overlooked in its relation to our space program although it has gotten some attention since sputnik. This area is education. It has been said by several people of high esteem that entirely new types of vehicles may be built and assembled in space. A new technology may arise unrelated to the extrapolated experience with missiles and aircraft. This means that we are building a new breed of cat, a composite of electronic-missile-airplane engineer if you like. By the same token, much of the predictions for space technology are in the future. We talk of programs in the next 5 years, in the next 10, in the next 20. This all presupposes that we are able to maintain a continuous flow of trained capable technical and scientific manpower. The boys, and girls for that matter, that we are educating in our elementary schools today are those who will be the young scientists and engineers in the space flight field of the 1970's. I think therefore we need to take a long-term look at education methods and philosophy in order to face the future with confidence. I should like to enter into the record at this point an editorial which appeared in the AAS publication, the Astronautical Sciences Review, vol. 1, No. 3, July-September 1959.

"Although we are proud of the contributions of many of the early workers in rocketry and space flight in the United States, it must be noted that our favorable position today in space technology, even though tenuous, is due also to the efforts and dedication of a group of scientists who did not receive their education or initial experience in this country. These were the men who pioneered in Germany and other areas for space flight and rocket propulsion in the early thirties. These were the men whose efforts were diverted to a military application in the forties. These were the men who, fortunately, were able to become citizens and workers in this country. Though a major portion of this group has remained as part of a single operation, a certain amount of healthy diffusion to other areas of Government and industry has occurred.

"Through their zeal and determination, these men have instilled some of the younger technical people in this country with the same spirit and doggedness that marked many of their efforts in their most early experiments. This has helped the United States to build a number of top space technology teams throughout Government and industrial installations.

"But, what does the future hold? Are there young men and women coming along to pick up the torch from these pioneering scientists and engineers? We must remember that many of the plans that detail the future of space flight achievements will occur 20, 30, even 40 years from now. We are today educating in our elementary schools and in our junior high schools the youth who must realize these achievements in space technology in the future years. Considerable criticism has been leveled upon our colleges and school systems. Much of it is well founded. It seems certain that we will not be able to develop and supply the space scientists and engineers of the future unless we have a school system which offers curricula firmly grounded to fundamentals, a system which teaches orderly thought processes, a system which disciplines the mind for scientific knowledge. The present elementary and high-school systems are not doing this now.

"Much thought has been given to correcting our colleges, but is this really where our initial correction must occur? A house is build upon a foundation. The foundation of our educational system is the elementary school. If the elementary schools are not supplying the firm foundation so necessary for future success the house will surely crumble under the future stresses we know will occur.

"We must start planning and acting now to correct this or there will be no Van Allens from our schools, surely no von Brauns, and in general no strong leaders in sufficient supply in the coming years to realize the full potential of the space age."

Therefore, it is suggested that this committee should consider, in conjunction with other appropriate committees, the implication of the U.S. educational program on the future of space technology. As I noted before, the United States has tremendous scientific and technical potential. This potential is constantly being diminished by our conservative approach, by our squabbling over who does what, by our poor utilization of manpower, and over the long pull by what appears to be a serious deterioration of quality in our educational system. In this diminishing of our potential, we are like other great world powers before us, sowing the seeds of our own destruction.

APPENDIX

1960 Board of Directors of the American Astronautical Society, New York, N.Y.

Name and AAS title	*Business*
George R. Arthur (Dr.), president	Advanced space systems, General Electric Co., Missile and Space Vehicle Department.
William Whitson (Dr.), vice president	Daystrom, Inc.
Robert Young, vice president	ACF Electronics.
John J. Campbell, treasurer	Radio Corp. of America.
Fernand F. Martin, secretary	RCA Airborne Systems Department.
Col. Paul Butman, director at large (1960)	USAF–ARDC.
John Crone, director at large (1960)	Airtronics, Inc.
Maj. Gen. William W. Dick, Jr., director at large (1960).	USA, Office of Army Research.
Edward H. Heinemann, director at large (1960).	Douglas Aircraft Co.
Robert E. Roberson (Dr.), director at large (1960).	Systems Corp. of America.
Cmdr. Malcolm D. Ross, director at large (1960).	Office of Naval Research.
Sydney S. Sherby, director at large (1960)	Hiller Aircraft Corp.
Ross Fleisig, director at large (1961)	Sperry Gyroscope Co.
Robert P. Haviland, director at large (1961)	General Electric Co., Missile and Space Vehicle Department.
Alexander Kartveli, director at large (1961)	Republic Aviation Corp.
Donald H. Menzel (Dr.), director at large (1961).	Harvard University.
Austin Stanton, director at large (1961)	Varo Manufacturing Co.
Ernst Stuhlinger (Dr.), director at large (1961)	Army Ballistic Missile Agency.
Robert M. Bridgforth, Jr., director at large (1962).	Boeing Airplane Co.
Col. Paul A. Campbell, director at large (1962)	USAF School of Aviation Medicine.
Brig. Gen. Robert Greer, director at large (1962).	USAF Deputy Assistant Chief of Staff for Guided Missiles.
Alfred M. Mayo, director at large (1962)	Douglas Aircraft Co.
Norman V. Petersen, director at large (1962)	Northrop Corp.
S. Fred Singer (Dr.), director at large (1962)	University of Maryland.
James A. VanAllen (Dr.), director at large (1962)	State University of Iowa.

The CHAIRMAN. The third witness that we have this morning, gentlemen of the committee, is Dr. H. Guyford Stever, representing the Institute of the Aeronautical Sciences for Gen. Donald Putt, who asked that he appear in his place. Dr. Stever has been before this committee previously, and his biography is before the members. Dr. Stever was formerly Chief Scientist of the Air Force, and headed the advisory committee which prepared the NACA for transformation into a space agency. He is presently a dean and professor at the Massachusetts Institute of Technology. He will present the statement of the Institute of the Aeronautical Sciences.

(The biography follows:)

[From "American Men of Science," vol. I]

BIOGRAPHY OF DR. H. GUYFORD STEVER

Stever, Prof. Horton Guyford, Department of Aeronautical Engineering, Massachusetts Institute of Technology, Cambridge, 1939; Massachusetts Aeronautics. B. Corning, N.Y., Oct. 24, 1916; married 1946; children, 3. A.B. Colgate, 1938, Ph. D. (physics), California Institute of Technology, 1941. Staff member, radiation laboratory, Massachusetts Institute of Technology and instructor radar techniques, Army-Navy Officers Radar School, 1941–42; technical liaison officer, London mission, Office Scientific Research and Development, 1942–45; member secretariat, national guided missile committee, Joint Chiefs of Staff, 1945; executive officer, guided missile program, Massachusetts Institute of Technology, 1945–47, assistant professor aeronautical engineering, 1946–51, associate professor, 1951; aeronautical consultant to industry, 1946, member guided missiles technical evaluation group, research and development board, 1946–48; air defense systems engineer command, U.S. Air Force, 1949–51; technical advisory panel ordnance U.S. Department of Defense, 1954; Presidential Certificate of Merit, 1948. Member Science Advisory Board, USAF, 1947, A.A.; fellow Physical Society; associate fellow Institute Aeronautical Science; fellow American Academy. Gas discharge; Geiger counters; cosmic rays; radar guided missiles; hypersonic aerodynamics; shock tubes; transonic aircraft; nuclear propulsion of aircraft; condensation in high speed flow.

The CHAIRMAN. Dr. Stever, we are happy to have you.

Dr. STEVER. Thank you, Mr. Chairman.

STATEMENT OF DR. H. GUYFORD STEVER, INSTITUTE OF THE AERONAUTICAL SCIENCES

We consider it a pleasure and a privilege to appear before your committee in response to your chairman's invitation. We recognize the importance of the work that your committee and the other committees of the Congress are doing in their effort to maintain the position of scientific and technological leadership which the country has long enjoyed.

Just as the Congress is the open forum in which economic, military, and political matters concerning the welfare of the United States are debated, so our scientific societies make up the forum in which scientists and engineers expose new theories and advanced ideas for debate and discussion in the presence of their colleagues. In this way science and engineering are advanced, and the body of basic scientific knowledge grows.

The Institute of the Aeronautical Sciences—

(*a*) Facilitates through its meetings and its publications the rapid interchange of scientific and technical information among the 15,000 scientists, engineers, educators, and industrialists which comprise its graded membership; and

(*b*) Encourage qualified students in our schools and universities to prepare themselves for positions of leadership in the aerospace sciences. It has some 5,000 students enrolled in branches at some 80 universities in the country.

The details of how we do these jobs are contained in the prepared statement and also in the appendixes thereto and I won't spend time here this morning discussing that. Let me say that we hold meetings, some of which are classified. We hold inspection trips both for our adult members and also our student members.

The institute's only mandate under its charter is to advance the aerospace sciences. Its sole objective is to raise the level of the country's scientific and technical competence in the aerospace sciences so there will always be an adequate number of qualified technical people to maintain our technological leadership.

With the above in mind, it is clear that we cannot come before your committee today to speak as an organization as to what should constitute specific goals in space research, development, and operations. These are questions of national policy which must be determined by the executive and the legislative branches of Government. The Defense Department must set the requirements for national security and conduct the necessary military space programs. Under the National Aeronautics and Space Act of 1958, the National Aeronautics and Space Administration has the responsibility to plan for and to conduct the nonmilitary aspects of space exploration. The Congress, after considering national policy objectives and the state of the national economy, must decide on desirable rates of development and optimum levels of operations for the space program.

Individually, many officers and members of this institute cooperate with and assist many agencies of Government in evaluating specific proposals and in determining properly balanced programs in aeronautics and in space technology. As individuals, many of them have strong personal views on such subjects.

And I may say parenthetically quite often express them as individuals.

Some of them have undoubtedly testified before your committee. As your chairman has pointed out, I have been here before. It would be quite presumptuous for us as an organization, however, to appear before you to recommend this or that specific program, or to suggest that more or less money be allocated to one or to the other of the armed services in support of one weapons system over another. We are not equipped to do so. Such things are outside the scope of our charter.

As an organization, however, we believe strongly in the necessity and in the urgency of extending the boundaries of human knowledge of the universe in which we live. New techniques developed in the past decade have opened up possibilities for exploration and for exploitation of space at speeds and at altitudes ranging from zero out to infinity. I know Mr. Fulton will enjoy our mentioning infinity with respect to speeds.

It is essential that we take full advantage of these capabilities both for the betterment of our people and for the security of our country.

Mr. FULTON. May I interrupt to say not only enjoyed it, but I compliment you. Your perspicuity is equal only to your perspicacity.

Dr. STEVER. At the same time, we must not allow ourselves to be completely distracted by these glamorous new capabilities. Few people now living will experience space travel or participate personally in space exploration. For the foreseeable future, by far the bulk of human travel, and, in fact, the major theaters of military conflict, will be restricted to the surface of the Earth, or the thin shell of atmospheric air which envelops it. Every space vehicle must transit the atmosphere on its outward track, and must cope with complex re-

entry problems on its return. We must, therefore, not overlook or neglect the aeronautical aspects of the aerospace sciences.

Our aerospace programs for national welfare and for national security must be properly balanced if they are to be effective.

Activities such as ours contribute directly to the ability of the country to meet such challenges by improving the technological capabilities of our scientists and engineers. In recent years there has been a marked shift in the interests and activities of our members from air-breathing aircraft and their components and research problems, to ballistic missiles, space vehicles and the associated space technology. (See app. D.) This did not start at the launching of Sputnik I, but was already underway by the end of World War II. In the following decade, although space vehicles were seldom mentioned as such, many of the papers presented in institute meetings dealt with scientific subjects on which present technology is based.

Leading aerospace engineering, scientific, and industrial people in this country are members of this institute. They are graduates of our great universities and engineering schools. Many of them have had up to half a century of background and experience in their profession. (See app. B.) We believe that membership in the institute has added to their capabilities.

The United States has a responsibility for world leadership. This leadership is compounded of many factors, and any nation aspiring for leadership must be a leader in all major factors involved. The past decade has seen science and technology emerge as a dominant factor in world affairs. Military, political, economic, and social decisions cannot be made without consideration of the influence of science and technology in such areas. Not only is technology the foundation of our national prosperity but also of our military strength. It is essential, therefore, that we adopt every possible means to expand and to improve our human resources in the scientific and engineering fields.

This last point that I would like to make is a point on which we, the institute, do feel that we can make an authoritative statement. The technological potential of this country as represented by engineers, scientists, and technical managers is sufficient to meet any challenge. Within the membership of the scientific societies, many of them represented here, there is a vast reservoir of highly trained and experienced men.

Further, many of them are helping to train personnel. Many are already engaged in the aerospace program of the country but there exists in other sections of the economy a great capability for emergency expansion as was convincingly demonstrated in World War II. We are certain that U.S. engineers and scientists can meet any demands that national policy may dictate. The institute will continue its effort to improve the professional competence of its membership and stands ready and willing to assist in any or all programs in the aerospace sciences which the Congress in its wisdom sees fit to establish.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you, Dr. Stever. We appreciate your appearance before the committee and for giving us an excellent statement which will cause our membership to do a lot of thinking.

(The full text of Dr. Stever's statement is as follows:)

STATEMENT SUBMITTED BY THE INSTITUTE OF THE AERONAUTICAL SCIENCES TO THE COMMITTEE ON SCIENCE AND ASTRONAUTICS, HOUSE OF REPRESENTATIVES, FEBRUARY 23, 1960

PART I—POLICY STATEMENT

We consider it a pleasure and a privilege to appear before your committee in response to your chairman's invitation. We recognize the importance of the work that your committee and the other committees of the Congress are doing in their effort to maintain the position of scientific and technological leadership which the country has long enjoyed. It is vital that we retain this leadership as a guarantee of our national security, and of our future economic welfare.

We appreciate the committee's inclusion of certain scientific and technical societies on its list of witnesses in the area of aerospace technology. Just as the Congress is the open forum in which economic, military, and political matters concerning the welfare of the United States are debated, so our scientific societies make up the forum in which scientists and engineers expose new theories and advanced ideas for debate and discussion in the presence of their colleagues. In this way science and engineering are advanced, and the body of basic scientific knowledge grows.

As a scientific society dedicated to the advancement of the art and science of aerospace technology, the Institute of the Aeronautical Sciences engages in two principal forms of activity:

(*a*) It facilitates through its meetings and its publications the rapid interchange of scientific and technical information among the 15,000 scientists, engineers, educators, and industrialists which comprise its graded membership;

(*b*) It encourages qualified students in our schools and universities to prepare themselves for positions of leadership in the aerospace sciences. It has some 5,000 students enrolled in branches at some 80 universities in the country.

Institute meetings are organized at national, regional, and sectional levels. Subjects range over the whole spectrum of matters relating to aerospace science and technology. In any calendar year, (not counting meetings held by student branches) their number averages one per working day. Nearly 600 papers are prepared and presented at such meetings yearly, many of which are published in IAS journals or periodicals.

Supplementing the regular meetings, frequent briefings, and inspection trips to Government R. & D. and testing facilities are organized. Most of these are classified, and all are carefully controlled by the sponsoring agency for security. Such field trips offer invaluable opportunity for Government and industry personnel to exchange ideas on an informal basis.

The IAS student program includes periodic branch meetings as well as annual regional conferences. Vocational guidance material for high school students is compiled and distributed on a countrywide basis. (See pt. II and appendixes.)

To service the professional needs of its membership the institute maintains two technical libraries, one in New York and one in Los Angeles. In addition to making available up-to-date books, periodicals, and reports, these libraries produce voluminous monthly abstracts of pertinent literature in the aerospace sciences from all sources, including the U.S.S.R. These appear monthly in IAS publications.

The institute is also the custodian of a number of annual awards to honor outstanding contributions by individuals to progress in the aerospace sciences. The most recent, and of particular interest to your committee, is the Hill Space Transportation Award. (See app. G.)

The institute's only mandate under its charter is to advance the aerospace sciences. Its sole objective is to raise the level of the country's scientific and technical competence in the aerospace sciences so that there will always be an adequate number of qualified professional people available to maintain our technological leadership.

With the above in mind, it is clear that we cannot come before your committee today to speak *as an organization* as to what should constitute specific goals in space research, development, and operations. These are questions of national policy which must be determined by the executive and the legislative branches of Government. The Defense Department must set the requirements for national security and conduct the necessary military space programs. Under the Na-

tional Aeronautical Space Act of 1958, the National Aeronautics and Space Agency has the responsibility to plan for and to conduct the nonmilitary aspects of space exploration. The Congress, after considering national policy objectives and the state of the national economy, must decide on desirable rates of development and optimum levels of operations for the space program.

Individually, many officers and members of this institute cooperate with and assist many agencies of Government in evaluating specific proposals and in determining properly balanced programs in aeronautics and in space technology. As individuals, many of them have strong personal views on such subjects. Some of them have undoubtedly testified before your committee. It would be quite presumptuous for us as an organization, however, to appear before you to recommend this or that specific program, or to suggest that more or less money be allocated to one or to the other of the armed services in support of one weapons system over another. We are not equipped to do so. Such things are outside the scope of our charter.

As an organization, however, we believe strongly in the necessity and in the urgency of extending the boundaries of human knowledge of the universe in which we live. New techniques developed in the past decade have opened up possibilities for exploration and for exploration of space at speeds and at altitudes ranging from zero out to infinity. It is essential that we take full advantage of these capabilities both for the betterment of our people and for the security of our country.

At the same time we must not allow ourselves to be completely distracted by these glamorous new capabilities. Few people now living will experience space travel or participate personally in space exploration. For the foreseeable future, by far the bulk of human travel and, in fact, the major theaters of military conflict, will be restricted to the surface of the Earth, or to the thin shell of atmospheric air which envelops it. Every space vehicle must transmit the atmosphere on its outward track, and must cope with complex reentry problems on its return. We must, therefore, not overlook or neglect the aeronautical aspects of the aerospace sciences. Many difficult and complicated problems yet remain to be solved before we can attain complete mastery of the ocean of air in which we all are living. Our aerospace programs for national welfare and for national security must be properly balanced, if they are to be effective.

Activities such as ours contribute directly to the ability of the country to meet such challenges by improving the technological capabilities of our scientists and engineers. In recent years there has been a marked shift in the interests and activities of our members from air-breathing aircraft and their components and research problems, to ballistic missiles, space vehicles and the associated space technology. (See app. D.) This did not start at the launching of Sputnik I, but was already underway by the end of World War II. In the following decade, although space vehicles were seldom mentioned as such, many of the papers presented in institute meetings, dealt with scientific subjects on which present technology is based.

Leading aerospace engineering, scientific, and industrial people in this country are members of this institute. They are graduates of our great universities and engineering schools. Many of them have had up to half a century of background and experience in their profession. (See app. B.) We believe that membership in the institute has added to their capabilities.

The United States has a responsibility for world leadership. Leadership is compounded of many factors, and any nation aspiring for leadership must be a leader in all major factors involved. The past decade has seen science and technology emerge as a dominant factor in world affairs. Military, political, economic, and social decisions cannot be made without consideration of the influence of science and technology in such areas. Not only is technology the foundation of our national prosperity but also of our military strength. It is essential, therefore, that we adopt every possible means to expand and to improve our human resources in the scientific and engineering fields.

The technical potential of this country, as represented by engineers, scientists, and technical managers is sufficient to meet any challenge. Within the membership of the scientific societies there is a vast reservoir of highly trained and experienced men. Many are already engaged in the aerospace program of the country but there exists in other sections of the economy a great capability for emergency expansion as was convincingly demonstrated in World War II. We are certain that U.S. engineers and scientists can meet any demands that national policy may dictate. The institute will continue its efforts to improve the professional competence of its membership and stands

ready and willing to assist in any or all programs in the aerospace sciences which the Congress in its wisdom sees fit to establish.

PART II—IAS ORGANIZATION AND ACTIVITIES

(The material presented in part II and in the appendixes to this report covers the organization and activities of the institute and is submitted for the general information of the members of the committee.)

I. THE IAS ORGANIZATION

The IAS was organized in 1932 "as a nonprofit scientific and engineering membership society to advance the arts and science of aerospace technology." The governing body of the IAS is its council. Council members and officers are elected by the membership. Its activities are supported by a permanent staff with headquarters at 2 East 64th Street in New York City. The relationship of these elements is shown on the chart attached (app. A). A list of the past presidents of the IAS for the past 20 years and a list of its present officers and council are included as appendix B.

The membership of the IAS has shown a consistently regular growth since its founding. Appendix C includes a chart showing its growth history, and includes some discussion of its basic operating philosophy.

At the end of 1958, in order to give some perspective for long-range planning, a 5-year summary of IAS activities was prepared. A copy of this report is attached as appendix D.

II. PROGRAMS FOR ATTAINING IAS OBJECTIVES

To facilitate the rapid interchange of scientific and technical information in the aerospace sciences, and to advance the state of the art, the IAS performs the following major services:

1. It organizes and conducts technical meetings of current interest to its members at national, regional, local, and university levels. Such meetings are open forums for free discussion of new scientific and technical ideas. They bring together men of widely diversified interests and of broad geographical location. Subjects may be "open" or classified. Where classified material is involved, proper security safeguards covering attendees and meeting places are maintained with the cooperation of some qualified agency of government (e.g., Air Force, Navy, etc.). Typical examples are included in appendix E.

2. It organizes, in cooperation with pertinent Government agencies, briefings and inspections of research and development and testing facilities for aerospace science. Such visits are usually of a classified nature with all attendees cleared and qualified as to "need to know" by the cognizant agency. These activities have proven to be extremely valuable in promoting interchange of ideas on a broad and informal basis, between top industrial R. & D. and management personnel and the representatives of Government. For a typical program see also appendix E.

3. It publishes scientific and engineering periodicals and monographs. (Examples are included in app. F.) No classified material is published by the IAS. Whenever classified material generated in IAS meetings is selected for publication, the responsibility for such publication, and subsequent distribution, is handled by some qualified Government agency (e.g., U.S. Navy, Air Force, ASTIA, etc.).

4. The institute maintains extensive and scientific libraries covering all phases of the aerospace sciences in New York and in Los Angeles. These libraries contain not only books and reference material but also the current periodicals in the field. Abstracting and indexing services are performed by both libraries to keep industry currently informed of available literature. Such abstracts are published monthly in Aero/Space Engineering, a copy of which is included in appendix F.

5. The IAS recognizes outstanding achievement by individuals in the aerospace sciences through honorary fellowships in the institute, and through the presentation of a number of annual awards, many of which include honoraria. These include the Chanute Award for research pilots; the Jeffries Award in the field of aerospace medicine; the Losey Award for meteorology; the Reed Award for scientific research; the Sperry Award for outstanding contribution by a young man; and the Hill Space Transportation Award, to encourage peaceful exploration of space, which carries with it an honorarium of $5,000 to $10,000. (See app. G.)

6. The institute encourages qualified students in schools and universities to follow scientific and technical courses and to specialize in advanced work in the aerospace sciences. To accomplish this, the IAS maintains student branches in some 80 U.S. universities. It conducts half a dozen regional student conferences in various parts of the country annually. It encourages the preparation of scientific papers by students, offering prizes and eventual publication of the best, as selected by committees of prominent scientists. (Typical student conference program included in app. J.)

7. It participates in advanced fellowship programs (e.g., IAS flight-test-engineering fellowship, brochure attached, app. H).

8. The IAS prepares and distributes vocational guidance material for the use of counselors and students at the high-school level. During the past 5 years, over 300,000 copies of such booklets have been printed and distributed. A revised edition emphasizing the newer opportunities in the aerospace sciences (100,000 copies) is now in the process of distribution (copy attached, app. J).

(NOTE.—Copy of IAS literature outlining membership requirements for individuals, students, and corporate members is included in app. K.)

APPENDIXES

(Appendixes A, C, D, E, F, G, H, I, J, and K are on file with the committee, and are too long to reproduce here. Appendix B is as follows:)

APPENDIX B

IAS Officers and Council, 1960

President: Lt. Gen. Donald L. Putt, USAF (retired), president, United Technology Corp.

Vice president (central): Col. Paul H. Dane, USAF, professor of thermodynamics, USAF Academy.

Vice president (western): Harold Luskin, staff assistant to manager, satellite systems, missiles & space division, Lookheed Aircraft Corp.

Vice president (eastern): Charles Tilgner, Jr., chief aeronautical engineer, Grumman Aircraft Engineering Corp.

Treasurer: Victory E. Carbonara, president, Kollsman Instrument Corp.

Council members:

Peter Altman, vice president, Research and Development Division, Continental Motors Corp.

John S. Attinello, assistant to chief engineer, Aircraft & Missiles Division, Fairchild Engine & Airplane Corp.

Preston R. Bassett, former president, Sperry Gyroscope Corp. (retired).

R. C. Blaylock, vice president, engineering, Chance-Vought Aircraft, Inc.

Rear Adm. C. M. Bolster, U.S.N. (retired), coordinator development, the General Tire & Rubber Co.

Milton U. Clauser, vice president and director, Physical Research Laboratory, Space Technology Laboratories.

Rear Adm. Luis de Florez, U.S.N. (retired), the de Florez Co., Inc.

Preston E. Dickson, group engineer, aerodynamics, Beech Aircraft Corp.

George F. Douglas, vice president, engineering, Norair Division, Northrop Corp.

Hubert I. Flomenhoft, group leader, flight loads dynamic science section, North American Aviation, Inc.

Welko E. Gasich, director, weapon system development engineering, Northrop Corp.

Donald P. Germeraad, chief engineering test pilot, Convair Division, General Dynamics Corp.

Nicholas J. Hoff, head, division of aeronautical engineering, Stanford University.

Lawrence Levy, president, Allied Research Associates, Inc.

William Littlewood, vice president, equipment-research, American Airlines, Inc.

Axel T. Mattson, head, Eight-Foot Tunnel Branch, Langley Research Center, NASA.

Clyde R. Murtaugh, flight sciences department, Bendix Systems Division, Bendix Aviation Corp.

Vernon Outman, chief technical engineer, McDonnell Aircraft Corp.
L. Eugene Root, group vice president, Lockheed Aircraft Corp.
William R. Sears, director, Graduate School of Aeronautical Engineering, Cornell University.
R. Dixon Speas, R. Dixon Speas Associates.
H. Guyford Stever, associate dean of engineering, MIT.
Y. A. Yoler, head, flight sciences laboratory, Boeing Airplane Co.

Past Presidents, IAS, 1940–60 (in Alphabetical Order)

J. L. Atwood, president, North American Aviation, Inc.
Preston R. Bassett, retired, formerly president, Sperry-Gyroscope Co.
Wellwood E. Beall, senior vice president, Boeing Airplane Co.
W. A. M. Burden, U.S. Ambassador to Belgium.
Frank W. Caldwell, consulting engineer, formerly with United Aircraft Corp.
Charles H. Colvin, president, Colvin Laboratories, Inc.
J. H. Doolittle, USAF (retired), chairman, board of directors, Space Technology Laboratories, Inc.
Hugh L. Dryden, Deputy Administrator, NASA.
R. H. Fleet, retired, founder of Convair.
Robert E. Gross, chairman of the board, Lockheed Aircraft Corp.
Hall L. Hibbard, senior vice president, Lockheed Aircraft Corp.
J. H. Kindelberger, chairman of the board, North American Aviation.
William Littlewood, vice president, equipment-research, American Airlines, Inc.
C. J. McCarthy, chairman of the board, Chance Vought Aircraft, Inc.
J. K. Northrop, engineering consultant, formerly president, Northrop Corp.
Mundy I. Peale, president, Republic Aviation Corp.
A. E. Raymond, senior vice president, engineering, Douglas Aircraft Co., Inc.
L. B. Richardson, USN (retired), senior vice president, General Dynamics Corp.
E. R. Sharp, Director, Lewis Research Center, NASA.
E. C. Wells, vice president, engineering, Boeing Airplane Co.

The CHAIRMAN. The fourth witness that we have set this morning is Dr. Lloyd V. Berkner, Chairman of the Space Sciences Board of the National Academy of Sciences.

Although we do not have a written acknowledgement of the committee's invitation to appear, mailed as it was on January 27, I understand that the Space Sciences Board may file a written statement for inclusion in the record rather than have Dr. Berkner or any other member of the Space Sciences Board or their executive secretary appear today.

To the best of my knowledge, this important group has never sought nor encouraged any contact with the only science committee of the Congress; namely, our committee.

I want to say this, of course, we are a new committee and we know it. Dr. Berkner probably doesn't realize that we are a new committee charged with responsibility in this respect, but I am informed by our staff that the Space Sciences Board receives every dollar of its finances from NASA and, therefore—is that correct?

Dr. SHELDON. And the National Science Foundation.

The CHAIRMAN. And National Science Foundation.

Therefore, we have a responsibility to hear from them as to the type of work and the character of work and the quality of work which they are doing.

We hope that Dr. Berkner will send up an excellent statement for incorporation in the record in lieu of his own personal appearance. We will wait and see.

Mr. FULTON. Mr. Chairman, on that——

The CHAIRMAN. Yes.

Mr. FULTON. May I say that Dr. Berkner is busy and I imagine most members of the Space Sciences Board are pretty busy, so that

we realize they have a difficult problem of meeting many deadlines. Dr. Berkner had appeared before our select committee, as you remember, which was the predecessor committee to this particular committee, had given fully of his time and made very good statements. So I think he has previously cooperated and I think he will in the future.

The CHAIRMAN. I think this: I don't want us to be critical of these things that come up from time to time. We are a new committee, of course, and the average individual will have to be acquainted with our operations and our needs.

On the other hand, we want to tell Dr. Berkner that we missed him on this occasion.

(The statement promised for the record has not been received.)

The CHAIRMAN. The fifth witness is Mr. Nelson P. Jackson, president of the National Rocket Club, which held a few days ago the successful missile/space age conference here in Washington. His biography is also before the members of this committee. He is also manager of the government office of the Joy Manufacturing Co. He will present the statement of the National Rocket Club.

[Furnished by National Rocket Club]

BIOGRAPHY OF NELSON P. JACKSON, PRESIDENT, NATIONAL ROCKET CLUB, WASHINGTON, D.C.

Engineer, lawyer, pilot, consultant, Nelson P. Jackson, is manager of the government office of Joy Manufacturing Co., a manufacturer of heavy equipment, whose products are used in missiles and on launchers, ground support equipment, aircraft, and submarines, and in construction work. Before joining Joy in 1959, he practiced law in Washington and, during that time, authored papers on "Education for the Space Age" and "The Law of Outer Space."

From 1954 to 1958 Mr. Jackson handled nuclear activities for General Electric Co. in Washington. At this time he was chairman of an atomic energy advisory group and published several articles on "Nuclear Powerplants," "Atomic Energy Economics," and "The Disposal of Atomic Wastes."

A 1933 graduate of West Point, he served as a fighter pilot, first in the Army Air Corps, later in the Air Force. His service included an assignment with the Joint Chiefs of Staff, atomic energy work. Strategic Air Command experience, command of a fighter wing in combat during World War II, 19 decorations, and the grade of colonel.

Mr. Jackson is married and is the father of five children. He is a member of a number of professional, technical, and social groups connected with his wide background of interests.

The CHAIRMAN. Mr. Jackson, we welcome you and happy to have your statement, either verbally or with reference to the written statement.

Mr. FULTON. Could we on the Republican side likewise welcome Mr. Jackson, both in his capacity as the newly reelected, unanimously reelected president of the National Rocket Club, and also as the husband of one of the prettiest wives in Washington and father of five children. [Laughter.]

The CHAIRMAN. Well he has five rocketeers.

Mr. MILLER. Mr. Jackson, that coming from a bachelor has great significance.

The CHAIRMAN. We are happy to have your statement, sir. Don't let that byplay distract you from the fundamental goal we are working toward.

Mr. FULTON. Just so Mr. Miller—I withheld the point, actually the Joy Manufacturing Co. is from Pittsburgh, Pa.

Mr. JACKSON. Thank you, Mr. Chairman, Mr. Fulton, Mr. Miller, and other members of the committee.

STATEMENT OF NELSON P. JACKSON, PRESIDENT, NATIONAL ROCKET CLUB

The National Rocket Club appreciates the invitation that you extended to us to come up here and give you some of our views on the problems that are before us, as a nation.

The handles of the illustrious gentlemen on my left, all being doctors, indicate a cleavage of ideas between their organizations and the one I represent. Mine is more of a businessman's organization—management in industry and in Government, with a lot of press members and a few members from here on the Hill. The National Rocket Club is described in appendix A attached hereto.

I am a member of two of the technical societies on the left, the American Rocket Society and the Institute of the Aeronautical Sciences as are a number of members of the Rocket Club, but most of us do not practice at being engineers or scientists. We are peddlers or do some other kind of activity.

I took up your invitation with the club at its annual membership meeting the other day, and they decided that I should come before you and speak pretty much as an individual except on one item which I will identify later on.

It was agreed that I could give you some thoughts expressed at the 1960 National Missile/Space Conference held in Washington last week and to add some of my own ideas.

The theme of this year's National Missile/Space Conference was "The Space Challenge As It Confronts the United States and the Free World." Our objective was to promote policies, programs, and legislation necessary to establish and maintain U.S. space leadership, and to stimulate civil and military space programs for the benefit of mankind. There were four panel sessions of the conference, two luncheons, two receptions, and the Goddard dinner. The agenda for all of this is attached as appendix B.

We were honored to have several members of this committee participate with us. The opinions of conference panelists varied from praise of our progress through 1959, to deploring our absence of competitiveness in space; from plugs for Saturn and Centaur booster programs, to urging the development of a nuclear-chemical rocket program; from using space as a colonizing medium for excess world population, to using it as a place for future wars; from urging acceptance of the status quo re NASA and DOD responsibilities in space, to plugging for more unification of our military and nonmilitary space programs; from using the Moon for colonization by excess people on the Earth, to using the Moon as a military base from which to control any area of the Earth; from our need to surpass Soviet achievements in space in order to recover our prestige throughout the world, to ignoring or belittling such Russian ascendancy; from a hesitancy to spend huge sums for space activities until our goals there are clear, to accepting and supporting $4 billion more per year that some think it will take to catch up with and overtake the Russians; from full international cooperation in space—through varying degrees of cooperation—to going it alone.

Luncheon speakers covered problems of the space age and the missile/space industry, and the Goddard dinner speaker told about U.S. achievements in planning and executing our missile and space programs.

The proceedings of the 1960 National Missile/Space Conference are not yet available. When they are, the National Rocket Club will mail a copy to each member of this committee.

In my opinion the hearings that this and the other interested committees of both Houses of Congress are and will be holding will help to clarify our goals in space and will stimulate and arouse public opinion to see that the administration carries on or steps up its activities to achieve success.

There are doubts and hesitations about some of our national requirements in space—military, scientific, prestigewise. The proper resolution of these doubts could mean national and free world survival. With the stakes so potentially high but still somewhat unclear, I recommend the expenditure of an additional $4 billion per year for military and scientific all-out efforts in space. This would amount to less than 1 percent of our gross national product, only 6 percent of our total national budget, less than $25 per year per U.S. citizen—a bargain price for what could be survival.

Russia is apparently building incentives for its engineers and manufacturers to produce for its state. Here in the United States it seems to be fashionable to destroy free enterprise incentives—at least in selling to the Government. Our national strength lies in free enterprise, among other things—in the incentive of the individual. Sociological and economic theories that seem to be fashionable make it appear as though there is something wrong in making a profit, particularly wrong in making a profit on sales to the Government. Our Government procurement system has thus become so distorted over the last few years that we are destroying incentive. We find companies preferring to sell their products commercially rather than to Government. Practices that seem to me to be destructive of incentive are (1) tight procurement; (2) audit piled on audit as (*a*) by a military service, (*b*) by the General Accounting Office, and (*c*) maybe by a renegotiation board; (3) under National Aeronautics and Space Administration contracts, patentable ideas are the Government's and may not be used in commercial work; (4) renegotiation; (5) acquisition of proprietary technical data and know-how.

In our competition with Russia over space, we will uncover new technologies in the carrying out of NASA contracts. Some of these technologies will have applications on Earth, but the Government will have all the rights to them—and we'll find ourselves backing into socialism.

I recommend the fostering of a climate of Government contracting whereby our corporate citizens, our industrial companies, will retain their incentive to serve our country.

Lastly, and on this recommendation, I speak for the National Rocket Club as a whole, I recommend the establishment by Congress of March 16 as Goddard Day in honor of our great rocket pioneer and as a stimulus to us, to our children and to our children's children to emulate Dr. Goddard's dogged determination to conquer the great frontier of space. On this date in 1926 he successfully launched the

world's first liquid-propelled rocket. Attached as appendix C is a brief history of Dr. Robert H. Goddard in support of this recommendation.

In summary, I recommend:

1. The expenditure of $4 billion more per year on missile and space activities.

2. The fostering of a climate of Government contracting that will encourage corporate incentive to do contract work for the Government.

3. The establishment of March 16 as Goddard Day.

Thank you for having invited me.

(The full text of Mr. Jackson's prepared statement is as follows:)

TESTIMONY OF NELSON P. JACKSON BEFORE THE COMMITTEE ON SCIENCE AND ASTRONAUTICS, U.S. HOUSE OF REPRESENTATIVES, FEBRUARY 23, 1960

I am Nelson P. Jackson of the Joy Manufacturing Co., a manufacturer of heavy equipment, whose products are used in missiles and on launchers, ground support equipment, aircraft and submarines, and in construction work.

My presence before you is in my role as president of the National Rocket Club, which organization is described in appendix A attached hereto. The invitation that I received from this committee, through Dr. Sheldon, asked me to testify on behalf of the National Rocket Club and, if unable to speak for the Rocket Club as a whole or for its directors, to testify as an individual.

Two weeks ago we took up your invitation with the club's committee for the then forthcoming National Missile/Space Conference. It was the consensus of opinion that, because of the divergent backgrounds, organizations and activities of our individual members who come from industry (large, medium, and small companies), from the press, and from the legislative and executive branches of our Federal Government, we would not be able to get together a statement setting forth the majority views of the membership in the time available. It was agreed that the best that I could do would be to give you some thoughts expressed at the 1960 National Missile/Space Conference held here in Washington on February 16–17, and to add thereto my own ideas. We took up this suggested modus operandi at the annual meeting of the club on February 17, and the membership approved the above procedure.

The theme of this year's National Missile/Space Conference was the space challenge as it confronts the United States and the free world. Our objective was to promote policies, programs, and legislation necessary to establish and maintain United States space leadership, and to stimulate civil and military space programs for the benefit of mankind. There were four panel sessions of the conference, two luncheons, two receptions, and the Goddard dinner. The agenda for all of this is attached as appendix B.

The opinions of conference panelists varied from praise of our progress through 1959, to deploring our absence of competitiveness in space; from plugs for Saturn and Centaur booster programs, to urging the development of a nuclear-chemical rocket program; from using space as a colonizing medium for excess world population, to using it as a place for future wars; from urging acceptance of the status quo re NASA and DOD responsibilities in space, to plugging for more unification of our military and nonmilitary space programs; from using the Moon for colonization by excess people on the Earth, to using the Moon as a military base from which to control any area of the Earth; from our need to surpass Soviet achievements in space in order to recover our prestige throughout the world, to ignoring or belittling such Russian ascendancy; from a hesitancy to spend huge sums for space activities until our goals there are clear, to accepting and supporting $4 billion more per year that some think it will take to catch up with and overtake the Russians; from full international cooperation in space—through varying degrees of cooperation—to going it alone.

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In my opinion, the hearings that this and the other interested committees of both Houses of Congress are and will be holding will help to clarify our goals in space and will stimulate and arouse public opinion to see that the administration carries on or steps up its activities to achieve success.

There are doubts and hesitations about some of our national requirements in space—military, scientific, prestigewise. The proper resolution of these doubts could mean national and free world survival. With the stakes so potentially high but still somewhat unclear, I recommend the expenditure of an additional $4 billion per year for military and scientific all-out efforts in space. This would amount to less than 1 percent of our gross national product, only 6 percent of our total national budget, less than $25 per year per U.S. citizen—a bargain price for what could be survival.

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1. Tight procurement.
2. Audit piled on audit as (*a*) by a military service, (*b*) by the General Accounting Office, and (*c*) maybe by a renegotiation board.
3. Under National Aeronautics and Space Administration contracts, patentable ideas are the Government's and may not be used in commercial work.
4. Renegotiation.
5. Acquisition of proprietary technical data and know-how.

In competition with Russia over space, we will uncover new technologies in the carrying out of NASA contracts. Some of these technologies will have applications on Earth, but the Government will have all the rights to them—and we'll find ourselves backing into socialism.

I recommend the fostering of a climate of Government contracting whereby our corporate citizens, our industrial companies, will regain their incentive to serve our country.

Lastly, I recommend the establishment by Congress of March 16 as Goddard Day in honor of our great rocket pioneer and as a stimulus to us, to our children, and to our children's children to emulate Dr. Goddard's dogged determination to conquer the great frontier of space. On this date in 1926 he successfully launched the world's first liquid-propelled rocket. Attached as appendix C is a brief history of Dr. Robert H. Goddard in support of this recommendation.

In summary, I recommend:

1. The expenditure of $4 billion more per year on missile and space activities.
2. The fostering of a climate of Government contracting that will encourage corporate incentive to do contract work for the Government.
3. The establishment of March 16 as Goddard Day.

Thank you for having invited me.

APPENDIX A

THE NATIONAL ROCKET CLUB

The National Rocket Club is the organization that sponsors the annual National Missile/Space Conference, which was held here in Washington on Tuesday and Wednesday of last week, February 16–17, and the Dr. Robert H. Goddard memorial dinner, which was held last Wednesday evening, February 17. The National Rocket Club was founded October 4, 1957, as an informal luncheon club for the exchange of ideas between people interested in rocketry.

The club was incorporated on March 31, 1958, as a nonprofit corporation under the laws of the District of Columbia. The objectives of the club are, to quote from the bylaws, "the advancement of guided missiles, rockets, and space flight for the benefit of the United States defense and scientific goals, and the maintenance on a nonprofit basis of a common meeting place in the National

Capital where, with a minimum of formality, representatives of all phases of rocketry may come to know each other. The club will, from time to time, provide suitable recognition and do honor to individuals and organizations who have contributed to the advancement of rocketry."

The club plays a role similar to that of the National Aviation Club as far as honoring people is concerned, similar to the Aero Club as far as sponsoring an annual dinner honoring America's first rocketeer, and the club stimulates other organizations and individuals to advace U.S. rocketry and astronautics.

The biggest need today for all segments of our population for the space age is education concerning rocketry and astronautics. The club aims to bring together personnel from Government, industry, Congress, the press, and others to exchange current nonclassified information on the subject, and through them to relay it to the public at large.

The club will stimulate the dissemination of unclassified information on rocketry or astronautics in the fields of the historical, educational, and business aspects of the missile business; will stay out of the technical aspects which are properly the province of the technical societies.

Rocket Club monthly luncheons have been held since its founding, and missile/space conferences and Goddard dinners have been held in 1958, 1959, and 1960.

APPENDIX B

THE NATIONAL MISSILE/SPACE CONFERENCE, FEBRUARY 16–17, 1960

PANELS

1. Space challenge—Philosophy

It was the aim of this panel to examine the philosophical parameters of the space challenge. What exactly is the nature of the challenge; what are its moral, ethical, religious, and legal implications? Is it necessary and desirable to establish footholds in space in the interest of defending the Nation and the free world? Does the national policy being evolved differ from currently stated U.S. policy?

Moderator of this panel was Dr. S. Fred Singer, professor of physics, University of Maryland.

Panelists were: Mr. Richard B. Canright, chief of research, missile and space systems engineering department, Douglas Aircraft Co.; Rear Adm. Thomas F. Connolly, Assistant Chief, Bureau of Naval Weapons, for Pacific Missile Range and Astronautics; the Honorable James G. Fulton, Pennsylvania, Committee on Science and Astronautics, House of Representatives; Mr. Bernard Haldane, career development specialist, Fairleigh Dickinson University; Mr. Ernest K. Lindley, bureau director, Newsweek magazine; Dr. Donald Michael, project coordinator, Brookings Institution; Dr. Leo Steg, manager, space sciences laboratory, General Electric Co.

2. Space challenge—Legislative aspects

The aim of this panel was to discuss the Nation's space legislative objectives. What new legislation is probable? What changes in present laws? What is the likelihood of international cooperation in the space field? And * * * is the U.S. space program apt to be a political issue in the coming national elections?

Moderator of this panel was Mr. Theodore F. Koop, vice president, Columbia Broadcasting Co.

Panelists were: The Honorable Victor S. Anfuso, New York, House Science and Astronautics Committee; Senator Thomas J. Dodd, Connecticut, Senate Space Committee; Dr. Franco Fiorio, United Nations (Italy); Mrs. Eilene Galloway, consultant, Senate Space Committee; Mr. Clarke Newlon, editor, Missiles & Rockets Magazine.

3. Space challenge—Outlook

This panel aimed to provide a recapitulation of where we are and where we are going, to catalog our accomplishments and our deficiencies to date and project the integrated national program for the exploration and exploitation of space which is required in the years ahead, and give a summary of specific programs and projects.

Moderator for this panel was Mr. Kurt Stehling, Aeronautical Research Scientist (Rocket Propulsion), National Aeronautics and Space Administration.

Panelists were: Spencer M. Beresford, Esq., special counsel, Committee on Science and Astronautics, House of Representatives, Mr. Norman L. Baker, publisher and editor, Space Business Daily, Dr. Vincent Cushing, president, Applied Sciences, Inc., Mr. Martin Decker, president, the Decker Corp., Brig. Gen. Donald D. Flickinger, USAF, Assistant for Bio Astronautics and Surgeon, Headquarters, Air Research and Development Command, Dr. Dorothy Simon, technical assistant to the president, Research and Advanced Development Division, Avco Corp., Dr. Homer Joe Stewart, Director of Program Planning and Evaluation, National Aeronautics and Space Administration.

4. Space challenge—Marketing

American industry contributes enormously to the missile-space business; will be asked in the future for much more help. Will industry continue on the planning as well as the hardware team? On prime as well as sub contracts? Or is the Government going to do its own planning and be its own prime contractor? Under whatever rules are in the making, what will be the marketing problems in selling to the Government? To prime contractors?

Moderator for this panel was Lt. Gen. Mark E. Bradley, Jr., USAF, Deputy Chief of Staff, Materiel, Headquarters, U.S. Air Force.

Panelists were: Mr. L. E. Tollefson, Washington representative, Douglas Aircraft Co., Inc., Mr. Karel Jan Bossart, assistant to the vice president of enginering, Convair Division, General Dynamics Corp., Mr. Ernest W. Brackett, Director, Procurement and Supply Division, National Aeronautics and Space Administration, Mr. J. W. Crosby, president, Thiokol Chemical Corp., Dr. Robert B. Dillaway, manager, Nucleonics, Rocketdyne Division, North American Aviation, Inc., Mr. R. R. Kearton, assistant general manager, Missiles and Space Division, Lockheed Aircraft Corp., Mr. Donald E. Perry, managing editor, Missiles & Rockets Magazine, Mr. N. I. Schafler, president, Consolidated Diesel Electric Corp., Mr. Ernest G. Stout, manager, Washington Operations, the Ralph M. Parsons Co.

LUNCHEONS

The speaker at the Space Age Luncheon was Mr. Krafft A. Ehricke, assistant to the technical director, Convair Astronautics Division, General Dynamics Corp.

Speaker for the Missile/Space Industry Luncheon was Dr. Arthur R. Kantrowitz, vice president and director, Avco Corp.

DINNER

The speaker for the Dr. Robert H. Goddard memorial dinner was Lt. Gen. Bernard A. Schriever, commanding general, Air Research and Development Command, USAF.

APPENDIX C

DR. ROBERT H. GODDARD

Dr. Robert H. Goddard, the world's pioneer in rocketry, is now often called the Wilbur Wright of the missile and space age. Born in 1882 in Worcester, Mass., Dr. Goddard attended Worcester Polytechnic Institute and received his M.A. and Ph. D. from Clark University. He was a research fellow in physics at Princeton University for 2 years and later joined the faculty of Clark University where he became a full professor in 1919.

At a very early age Dr. Goddard became interested in rockets and by 1912 had worked out the detailed mathematical theory of rocket propulsion. In 1914 he obtained two U.S. patents upon which today's rocketry is still based. He was the first to develop the use of liquid fuels in rocketry, the first to develop gyrosteering apparatus for rockets and the first to explore mathematically the practicality of using rocket power to reach the moon.

His efforts were largely ignored throughout the United States although he was granted $5,000 by the Smithsonian Institution to carry on his experiments. His talents applied this grant to the development of the bazooka rocket 15 years before it was finally recognized and put into service during World War II. While his work received little attention here, in Europe foreign powers took Dr. Goddard very seriously indeed. They studied the results of his experiment in detail and applied them to the development of the German V–2.

Dr. Goddard persistently carried on his experiments. On March 16, 1926, he successfully launched the world's first liquid-propelled rocket. This and other more successful firings still were unfavorably received until they were brought to the attention of Daniel Guggenheim, who in 1930 granted him $25,000, making possible the first large-scale rocket experiments in the United States.

By 1935 Goddard's rockets had reached a weight of 85 pounds, 18 feet in length and soared 7,500 feet at 700 miles an hour.

He suspected the Germans of following a similar program and for several years urged the War Department to take an interest in the rocket as a weapon. Finally in 1941, the Navy began to show some interest in his work and Dr. Goddard patriotically volunteered his services to the Nation's war effort and until his death in 1945, worked on jet-assisted takeoff rockets and glide bombs.

Had Dr. Goddard lived to see today's effort in the missile and space industry, he would surely have seen his life dream becoming a reality.

His enormous work of bringing to practical realization the possibilities of rocket and space flight, will forever be recognized as the most important technical achievements of these times, marking a turning point in the history of mankind.

APPENDIX D

OFFICERS AND DIRECTORS OF THE NATIONAL ROCKET CLUB, WASHINGTON, D.C.

President: Nelson P. Jackson
First vice president: C. Lincoln Jewett
Second vice president: Robert D. Ladd
Secretary: Rooney E. Wilson
Assistant secretary: Daniel T. Garges
Treasurer: Richard A. Carpenter
Counsel: Bernard J. Gallagher
Governors:
Ralph M. Anglea
Norman L. Baker
Barney Capehart
Hon. H. R. Collier
Dr. William Cooley
James J. Fisher
Governors—continued
George C. Gilman
Peter S. Hackes
Vern Haugland
Herbert F. Hodge
Senator Henry M. Jackson
Ben S. Lee
A. S. Mrozek
Donald E. Perry
Charles M. Poll
Col. H. W. C. Shelton
Warren R. Smith
H. A. Timken, Jr.
Joseph R. Trueblood

The CHAIRMAN. Thank you very much, Mr. Jackson. That also is a very fine statement.

Mr. WOLF. Mr. Chairman, did he mean "cooperative" or "corporate"? There is quite a difference there. In point 2 in his summary.

Mr. JACKSON. Encourage corporate incentive to do contract work. Thank you for the correction.

The CHAIRMAN. That, too, is a very fine statement.

Now, gentlemen, there are complete statements prepared by these gentlemen and I think in fairness to them that we ought to have those incorporated in the record. So if there is no objection——

Mr. FULTON. I so move.

The CHAIRMAN. All of those statements will be incorporated in the record.

(The statements referred to are placed in the record in conjunction with the oral presentations.)

The CHAIRMAN. Mr. Jackson, I want to ask you this: I want to first state that I am thoroughly in sympathy with the establishment of Goddard Day. I think that ought to be attended to, as proper recognition of a man who did pioneer space.

In reference to your suggestion about $4 million additional expenditure, I want to ask you this: Do you mean $4 million——

Mr. ANFUSO. Billion.

The CHAIRMAN. $4 billion over and above what is presently planned or do you mean—what sum total do you mean?

Mr. JACKSON. $4 billion over and above what is presently planned.

The CHAIRMAN. What would that make as a total for expenditures of Government for space?

Mr. JACKSON. I don't have that figure, sir.

The CHAIRMAN. But whatever that is—are you familiar with the plans for the future, expanding plans on space?

Mr. JACKSON. Not if they are classified; no, sir. Only what I have read in the papers.

The CHAIRMAN. At any rate, that clears up the idea I had in mind.

Mr. JACKSON. I did not, if you will notice, sir, I did not suggest a division of that expenditure between the military and NASA. I thought that the executive branch of the Government and the Congress in their wisdom could figure out how this could be done.

The CHAIRMAN. I want to ask you this then: Do you think we can successfully divide military space from peacetime space?

Mr. JACKSON. That is the $64 question.

The CHAIRMAN. I am going to ask every other one on the panel the same question.

Mr. JACKSON. Traditionally plowshares have followed swords. Maybe for once in history we might reverse this, if we put enough money into NASA, and thereby and thereafter have the swords following the plowshares.

I think there are unknowns in space that money has to be spent on now, vis-a-vis, the Russians. We don't know why they are doing what they are doing, but they are sure busy at it. [Laughter.]

And, if we don't at least try to keep up, we may find ourselves lacking things that can be developed through NASA that could be used by the military.

The CHAIRMAN. Dr. Seifert, do you have any statement in reference to that question?

Dr. SEIFERT. I would just like to quote the last sentence of my prepared statement, which says:

We hold that we must not force an artificial separation between the scientific and military potential of space and that we must be fully aware of the possible military aspects of space if we are to assure ourselves of an opportunity to explore space peacefully.

I think they must go hand in hand.

The CHAIRMAN. Together?

Dr. SEIFERT. Yes.

The CHAIRMAN. They can't be entirely separated?

Dr. SEIFERT. Right.

The CHAIRMAN. What about you, Dr. Arthur?

Dr. ARTHUR. I would also like to quote from our statement. We take no position as to whether the military or the civilian should control space.

The CHAIRMAN. I am not asking that question.

Dr. ARTHUR. But we do feel that it is a mutual problem; there cannot be a separation.

The CHAIRMAN. Do you believe that peacetime use of space and military use of space can't be divided?

Dr. ARTHUR. Not too well. I think it would be artificial. There is a common technology.

The CHAIRMAN. And what about Dr. Stever?

Dr. STEVER. The institute has no position on this at all, although the individual members take each of the three positions, three possible positions, and take them very strongly. Personally I believe that the associated sciences and technology are quite similar in both military space and nonmilitary space.

The objectives are somewhat different. Again I think that there are important objectives in both fields.

The CHAIRMAN. The objectives are different but the development of the rules, for instance, under which you operate, the laws of nature which you discover and utilize are adaptable either to military or nonmilitary; is that it?

Dr. STEVER. I think that is right.

The CHAIRMAN. Mr. Fulton.

Mr. FULTON. We are glad to have you here. I believe the statements are both interesting and informative.

Of course, the question comes up when the Congress has unanimously said that the U.S. policy will be to proceed into space by peaceful means for peaceful purposes, shall we change that basic policy?

The second great question is when the United Nations has unanimously in General Assembly set up a committee for the peaceful uses of space, shall we in the United States go directly contrary to that and make ourselves a military entry for a military purpose, ending up as we did in past history when we had the sea on this basis in the days of the Spanish Armada for crucial control in that particular area. Now, my question is this: If our Government military programs are for weaponry systems and too often there is little room in those programs for basic science, I am surprised that you scientists are not pleading for room for pure science and for exploration and for the use of a medium for its best purposes for the benefit of not only this country but mankind.

The second thing is this: Historically NACA—National Advisory Committee for Aeronautics—was very successful as a civilian organization moving right alongside with the military applications of planes. But, of course, planes were used for both purposes.

Nobody said to put the manufacture of all planes under the military and the exploration of all atmospheric space under the military. They knew better.

Now, the question comes up: Does any one of you think the method of NACA was wrong and therefore we should at a certain point in time and in altitude from the center of the Earth say that we will not base a national aeronautics and space agency on NACA, but we will change it and put it all over under the military?

Does any one of you say that?

Mr. JACKSON. No, sir.

Mr. FULTON. Would you each reply for the record without nodding your head?

Dr. SEIFERT. No, sir.

Dr. ARTHUR. No.

Dr. STEVER. No.

Mr. JACKSON. No.

Mr. FULTON. The two greatest space programs have been the Russian and the United States and right from the beginning it has been the Academy of Science of Russia, with a scientist at the head of it, president of it, and a scientist at the head of the Interplanetary Commission that ran it, and have done it pretty successfully.

Do you think that was wrong of the Russians to do that? They have had quite a mixture, I must say, down below, generals, admirals, corporals, and scientists, mixed them all up together, but at the head of it there was a scientist.

I think it was about 1926 when it was decentralized and moved off into institutes with a broad base.

Would you please again reply, each of you? Was that right or wrong in view of the results of the Russian programs in space? Just say "Yes" or "No" and move on.

Mr. JACKSON. No comment.

Mr. FULTON. Next.

Dr. STEVER. May I—

Mr. FULTON. These Russians are human beings. They are scientists and they are military people just like we are. Whether we——

The CHAIRMAN. Strike out "just like we are" and then I would agree with you.

Mr. FULTON. I mean that. Whether we agree with their form of politics or not, we disagree with their politics; but again I emphasize they are human beings just as we are, because I have had a Russian brother-in-law and I am a great admirer of the Russian people, so I will refuse to strike that one out.

The CHAIRMAN. The gentleman can use his own judgment. I am not going to insist on it, but I simply don't want to be associated with being just like the Russians. I don't think we are.

Mr. FULTON. Don't you think you are a human being just as the Russians are?

The CHAIRMAN. Oh, yes, I am a human to that extent.

Mr. FULTON. That is the least common denominator of existence.

Mr. WOLF. Would the gentleman yield to me?

Mr. FULTON. Yes.

Mr. WOLF. I don't think they can answer this question with a "Yes" or "No" answer. I would hate to bind them with that kind of an answer.

Mr. FULTON. Let them put it in the record later. Since it is already set up by the order of the President that we shall have a National Aeronautics and Space Administration to come up with scientific and peacetime answers, to change from that, putting it all under military and therefore having the emphasis of the Federal Government on weapons systems with little room for pure science, the question then arises: Shall we now make the change?

Would you please answer that one "Yes" or "No"?

Mr. JACKSON. I don't think we should make the change, no.

Mr. FULTON. All right. Next one.

Dr. STEVER. May I add a little to just a "Yes" or "No" statement?

Mr. FULTON. All right. My time has expired.

The CHAIRMAN. Sure is.

Mr. FULTON. Oh, no, 6 minutes have.

Dr. STEVER. It seems to me that we have been making military and scientific people as different people. In all of our experiences in the Institute of the Aeronautical Sciences they appear to be the same people, possibly in different suits. In our scientific and engineering forums we find that military scientists, scientists who are working for the Government in military organizations, are high quality and can stand up with others. In fact, many of these change their hats from time to time in their lifetime.

Mr. FULTON. Would you make the statement for the record for us? I don't want to go over my time. Would you do that for us?

Dr. STEVER. Yes, sir. Certainly.

Mr. FULTON. Next man.

Dr. ARTHUR. Our position was that we take no position as to whether it should all be under the military or under the civilian.

Mr. FULTON. Should it be changed now?

Dr. ARTHUR. No, we take no position on this.

Mr. FULTON. Would you submit, each of you, for the record, and give it some thought?

Dr. ARTHUR. But we do feel it is a mutual problem, military and civilian.

(Dr. Arthur's further statement is as follows:)

FURTHER COMMENTS OF G. R. ARTHUR, ON CIVILIAN VERSUS MILITARY CONTROL OF SPACE PROGRAMS

As noted in the testimony this is a mutual problem. The comparison of NASA with NACA is not a valid one since NASA is much more involved in applications than NACA ever was. The military is perfectly capable of pursuing peaceful scientific programs in areas which may have military overtones. Antarctic exploration for example is a clear case in point. The Navy has had the facilities and has done much valuable work there. The same situation exists for space. The military resources for exploration are great and must be utilized. In most application areas the military is probably best suited to pursue the program under civilian check and balance.

The NASA strong suit is research and early development as was done in NACA days. It would appear that with firm leadership and a thought-out plan, NASA in research and the military in applications could advance our space efforts in concert. All we need is some clarification of charter areas and then an enforcement of this by strong, dedicated leaderships, leadership which wants the United States at the top.

Mr. FULTON. I want to compliment Dr. Stever on the statement that the speed is to be calculated from zero to infinity rather than from zero to the speed of light.

The CHAIRMAN. May I say to the gentleman, we don't want to rush anyone unduly in reference to the supplementing of these statements as has been suggested here. However, we would like to have those statements very soon. Some of our records, I am told by the staff, have been held up for weeks because we are not able to get these statements that were supposed to be submitted for the record.

To that extent in the future we are going to have to be a little bit more careful about holding the record open.

Mr. Miller?

Mr. MILLER. How much time do we get; 5 minutes?

The CHAIRMAN. Five minutes; yes.

Mr. MILLER. Dr. Arthur, I was struck by something you said on page 2 of your statement that although there had been some advanced

planning in the program at the present time in the manned satellite field, it is felt that the lack of strong support for a substantial follow-on program to Project Mercury is a definite gap.

Would you expand that a little bit, please?

Dr. ARTHUR. Yes. There are many areas in the manned field which do not seem to be covered in the present programs. Among these are more intensive work on closed life systems which are going to be necessary to support the man for a length of time longer than a few days. In addition, work in the rendezvous and satellite ferry area doesn't seem to have been covered in the planning to any great degree. These are areas which actually are vital to any long-term manned program.

Mr. MILLER. You think we should be doing more in those fields now?

Dr. ARTHUR. Yes, sir.

Mr. MILLER. We have practically done nothing in them to date?

Dr. ARTHUR. Only study work by various companies has been done in rendezvous to my knowledge.

Mr. MILLER. That is all, Mr. Chairman.

The CHAIRMAN. Mr. Van Pelt.

Mr. VAN PELT. No questions.

The CHAIRMAN. Mr. Anfuso.

Mr. ANFUSO. Gentlemen, I first of all want to congratulate each and every one of you for the very fine statements you have made.

Would you agree with this statement that we cannot help but recognize the fact that the military aspects are interwoven with the peaceful uses of outer space, and they are inseparable and certainly the Russians recognize that fact and whatever research they are making they intend to use both militarily and for peaceful purposes?

But would you say that while we can't help but recognize that existing fact that our goal, our goal nevertheless, the goal is for the exploration of outer space for peaceful purposes and if military results are derived therefrom, of course, we must utilize those things, but our goal should always be the peaceful exploration of outer space for the benefit of mankind?

Would you agree with that statement?

Mr. JACKSON. I agree with that.

Mr. ANFUSO. Would you, sir?

Dr. STEVER. I believe that there is a peaceful goal in space and there is a military one and if there were no peaceful one there would still be a military one left, and vice versa.

Dr. ARTHUR. I agree, sir, that the peaceful goal is a vital one. I think, however, we can't overlook the military implications.

Dr. STEVER. I agree.

Dr. SEIFERT. I think the peaceful one is the one we would like idealistically to have, but the other one is thrust upon us.

Mr. ANFUSO. Now, gentlemen, Russia graduated something like 93,000 scientists last year, and I think you will all agree that we could very well speed up our efforts to encourage young men to go into this field. I think all of you have partially covered that in your statements.

Do you think that perhaps the creation of an institution, of an academy for these young men who can't afford a college education, but supposing we had something on the order of the Military Acad-

emy at West Point or Annapolis, or the Air Force Academy at Colorado Springs; suppose we had one that restricted itself solely to creating scientists, giving these young men an opportunity, those who are interested, giving them an opportunity to take up science, for the Government to encourage them, to provide a proper academy for research and learning in that field, to provide the proper instructors, don't you think that that would be a good thing for the country?

Mr. JACKSON. No, sir, I don't, Mr. Anfuso. When West Point was founded in 1802—and I graduated from West Point—there was no place other than Rensselaer for the Government to send young men for a technical education.

Mr. MILLER. As an engineering school?

Mr. JACKSON. As an engineering school.

Mr. MILLER. That is right.

Mr. JACKSON. I wrote a paper a number of years ago, about 15, recommending that the then existing academies, West Point and Annapolis, and a possible future Air Force Academy, should become postgraduate institutions because in this century we have literally hundreds of educational institutions where boys can go to get undergraduate engineering educations, and for this reason I don't think we need a special college to do this. I would recommend Government aid to existing institutions to educate potential engineers who couldn't otherwise get such an education.

Mr. ANFUSO. Will you allow me a minute, Mr. Jackson? Wouldn't you say that the Air Force has already contributed a great number of engineers and has helped the effort? We have created an undergraduate Air Force Academy even though you opposed it.

Mr. JACKSON. Yes, this we have done.

Mr. ANFUSO. Don't you think an additional academy would help? After all, do we have enough colleges and do we have equal opportunity for all young men who want to take up science courses at this moment? I don't think we have.

If you wish to submit something further on that, Mr. Jackson, I certainly would like to have it, because I have a bill in that respect.

Dr. Seifert.

Dr. SEIFERT. I am inclined to favor all support toward education, although on reflection if you say that you want to produce scientists, this sounds like a graduate school rather than an undergraduate school. One doesn't usually label them scientists until some years after graduation from the ordinary undergraduate college.

Mr. ANFUSO. I mean, do you favor the creation of an academy that would bring about more scientists after a proper examination is given to them, of course, to qualify?

Dr. SEIFERT. I think I would favor the creation of something you might call a graduate academy.

Mr. ANFUSO. Graduate academy; all right.

Next one.

Dr. ARTHUR. I don't feel I can formulate an opinion on the academy. I do feel that further encouragement and shoring up of all of our existing institutions and an encouragement of science and engineering as a profession would be a step in the right direction.

Mr. ANFUSO. All right.

Dr. STEVER. Mr. Anfuso, I think the objectives, the two objectives you stated can be achieved in other ways and possibly more effective ways. Those two objectives are: Giving opportunities for young men who couldn't afford college—that can be achieved in other ways; and expanding the total facilities for science and engineering education—that also can be achieved in other ways, and possibly more effectively.

The CHAIRMAN. Mr. Riehlman?

Mr. RIEHLMAN. Mr. Chairman, I have enjoyed the statements made by these four distinguished gentlemen here this morning. I am sure they are all familiar—they are all interested in our exploration in space because of their statements. But I am wondering if they have taken a look at the recent program that NASA has presented to cover a period of 10 years and what your feeling is in respect to it, what we can accomplish under that program.

I would ask all of you to comment on that if you would, if you are familiar with the 10-year program presented to this committee by NASA for the exploration of space and with the end of the program, the landing of a man on the Moon.

Dr. SEIFERT. My feeling about this is that I would indeed approve such a program for the first 10 years. I was talking about things which might go longer than 10 years, might go 25 years in extent. But this seems like a very suitable program if it is indeed implemented consistently.

Mr. RIEHLMAN. All right. Dr. Arthur?

Dr. ARTHUR. I think the NASA program is an excellent one. The feeling which was reflected in our statement was that perhaps it could be a little bolder and a little more intensive, especially in the manned area. I think the scientific exploration aspects of the NASA program are really topnotch.

Mr. RIEHLMAN. All right.

Dr. STEVER. Personally, I think it is a fine program.

Mr. JACKSON. And I think if it had a little more in it in the way of money it should go a little faster.

Mr. RIEHLMAN. You made an interesting statement that you would like to see $4 billion additional expended in the field of the exploration of space and in our missile program. Have you given any serious study as to how that would be allocated or is that a figure just arrived at without serious consideration as to how you could economically and constructively spend $4 billion additional a year?

Mr. JACKSON. This figure came from one of the panelists at the missile/space conference last week, and I did not go into detail with him into the basis of it, but he comes from a substantial establishment that I am sure helped him in the research of it.

Mr. RIEHLMAN. This is one man's opinion; is that correct?

Mr. JACKSON. Yes.

Mr. RIEHLMAN. Or is this the opinion of your whole group?

Mr. JACKSON. No; this is one man's opinion.

Mr. RIEHLMAN. I see.

Mr. JACKSON. Which I adopt as my individual opinion, sir.

I think that this sum of money split between the Department of Defense and its various services, and NASA, would help us along with the program where we might not get caught short here a few years hence.

I think this is the difference as was expressed last week between what Russians are doing and what we are doing.

Mr. RIEHLMAN. That is the only question I have, Mr. Chairman.

The CHAIRMAN. Mr. Sisk.

Mr. SISK. Dr. Seifert, I would like to ask you to comment on two or three things in your statement. I think, by the way, all of your statements are good, gentlemen.

You say, on the bottom of page 5, in your statement, that once we have defined our aims for the space program we shall be able to establish a series of logical steps and so on and so forth.

Now, do you feel that there are lacking some definite decisions or aims at the present time and that we probably should outline more definitely where we are going or where we hope to go and what our exact aims are?

Now, I am going to later refer you to page 7 regarding technical goals also, and to some extent, I think they are joined. At least my question that I have in mind joins them here with reference to setting up distinct goals and definite aims in this program.

Now, I wonder if you would elaborate a little bit further on just where you think we stand as a nation today with reference to whether or not we have defined goals and definite aims?

Dr. SEIFERT. I think we are just crystallizing these aims. The NASA 10-year plan is one example of such definite goals. I think we are sort of in the midst of jelling this program. This sounds like a criticism here, but actually it is a statement of an ideal which we may indeed be implementing. I am not so familiar with the details of the program that I know exactly how well all this is being carried out.

I feel that there should be something like a system study of the whole problem and a selection of a finite number of goals and this may indeed be in process of being carried out with my not being informed within the last few weeks of it.

Mr. SISK. Of course, I have been somewhat critical of an attitude in NASA about the lack of certain specific goals, or at least the lack of concentrating on certain specific goals. I notice on page 7 under your technical goals you mention something that I have been personally very much concerned with, and this was making an all-out maximum effort on so-called superboosters, with the idea of the earliest manned exploration to the Moon as being the most feasible, immediate goal.

In view of the fact that you actually seem to be going in that direction, I was just curious to know if you do feel that is a goal that we possibly could work for a little harder than we are doing at the present time.

Dr. SEIFERT. I am speaking without enough staff work here to have a very firm conviction, because when you recommend a particular program it should be done only on the basis of a rather extensive study, and this document was written as a collection of opinions solicted from the board of directors.

However, individually, my feeling is that the effort on the very large scale boosters could indeed have some more emphasis on it. It may turn out that money cannot be spent at a rate very much greater than it is at present, but my personal feeling is that such an attempt should be made.

Mr. SISK. We realize, of course, there is a limitation on how rapidly money can be spent. Of course, just to pour money out doesn't do any good unless we have all the other things to go with it in the way of know-how, people, the human side of the equation.

However, I have been of the opinion, certainly, and that is why I wanted to explore it with you, that we should, seemingly, at this late date, have made a definite decision here with respect to what our goal is.

Now, certainly the immediate goal—apparently No. 1—DX priority by NASA is to put a man in space. But the logical next step is: What are you going to use the man for? which would seem to me to indicate that we should more firmly have our eye fixed on that goal of exploration of the Moon or else, if you are going to skip the Moon, let's go on somewhere else.

I don't think we should skip it; I think this should be it. That is the point I was attempting to see just how strongly your people felt on this issue.

Dr. SEIFERT. I think I must beg off on the manned missions beyond Mercury, because of a lack of considering it carefully. This is such an expensive program that ordinarily in industry one would not even venture an opinion on it without a long study. On that particular one I think, "No comment, beyond approving the present program."

The CHAIRMAN. Mr. Wolf.

Mr. WOLF. Thank you, Mr. Chairman.

Mr. Jackson, I was intrigued by your comment on page 2 that our Government procurement system has thus become so distorted over the last few year that we are destroying incentive. This is in the 5th paragraph. Of course, I am sure you are aware that the complicated procurement system was brought on by the disclosures many times of too great profits on the part of industry.

Mr. JACKSON. Yes, sir.

Mr. WOLF. And almost a greed.

Like everyone else, where I am concerned about the fact that it is a complicated procedure and I don't want to take part of my limited 5 minutes to discuss with you what we can do, but I am sure that you wouldn't have said this if you didn't have some ideas on how we could improve it.

I don't think you developed them as much as you could, and I would be grateful if you would, for the record, put something in the record on this, developing these ideas. If you have a quick comment or two you would like to make at this time, I would appreciate it.

Mr. JACKSON. As you know, sir, management was guilty of abuses and then unions grew and became powerful and then they became guilty of abuses. Maybe management was guilty of too high profits a while back. I believe that we are squeezing the rubber ball now and it is bulging out in the area were people say to me: Gee, if I have a choice between selling to somebody in commerce or selling to Government, I will sell to commerce any time.

This is felt and thought today—an openly stated idea—by many people in business, who have to do business with the Government or whose products are salable to the Government. This I don't think is healthy. What I am going to say is just general, sir, without being too specific——

Mr. WOLF. Would you get specific in a report that you would place in the record at this point?

Mr. JACKSON. I would prefer to work——

Mr. WOLF. After thinking it through a little while.

Mr. JACKSON. I would prefer to work that up and send it in.

Mr. WOLF. Yes. He only gives me 5 minutes, my fine chairman, so we couldn't get into this in detail.

Mr. JACKSON. I will be glad to send that in.

The CHAIRMAN. Do that in the next few days.

Mr. JACKSON. Yes, sir.

(The statement referred to follows:)

SUPPLEMENT TO STATEMENT AND ORAL TESTIMONY OF NELSON P. JACKSON

During the course of my testimony before the committee, I cited certain practices that seem to me, on the basis of my experience in private industry, to destroy or hinder the incentive of manufacturing companies to devote a part of their total output to the needs of national defense. Because of the existence of these factors, we find that a number of prominent executives of some of these companies which have played a very great role in defense procurement through World War II, the Korean war, and the post-Korean emergency, have privately voiced a reluctance to do business with defense establishments and a desire to devote all of their business to commercial customers because of these disincentive features which I mentioned. This feeling of dissatisfaction with present Defense Department procurement policies and procedures is clearly relevant to this committee because Dr. Glennan has made it clear that, generally speaking, NASA will follow the procurement practices and policies of the Defense Department.

Congressman Leonard G. Wolf has requested that I offer suggestions as to how contractor incentives might be increased. This is rather a large order to undertake in so short a time. However, the elimination of the disincentive features, referred to in my testimony, would certainly improve the atmosphere considerably.

The first point I mentioned was tight procurement. There seems little doubt that present DOD procurement policies tend to encourage military contracting officers to place almost complete emphasis on low cost to the exclusion of the considerations of quality, technical competence, and ability to furnish spare and replacement parts, in both formally advertised and negotiated procurement. ASPR regulations require that awards be made to the low, competent, and qualified bidder, but in the few instances where the military services have attempted to give due consideration to quality factors, the General Accounting Office has apparently decided that this is contrary to the intention of the competitive bid statutes. Another example of tight procurement is the inordinately low fixed fee prescribed by ASPR for CPFF contracts.

The 10 percent fee limitation for CPFF supply contracts established by statute has, for example, been administratively lowered to 7 percent by section III of the procurement regulation.

Secondly, I mentioned audit piled on audit. All contracts with the military services are subject to renegotiation. The renegotiation process normally entails the furnishing of detail cost data to the Renegotiation Board. In many cases, the sources for such detailed cost data are subject to audit by the Renegotiation Board personnel. Moreover, all negotiated contracts, even those awarded under firm fixed prices, are subject by statute to postcontract audit from the General Accounting Office. Finally, the military services frequently use rather detailed contract clauses to provide themselves with extensive audit authority. In this connection, it should not be overlooked that the Defense Establishment apparently has nearly a complete audit cognizance of all types of contracts, under the Second War Powers Act.

It certainly seems to me that there is no need to audit the books and records of contractors doing business with the Government under formal advertising. Even in those instances where a case can be made out for Government audit, for example in cost-reimbursement contracting, it seems to me one audit would suffice. It should not be overlooked that such Government audits cost companies

a great deal, in terms of tying up manpower and facilities over a long period of time.

In the third place, I mentioned the patent provisions of the Space Act. It hardly seems necessary for me to repeat what has been so forcefully brought to this committee's attention during the hearings on NASA patent policies which took place before this committee last December. I might just recap briefly, however. The Space Act gives authority to the Administrator to take title, under certain conditions, to inventions occurring during the performance of a research and development contract or subcontract with NASA. Thus, when a contractor enters into such work for the Space Administration, he has no knowledge as to whether he will be allowed to obtain patents on inventions occurring during the performance of such contract work. At the very least, the committee should consider ways and means of providing such certainty to contractors. You will recall that Mr. Johnson, the General Counsel of NASA, specifically mentioned the adverse effect of the Space Act patent policy on getting people to do contract work for the Space Administration.

Fourthly, we come to renegotiation. Everyone seems to recognize the fact that contracts with firm fixed-price provisions offer the maximum incentive for prompt and efficient performance of Government contracts. Competitive bidding has always been thought to have the built-in feature maximizing contractor efficiency and holding out the reward of a sound profit for good performance. Why should such a profit figure, computed as a part of the contractor's original bid, be subjected to second-guessing by the Renegotiation Board or by anyone else?

There have, I recognize, been many allegations about exorbitant profits on the part of defense contractors. Without trying to discuss the merits of such complaints, I note that there have been no such allegations regarding contractors doing business with the Government under formal advertising. Accordingly, I can see no argument for continuing renegotiation in this area.

The fifth point I mentioned concerned present policies regarding the acquisition of proprietary technical data and know-how. The present ASPR regulations provide that the Government may acquire proprietary technical data under supply contracts only upon payment for such data. However, it is becoming increasingly clear that the military services in many cases refuse to recognize that a contractor's detailed manufacturing drawings are proprietary to that company. Regardless of whether such drawings are what the Government lawyers call proprietary data, there is no question that such drawings embody the fruits of many years of research and development and the spending of large amounts of money by private companies.

The Government does not attempt to acquire title to private patents resulting from research performed by a company at its own expense. I can see no reason why the Government does not follow a similar policy with respect to the nonpatented fruits of a company's own research program. I suggest that recognition of a contractor's proprietary rights in the results of his own research and development program will have a significant incentive in the willingness of many manufacturing companies to bid on procurements for standard-type items with only slight military modifications.

There are some instances, and this situation is growing, where private firms are investing large sums of their own in development work and are contributing proprietary knowledge developed by the company prior to acceptance of the Government contract. Quite often individual firms are asked to give up existing proprietary rights on previous work as a condition to obtaining contracts. In these and similar instances, the equities of the situation should be weighed carefully by contracting offices to insure that legitimate proprietary interests are taken into account. This is an important factor in eliciting a maximum contribution from the industry.

Mr. WOLF. I would like to congratulate Dr. Arthur on his statement. I think the most significant point in your whole statement from my point of view is—

If the elementary schools are not supplying the firm foundation so necessary for future success the house will surely crumble under the future stresses we know will occur.

I want to congratulate you for this statement.

I would like to ask if we can get into this area sometime in the future, would you be willing to come back and develop this theory a little bit more?

Dr. ARTHUR. Yes, sir; I would. I am working locally in my own residential area in this problem which I feel very strongly about. I found general agreement among the board of the society that this indeed was a problem. I should indeed be most happy.

Mr. WOLF. I am wondering if you might have some ideas offhand at the moment, or you can supply to us, of some other folks who might help us with this area?

Dr. ARTHUR. I should be glad to send you some information on this.

Mr. WOLF. I also notice your comment: "This potential is constantly being diminished by our conservative approach," for which I congratulate you.

I don't want to put you on a spot, but I wonder if you favor either of the Federal aid to education bills. One has already been voted on in the Senate and we are hoping to get one up in the House.

Dr. ARTHUR. I think, speaking for the society, I don't think I can take a position on this.

Mr. WOLF. All right. If you would like to speak for yourself.

Dr. ARTHUR. Speaking for myself, I think that Federal aid to education is a real problem. I think the real help that Federal can make is in the physical area, physical plant, and so forth. Our educational system is such that it is still handled on a local basis. The only Federal aid here would be, I think, in terms of information and a greater education so to speak of local school boards as to the needs of the country in this area.

Mr. WOLF. I would be happy to have you come back, I am sure, for myself. I don't think I can speak for the committee on this.

I hope we can develop this area, Mr. Chariman. I want to congratulate these gentlemen for their provocative statements.

The CHAIRMAN. Thank you. Mr. Daddario?

Mr. DADDARIO. Dr. Stever, in your statement you referred to the United States having the responsibility for world leadership and you also say the technical potential of this country is strong enough to meet any challenge. Do you think in the field of space that we haven't properly utilized our technical potential to be in a condition of world leadership that we should?

Dr. STEVER. As far as utilizing our talent with respect to giving them jobs to do and providing the proper backing, I think the contracts and the programs that have been laid out are very good in that respect. Our statement was pointed to the fact that essentially we wanted to get on the record that we have greater capability than we are using.

We didn't comment on the level of support, and I think this is the main job of this committee and the Congress to do, to get the level at which we in this country should support this effort. We are sure that if it is supported to a greater degree, the scientific and the engineering talent can be found. We have it.

Mr. DADDARIO. Then getting back to the spending of more money or to the pushing faster of these programs which we have, it is your opinion, then, that we are not using our full potentials and that we

have the people who could be utilized in order to push this whole program ahead?

Dr. STEVER. Yes.

Mr. DADDARIO. And you also say that we have the great capability for emergency expansion. Now taking the speed with which an emergency could come upon us, don't you believe that actually the emergency in the space area is now rather than after something has been accomplished?

Dr. STEVER. Yes, sir. I think you are referring to a time lag or a buildup period. There certainly is a buildup period and we know from experience in World War II that this was of the order of a small number of years to bring our strength up to maximum size.

However, at the present time I suspect we could marshal strength in this field at a more rapid pace because there are people who are trained in this program who are not being fully utilized in the program.

Mr. DADDARIO. Well, do you believe that we could and should prepare some kind of a program with the skills of these scientists properly cataloged and with some kind of a schedule set up so that there wouldn't be any organization problem, to use them in the event of an emergency, but so that this work could be done ahead of time? And if you believe so, do you think there is anything that exists now that could be quickly packaged in such a manner so that it could be used?

Dr. STEVER. I would like Mr. Daddario to make very clear that the Institute of the Aeronautical Sciences takes no position on this subject at all. So what I would say would be my personal feeling.

Mr. DADDARIO. Yes.

Dr. STEVER. Among my colleagues in the Institute of the Aeronautical Sciences, I think I would be considered an enthusiast for this space program and I personally would like to see more done.

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

The CHAIRMAN. Mr. Moeller?

Mr. MOELLER. Dr. Stever, on page 6 of your prepared statement, the last paragraph you made mention of the activities of yours that contribute directly to the ability of the country to meet the challenge by improving technological capabilities of our scientists, et cetera.

Then you go on further to say:

> This did not start at the launching of Sputnik I but was already under way by the end of World War II.

We are told that the Soviets got in dead earnest in this immediately after World War II. If we had this ability then, what accounts for this tremendous gap at the present time? I am sure this Government must have looked to you people for the guidance and the advice and for maybe the prodding that might have been necessary at this time.

Why did we wait so long before we actually got into this?

Dr. STEVER. I think this is a very good question to delve into. There is no question that a number of our people in this country were developing their own strengths, they were doing research, doing development in this area, in fact, they were being supported by the Government. Their support in this area was not as high, apparently, as it was in Russia.

The balance of opinion in this country was that our engineers and scientists should work—the majority of them should work on other things. I think time has shown that our balance wasn't proper.

Mr. MOELLER. To whom were these reports made? Who had this information and wasn't using it?

Dr. STEVER. I think every agency of the Government was pretty well aware of the work that was going on in this field. I can't think of any agency that didn't have it in their reports.

Mr. MOELLER. So it was negligence on the part of people in Government that we didn't pick this thing up and get going?

Dr. STEVER. I don't know whether negligence is the proper word. I think their judgment indicated we should go elsewhere. I am afraid that we all benefit by hindsight here. We mustn't fail to remember that we did maintain the strongest nation during those years. Possibly we had the wrong balance between future strength and present strength, but nevertheless we had strength then.

Mr. MOELLER. Nevertheless, we don't want to repeat any of our mistakes.

Dr. STEVER. No, sir.

Mr. MOELLER. We are told that the Soviets have leapfrogged much of what we have been doing in the way of huge bombers, et cetera. They went immediately into missiles. Haven't you fellows got some idea now that we can go beyond missiles? Why are we sitting around and letting the Russians leapfrog again?

Ought we not be thinking about—well, you name it, I don't know what it is, but there should be something.

Dr. STEVER. We are getting far afield from my representation for the Institute of the Aeronautical Sciences.

Mr. MOELLER. This is certainly going to be in your field.

Dr. STEVER. But I would say that every member in the community of scientists and engineers that I know is looking very hard at the future. But let's not say that just because one leapfrogging has been accomplished, we can forget that field and go on to a new field.

Mr. MOELLER. They maybe won't be able to leapfrog any more?

Dr. STEVER. That is right.

Mr. MOELLER. One final question—any of the four of you can answer it: Are you willing to make a statement—you are, I am sure, familiar with the Mercury program. Are you willing to make any statement as to what you think of its present value with respect to putting man in space?

Do you want to stick your neck out on it?

Dr. STEVER. Well——

Mr. MOELLER. I don't care who answers.

Dr. STEVER. May I say again that this is a personal remark and doesn't represent the Institute of the Aeronautical Sciences in any way. I think it is a program which is needed in the field. When taking our first step, it must be rather simple. I think the Mercury program is an important first step. I don't think it is the only possible first step one could have thought of.

Mr. MOELLER. Do you think there is a possibility we could have bypassed this?

Dr. STEVER. I suspect if we went back a few years in time and selected a different program we might have done better, but at this stage I don't think we should abandon it and go on to another one which, in turn, may be abandoned 4 or 5 years in the future.

I think we have to take these first steps so let's get on with the job. That is a personal opinion.

Mr. MOELLER. That is all.

The CHAIRMAN. Mr. King?

Mr. KING. I should like to ask a question to whichever of the four wants to take a crack at it. General Medaris in his testimony to this committee, of course, advocated very vigorously, as you gentlemen know, a unified space program under one unified authority or agency and his feeling, of course, was that the Department of Defense, since it was in the picture and has been in it traditionally from the beginning and has available its technical services and procurement and all of the rest. He felt and argued persuasively that the Department of Defense should remain in control of the program and that it should be unified under the Department of Defense.

Among other things he also argued—and this, I think, was quite persuasive and affected me. He said it is impossible where you have two agencies carrying on a single program like this—it is impossible to coordinate all of the technical work, the experimentation that is being done.

Invariably you will have in your separate agencies—you will have the same type of work being done and it is impossible to have one central clearinghouse to make certain that you don't have duplication, overlapping, and so on.

If you have one agency, he said, you can do that. You have a clearinghouse, you don't have the situation of two laboratories or two departments carrying on the same research.

But where you have two entirely different commands, that type of overlapping is inevitable. He argued that there would be a saving of at least 20 percent by uniting all of our space activity under one administration.

I should like to get your comments on that line of reasoning.

Do you feel specifically that there is an inevitable overlapping and duplication of technical effort where you have NASA on the one hand and you have the Department of Defense on the other hand, both in the space field and both in R. & D. aspects of space?

Whoever would like to comment on that. This is a great problem, of course.

Dr. SEIFERT. Thank you for the privilege.

I think it is important that the civilian influence on what is essentially a scientific program not be lost. Admitted that things could be more efficient if under a single strong head, my own personal reaction—I am speaking only as an individual—would be that a civilian influence should be very strong in guiding this program. If it has to done through a second agency, then so be it.

I would not want to sacrifice the civilian control of certain portions of the program for the sake of 20 percent of the program.

Mr. KING. You think his argument, though, may have some merit on that 20 percent?

Dr. SEIFERT. Yes.

Dr. ARTHUR. I think the single agency approach is certainly a good one. I am not prepared to say which agency, although, for example, in the applications area when you consider what we think about in the future, like networks of communications satellites or networks of navigation satellites, certainly programs of this scope should be under one agency.

Dr. STEVER. Again this is a personal belief; since I believe there are important military goals and important nonmilitary goals, I think it is important to have two agencies.

I believe that if the space program is put under a military agency, the military goals will be achieved at the expense of the nonmilitary ones; and if the space program is put under a civilian agency, the nonmilitary goals will be achieved at the expense of the military ones.

I think they are both good goals and we ought to have both groups.

Mr. JACKSON. In nonmathematical and nonscientific problems there are often a number of solutions and men, if they want to, can make several solutions work, any one of several work, and I think that can be done in this case.

Sure, there will be a little overlapping, but if men are alert to try not to have it, it can be held down.

There isn't really a distinction between the missile business, say, and space business. They both are contiguous until a rocket-propelled missile, say, is well out into space with things for science and whatnot with it. Up to that point they all use much the same boosters and the same missiles and so on.

Mr. KING. Would I be correct in assuming that all four of you gentlemen would be of the opinion that a very strict, tight cooperation and collaboration and coordination between the space and the military aspects of our space program would be essential?

Mr. JACKSON. Yes.

Dr. STEVER. Yes.

Mr. KING. If we have the two commands, certainly they must work together as a team on all levels. I think I would agree.

Dr. STEVER. Yes, sir.

Dr. SEIFERT. Yes.

Mr. KING. That is all.

The CHAIRMAN. Mr. Morris.

Mr. MORRIS. I just have one question.

Mr. Seifert, on page 7 of your testimony you list the board suggestions for increased studies in various fields and among them you list metallurgy.

Would you give us a little bit more detail on what you mean there, specifically? Do you mean high temperature research on metals?

Dr. SEIFERT. I mean those aspects of metallurgy which relate to astronautics. That could be high temperature metallurgy or it could be the properties of metal in space which in the absence of atmosphere may be different from those at the surface of the Earth.

I was primarily thinking in this list of those experiments that are done in conjunction with satellite-engineering laboratories; I wasn't trying to be too broad in this list.

Mr. MORRIS. There would be very high temperatures.

Dr. SEIFERT. That is one phase. That wouldn't necessarily be studied in space. It might, as in the case of a nozzle of a rocket engine which is operating at a high temperature.

Mr. MORRIS. Thank you.

The CHAIRMAN. Thank you.

I want to thank all of you gentlemen for appearing here before the committee. We appreciate your fine statements. They will be printed in the record in full, together with the questions and answers that have been propounded to you.

If at any time you feel the committee should be aware of any views that you may have, strong views on this subject, we will be glad to hear from you.

Should vital questions come up in the future, we would like to feel able to call upon you for your valuable assistance. We want to thank you very much.

Now, at this time I have two or three matters that I would like to take up with the committee. I think it probably can be best taken up in executive session. So if there is no objection, we will go into executive session.

(Whereupon, at 11:43 a.m., the committee proceeded in executive session, on matters of internal administration. The committee adjourned at 12 o'clock noon to reconvene at 10 a.m., Wednesday, February 25, 1960.)