PRELIMINARY HISTORY

OF

NASA

1963 - 1968

FOR THE

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1969

FINAL EDITION

PREFACE

Administrative Histories Project

PRELIMINARY HISTORY

OF THE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

DURING THE ADMINISTRATION

OF

PRESIDENT LYNDON B. JOHNSON

November 1963 - January 1969

FINAL EDITION

National Aeronautics and Space Administration
January 15, 1969

PREFACE

This is an attempt to capture the content and meaning of contemporary NASA experience. The nation's space program is characterized by a unique set of interacting factors: a swift pace of creative innovation, difficult technological requirements, relatively high costs and hazards, large-scale institutional dimensions, fascinating new fields of science and technology, complex application opportunities, changing national and international political environments, and an imperative need to succeed in difficult pioneering ventures before the watching eyes of the world. Prepared as a contribution to the Administrative Histories Project of the White House, this "Preliminary History of the National Aeronautics and Space Administration" is intended to serve as a guide to future historians concerned with the Administration of President Lyndon B. Johnson. It reflects the advantages and the hazards imposed upon the preparation within a three-month period of a "contemporary history"; a history written while the history-makers are alive and much concerned. Future publications of the NASA Historical Program, which may benefit from this preliminary effort, also should be of interest to future scholars, who ultimately will write the definitive history of NASA in this era.

The central purpose of this work was to set forth the best possible documentation of the salient aspects of NASA's history during the past five years. The assistance of knowledgable participants and well-informed critics, and the availability of intact files, documentary resources, and a modest on-going NASA historical venture may compensate somewhat for the short time perspective involved. There are no dimmed memories nor paucity of available historical detail; as an independent Federal Agency, NASA itself is just ten years old. Differing viewpoints inevitably exist, however, as to the meaning and implications of recent events, decisions, and actions. These hopefully are evident in this account.

The manner in which this "preliminary history" was prepared may be of some interest to its readers, those in the present and those readers in future decades. It was intended

to emphasize source documentation and citations, while its tentative nature precluded thoughts of scholarly publication. Backnotes in each chapter, extensive appendices, and bibliographical notes were provided for direct guidance to scholars beyond the narrative text, the preparation of which enhanced the compilation of the reference materials. Further, NASA papers selectively microfilmed for the Johnson Library, independent of this project, provide a separate means of validating the scope and qualitative content of this history.

The drafting of each section or chapter was the responsibility of a selected, informed author. This avoided an anonymous bureaucratic product and encouraged greater depth and timeliness of preparation. The respective drafts were critically commented upon by Mr. James E. Webb and other top-level and middle-level NASA managers and specialists. These comments provided additional documentation and varied, in-depth interpretations for the text. Future scholars will, of course, view the recent life of the National Aeronautics and Space Administration with differing perspectives. If this manuscript offers valid clues on "how it was," or, at least, "how it seemed," it should contribute to a more fully documented recapturing of current viewpoints, and, as such, be adjudged a worthwhile effort.

As Acting Administrator, I served as overall monitor of NASA's contribution to the Departmental Histories Project. The NASA Historian since 1959, Dr. Eugene M. Emme, served as Project Director and General Editor of the draft. A top-level review panel, representing personal knowledge rather than managerial position, was created. It consisted of myself as chairman, Associate Deputy Administrator Willis Shapley, Assistant Administrator for Policy Alfred J. Eggers, Jr., Assistant Administrator for Public Affairs Julian Scheer, and the Project Director. Comments of well-informed technical readers for each chapter were provided to the chapter authors for their numerous revisions, and the entire manuscript was read for completeness and accuracy in-so-far as it was possible.

Mr. James E. Webb, who served as Administrator from February 14, 1961, to October 7, 1968, was asked to review carefully the total product and to write the Foreword. His Foreword thus communicates directly to future historians some of the features of recent NASA experience he personally considered to be of central importance in comprehending the role of NASA in the history of the Administration of President

Lyndon B. Johnson. His long experience in public administration and his singular responsibility as the chief executive of NASA make his commentary of unique value. So much of Washington contemporary history is made orally through personal contacts that the documentary record always must be incomplete. Mr. Webb's Foreword will help in completing the record of NASA during these years.

The seven chapters which follow cover the activities of NASA up to approximately early October, 1968. Events in that interim period since last October are recounted in a Supplement to these chapters.

ACKNOWLEDGMENTS

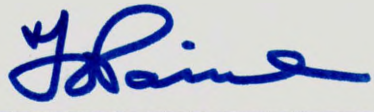
Principal initiative was carried by the authors who prepared drafts of the individual chapters, and their identities should be acknowledged. Chapter I, setting the historical stage from the beginning of NASA until the start of the Johnson Administration, was drafted by Mr. Jay Holmes, author of America on the Moon (1962), and a member of NASA's staff for the past seven years. Chapter II, recounting the intricate course of NASA's budget requests as determined by the Bureau of the Budget, the White House and subsequent Congressional actions, and as influenced by space achievements and public opinion, was written by Mr. Manning Williams, a studious and literate observer in NASA's Office of Public Affairs.

Chapters III, IV, and V represent a three-fold breakdown of the major areas of NASA's overall program, while the annotations enable the scholar to begin to dissect major projects. Mr. William Putnam, Assistant NASA Historian and formerly historian at the Air Force Space Systems Division, drafted the material used for the chapter on "Manned Space Flight." Mr. William Corliss, author of numerous volumes on space science, including Scientific Satellites (NASA SP-133), drafted material for the chapter on "Space Science and Applications," and Irwin Hersey, former editor of the American Rocket Society's Astronautics and former director of publications of the American Institute of Aeronautics and Astronautics, prepared a draft for Chapter V on "Research and Technology." Each writer conducted extensive interviews, tapped ongoing historical projects, and was familiar with basic source materials before he started.

Chapter VI on "Organization and Management" treats the overall structure and operations of NASA. It was prepared by Mr. Charles Bingman, formerly of the Manned Spacecraft Center at Houston, now special assistant to NASA's Associate Administrator for Organization and Management. The final chapter, concerned with the broad politico-socio-economic context of the impact of NASA, was authored by Mr. Volta Torrey of NASA's Scientific and Technical Information Program, long a studious observer of technico-social affairs and a former editor.

Mr. William Lockyer of the Kennedy Space Center, who served as editor of the Apollo Accident Board Report of 1967, capably organized and collected the lengthy appendices and other supporting data. In this effort he worked closely with the Project Director and the author of the draft of each chapter as well as the archivist of the Historical Staff, Mr. Lee Saegesser. As will be noted, Volume II with the appendices and other supporting data not only buttresses the text of the entire preliminary history, but also serves in its own right as a useful tool for the future historian.

Mr. Alan D. Ullberg of the General Counsel's office was particularly helpful in working with former Administrator Webb in his review and comment on each chapter. The authors, key specialist readers and reviewers, the NASA Historical Staff, typists, librarians, and many others who contributed, deserve major thanks for their efforts which produced this "Preliminary History of NASA." As an intellectual inventory of our recent experience, we in NASA consider that this work also has been helpful in essaying our present-day realities as we face our even more eventful tomorrows.



January 15, 1969

T. O. Paine
Acting Administrator

FOREWORD

FOREWORD

Those of us who have been closely involved with these first years of the United States space program, with its strong ties to the National Advisory Committee for Aeronautics' many years of successful government, industry and university cooperation in aeronautical research, welcome the opportunity presented by the Johnson Library history to recount, in as reflective an atmosphere as our short separation from recent events will permit, our impressions, recollections, and views on the activities and historical significance of NASA. The individuals who have prepared and reviewed this history are very clear that no one of us has a full knowledge of the major events and elements of NASA's first ten years. Future historians may well develop variations and disagree about interpretations of events. However, we have all done our best to set down and help document the NASA story.

Because my service as Administrator of NASA covered a period which encompassed all but the last few months of President Johnson's Administration, and practically the entire period of his service as Vice-President, my effort has been to round out and make this material as complete as possible in overall perspectives, and to indicate a number of areas and activities where the documentation on which this history is based appears not to have kept pace with NASA's rapid rate of development and seems incomplete. Some of my comments may help explain why certain things were done in cases where there was not sufficient documentation to form a basis for the authors of the various chapters to fully cover the event or action. In some cases where documentation is available and I was a participant, my views may differ from those of others, and particularly those who must form judgments on the basis of what the "cold record" shows. I recognize, however, that I cannot avoid all bias inherent in the fact that I was involved until quite recently as the individual with final responsibility for many of the actions taken.

First, I would like to focus on the major elements of NASA's management philosophy and organizational and management

practices. When I came to NASA, my background included participation in the management of a wide range of governmental and non-governmental endeavors, many of considerable magnitude. This experience had given me a background of knowledge of the structure, capabilities, and competitive features of American industry and in particular the aerospace industry, as well as the areas of government concerned with this industry. Many of the industry's senior executives were known to me and much the same can be said of the aerospace-related universities. Dr. Dryden and Dr. Seamans also had a strong foundation of understanding of practically every phase of the industry and university elements upon which we decided to rely. Dr. Dryden and I both had the benefit of varied service in government. Dr. Seamans had participated actively in the MIT aerospace and instrumentation research related to World War II and the urgent efforts that attended the ballistic missile effort of the 1950's. He had served for years on important NACA panels, knew most of the university and industry leaders in instrumentation and electronics, and had served as a research and development manager in industry. Most of the 1961 and many of the later period analysts and public media reporters on whom many hostorians lean did not understand this and simply did not recognize that many decisions and actions that moved NASA rapidly forward were based on the combined knowledge of Dr. Dryden, Dr. Seamens and myself, of what the industry could do and the conditions that were essential to stimulate its best performance.

All three of us also had a common approach to the essential role our management decisions would play in our success. We all felt a deep concern to make certain that all aspects of the leadership needs of NASA were considered and met at all levels in the organization.

In our efforts to maintain management initiative and drive, we deliberately employed fairly frequent organizational restructuring as an important element of our joint leadership. Thus, one of the fundamental principles of the management of NASA has been flexibility, both from the standpoint of the duties of individuals and of organizational structure. NASA had the task of achieving difficult, yet clear and unambiguous goals within an environment of very rapidly advancing technology. We did not hesitate to make the necessary organizational changes whenever they were needed to facilitate our work. As might be expected, this rather frequent use of organizational restructuring as an element of our leadership

placed severe demands on us and upon our executives. They had to retain flexibility within their current assignments and be willing to shift to new positions. We, in turn, had to personally evaluate a large amount of "feed-back."

In a short span of years, NASA's work load multiplied six times in volume and by a much larger factor in complexity. In such a fast-moving effort the need for carefully structured procedures and processes of feed-back to senior officials was a constant concern. The Apollo fire in January of 1967 gave us a severe input of needed feed-back, and showed deficiencies in our assumptions and systems. But we went to work, corrected these, and proved we had an organization that could and would make the necessary adjustments. We learned that inadequacies and lapses in the interface areas between various components of the organization could nullify even our best efforts at insuring conformance or proper approval of exceptions, and we improved on feed-back.

Managing NASA was not merely the task of leadership in a government agency with something over 30,000 employees. The NASA program required the employment of the best talents available in the industrial and the university areas as well as in the governmental sector. At the height of the program, this task involved the effective utilization of over 400,000 individuals. Within this large undertaking, and in utilizing thousands of working groups throughout the country, many changes were made in previously accepted patterns of work. As an example, interdisciplinary studies in the space sciences were needed at a number of universities. In the evolving pattern, the academicians in various specialities had to adjust to increased opportunities for cooperation and collaboration with colleagues in different fields that previous efforts had not required.

Another significant management development related to the effective use of industry for research and development in advanced areas where there could be few possibilities for follow-on production in quantity to insure profits or a recovery of research and development losses. The Source Evaluation Board procedure used in NASA for choosing industrial contractors was a special management device. These boards stood at the apex of the procurement pyramid, whether the contractor selection was to be made at the field center level or at NASA Headquarters. Beginning with a publicly announced competition, industrial contractors would submit their proposals. These

proposals then were evaluated in depth by panels composed of technical and management officials of NASA and ranked in numerical terms. Each board was required to report fully on its findings to the selection officials, who in the case of procurements over five million dollars consisted of the three senior officials of the agency; these officials would, in turn, make the decision as to the contractor or contractors selected for negotiation.

Through this procedure, no one person nor small group could be subjected to improper pressure; and the senior NASA officials were constantly involved with several levels of NASA personnel in evaluating the performance and capabilities of contractors who were bidding on NASA work. At the same time the various levels were evaluating the basis on which their senior and junior NASA colleagues formed their judgments. These procedures required a complete analysis and clarification as to all of the questions involved in the research and development called for by new equipment and in the selection of the contractor who would be responsible for it. This procedure established a pervasive, open, give-and-take kind of management pattern which was important also for its self-policing features. It contributed much to insuring the integrity of NASA's engineering and procurement activities. These procedures were honed to a fine point of effectiveness over a number of years.

Another area that deserves attention is the design and construction of NASA's facility base, which now includes 19 geographic locations valued at over four billion dollars. One of the points about NASA's first ten years which is frequently overlooked is that in this capital plant our country now has a national resource that can efficiently carry out aeronautical and space research and development for years to come.

In the construction of facilities, NASA relied upon the Corps of Engineers of the U. S. Army. By using the Corps, we were able to draw upon an established and fully developed management structure and capability. In addition, NASA minimized the kind of capital investment problems that frequently arise from political or other pressures; it also avoided the need to build a substantial in-house construction management capability.

One of the difficult matters which faced NASA during my term as Administrator was the demand, in the context of

the Congressional investigations of the Apollo 204 fire, for the public release of what became known as the "Phillips Report." This was a collection of contractor evaluations generated by a group under Major General Samuel C. Phillips, Apollo Program Director, about a year previous to the fire. NASA's response to the requests of individual legislators to produce these evaluations for release to the public was based upon a strong need not to destroy the system which had been carefully worked out over the years whereby contractors and their key personnel cooperated to the fullest extent in assessing inadequacies in performance of both in-house and out-of-house organizations and equipment. This system was designed to assist in overcoming the inadequacies rather than to fix blame. In the case mentioned, the substance of NASA's records was made known to all committee chairmen who were interested, but the fact that the documents were not produced in public session was assessed by much of the press as a lack of candor. It is a matter of record, however, that the basis and findings of the documents in question were fully explained in public session to both the committees conducting the Congressional investigation of the Apollo 204 fire, and the documents and principal authors were questioned fully in an Executive Session of the Senate Committee on Aeronautical and Space Sciences on June 12, 1967.

On numerous occasions, the decision of 1961 to expand and accelerate the space program and build up the nation's space capability to the point that we could land a man on the moon and return him safely to earth has been referred to as constituting a national commitment. But in the context of the budgetary relationships inherent in NASA's position as a member of the Executive Branch of this government, it would have been more appropriate to state this objective as a national goal. The annual congressional authorizations and appropriations have been in accordance with that concept and there was never at any time a commitment to continue to fund this program. Each year it was necessary for NASA to present a full exposition of its program requirements in support of a request by the President to the Congress. NASA's support for the necessary funds to carry the program forward was based on program needs and not to carry out a commitment. NASA never had any "blank check" for the Apollo program.

Dr. Dryden, Dr. Seamans, and I always were conscious that events might require us to stretch out or terminate the Apollo program. One of the great merits of the Gemini program

was that, while it gave us tremendous value for Apollo, it also gave us a stopping or resting point if for any reason Apollo could not be finished as planned.

A vigorous effort has been underway in NASA during the five years of the Johnson Administration to reach the major goals set in the early part of this decade. Budgetary constraints over the last several years have precluded new starts toward future program goals or a much needed continuity in important production lines. However, we have been able to maintain critical elements of capability to move forward again as soon as pressing non-space needs are less acute. We have attempted during this time to maintain a balanced program, a program not organized solely around the attainment of immediate goals such as the building of the capability to land on the moon and return. NASA has endeavored to maintain the essentials of basic research, to hold onto the beginnings of a planetary program, and to preserve the essential base of personnel to manage the present programs and to organize future efforts in space.

I am confident that the capability which this nation already has demonstrated in space will continue to be needed and will have to be expanded in future years. It has become increasingly clear that accomplishments in space and the capability which can sustain and increase these accomplishments constitute a new barometer of national power and of the stature of a nation. If the United States is to retain its position of world leadership, we must recognize the significance of this barometer. It will be read in the years ahead by all peoples of the world as an indication of the ability of the United States to respond to the multiple challenges which lie before us.

Over the years of its existence NASA has been heavily involved both in utilizing and in advancing most of the major technical, scientific and management disciplines which are critical to the functioning and survival of our nation. The agency is involved in nearly all of the major areas of physical and social science. It has an extensive program to develop nuclear electronic generators for use in space as well as a rocket engine powered by nuclear energy. Our spacecraft are constructed in great part of new synthetic materials and the products of advanced metallurgy. NASA's rocket engines apply the most advanced techniques in propulsion, and we also are working with new jet aircraft engines. The need of NASA

to track and communicate with its spacecraft which travel out to increasing distances in the solar system requires the refinement and extensive use of modern microwave technology. To build and fly the spacecraft, NASA has been forced to advance computer technology. Perhaps even more significantly for the future, we have been heavily involved in the application of large-scale management techniques to control this fast-growing and complicated space program in a manner such that the jobs we are charged with are accomplished. In the behavioral science area, NASA is faced with problems of the study of man's behavior in large and small groups, particularly while confined over periods of time in constraining circumstances such as the inside of a spacecraft or an orbiting space station.

Because of NASA's involvement in all of these critical disciplines, the space program has become a central, organizing and advancing force in the maintenance of the technological health and overall stability and prosperity of this nation, and I am proud it has been able to contribute in this way to the sustenance and advancement of the health of this nation.

During these first years of the space program it has been necessary to emphasize to the nation that we must continue the development of large rocket boosters if we are to be able to push increasingly heavy payloads into orbit and out to the moon and beyond. The Soviet Union confronted us initially with a burst of technological energy in the space field and has continued to demonstrate an advancing capability in space. I feel this nation must meet that challenge if we are to be present at the bargaining table when the big decisions will be made as to the future of the world. But for the long run it is my hope that the space program will not need to be stimulated by the accomplishments of any one nation or nations, or with the implicit threats such accomplishments pose to the security of this country. I hope that we can be motivated in the future by the realization that space exploration increases our total scientific and technological capability and at the same time contributes to a more stable world order. Space offers a continuous opportunity for this country to exert its best efforts; an exciting activity to bring our citizens together in a program in which all can be interested and involved. Space exploration can become in this way a national goal which stimulates creativity and hard work without increasing hostility toward other nations. Space furnishes, then, the kind of challenge of which man appears to be sorely in need; a challenge offering unlimited scope for

man's exploration in thought and the exercise of the competitive drive in all of us while not adding to the risks of military confrontation.

It is my belief, therefore, that the landing of men on the moon and their safe return to earth, which we expect to accomplish in the near future, will be only the beginning. Space exploration by this country could go on to encompass large cooperative ventures with many other nations and has the potential of building an international climate of increased cooperation in other areas. I can think of no better way for mankind to join hands than in facing together the challenge of the solar system and the universe.

January 15, 1969

James E. Webb

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S U P P L E M E N T*

(Covering October 7, 1968 - January 20, 1969)

*Notebooks 8, 9, and 10.

CHAPTER I

Chapter I

C H A L L E N G E A N D R E S P O N S E*

1947-1963

The National Aeronautics and Space Administration (NASA) was barely five years old as an independent Federal agency when the Administration of Lyndon B. Johnson began. Although the full history of NASA's first five years has yet to be written, this "Preliminary History" focuses on the second five years and the process of arriving at and implementing major decisions.[1]

Like all major research and development programs, the United States space program is characterized by long-evolving, inter-related activities. Any account of the events and major decisions of a specific time period must therefore trace the beginnings several years or even a decade earlier.[2]

With respect to the space program under the Johnson Administration there is added reason for examining earlier events. As Majority Leader of the U. S. Senate, Mr. Johnson was one of the principal architects of the National Aeronautics and Space Act of 1958, which set forth the Nation's goals in space and which created NASA. And, as Vice President and Chairman of the National Aeronautics and Space Council during the Administration of John F. Kennedy, Mr. Johnson carried major responsibilities in the setting of national policies and their implementation from 1961 through 1963. This chapter examines the events and decisions of earlier years setting the stage for those that occurred during the Johnson Administration.

The events and decisions may be traced to 1947, when Soviet Premier Josef Stalin is reported to have decided to contest United States air atomic superiority by developing rockets with the power to launch intercontinental missiles.

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*This chapter was prepared by Jay Holmes, and succeeding drafts were read by history-makers and historians for accuracy and interpretative suggestions. The same process was followed on subsequent chapters.

This country was slow to react and when it did its response focused upon the immediate threat of Soviet ICBM's to national security. It was not until after the Sputnik challenge of 1957, as this chapter describes, that the United States determined to make space activities a full-fledged national effort.

DECISIONS AND IMPLEMENTATION

Five basic decisions largely defined the scope and emphasis of United States space activity up to November 1963. They were:

July 29, 1955 -- to launch an earth satellite during the 1957-58 International Geophysical Year, announced at the White House by high officials of President Eisenhower's Administration.

July 29, 1958 -- President Eisenhower's signing of the National Aeronautics and Space Act, the culmination of a process of national decision and including the creation of NASA.

May 25, 1961 -- President Kennedy's proposal to expand and accelerate the space program to include, before the end of the decade, the landing of a man on the moon and his safe return; approved by the Congress on July 20, 1961.

November and December, 1962 -- the Kennedy Administration decision to maintain a balanced space program, with the principal manned space flight effort under civilian management, and to proceed into the next phase of the manned lunar landing program.

Fall 1963 -- the Kennedy Administration decision to proceed into the final phase of implementing the manned lunar landing program. This decision occurred during a great national debate on the space program, which extended into 1964. The implementation of this last decision covers the entire period of the Johnson Administration and is a principal theme in the succeeding chapters.

Many factors must be considered, of course, in arriving at major national decisions. The circumstances and the political climate differed at each of these times. Nevertheless, all of these decisions involved the consideration of six major factors. They were:

--The visible challenge of Soviet achievements.

--National pride and other sentiments of the public and its representatives in the Congress.

--The real and apparent relationship to national security.

--The views on space activities held by leading scientists.

--The availability of technology, in-being and feasible, to implement the decision being considered.

--The institutional and technical capacity of those elements of the governmental, industrial and university sectors that would be involved, and the anticipated effect on them because of their involvement.

The interplay among these factors and the differences in the historical circumstances largely account for the differences in emphasis in the implementation of the five decisions.

THE IGY SATELLITE DECISION

A Soviet advantage in ballistic missile development by 1954 had resulted from a decision to assign top priority to large rocket development several years sooner than the United States. According to G. A. Tokaty, a former colonel in the Soviet Air Force, Premier Stalin made the basic decision to build "transatlantic rockets" in March, 1947.[3] This was seven years before U.S. rocket development efforts were raised to top priority in 1954, and before thermonuclear missile warheads were proved to be feasible.[4] The resulting Soviet-U.S. missile race also led to rapid technological development that was to be a principal stimulus for consideration of the future potential of space flight.[5]

A major stimulus for the U. S. decision in 1955 to launch an earth satellite emerged from a belief among some leading U. S. scientists that there was a need of more public funding support for science. Among those who held this view was Dr. Lloyd V. Berkner (1905-1967), a geophysicist and scientific administrator who had originated, in 1950, the idea of the International Geophysical Year (IGY), an 18-month period of world scientific activity to begin in July 1957.

Through activities in national and international scientific organizations, Berkner and his colleagues had the opportunity to exercise considerable persuasion. In September 1954, the international committee for the IGY adopted a resolution urging that earth satellites be launched during the 18-month "year." The resolution was introduced by the U. S. delegation at a meeting in Rome.[6]

The idea was put forth at a time when public interest in science and space flight was growing. Evidence of this growth could be seen in an increase in attention given by the public media. One of many examples was a Walt Disney film, Man in Space, which drew a national television audience estimated at 42 million persons in the fall of 1954.[7]

Alan T. Waterman, director of the National Science Foundation, recommended to President Eisenhower in March 1955 that a U. S. IGY satellite project be established. This raised the question of interference with the ballistic missile efforts just then being accelerated. Facts were assembled by the military services and the Department of Defense and provided to the White House.

The Department of Defense report said that support of a scientific satellite and recognition of its peaceful purposes must not prejudice freedom of action to develop military satellites. But it added that such a project should not delay major defense programs: "The satellite itself and much information as it its orbit would be public information; the means of launching would be classified."[8]

Meanwhile the Soviets had let it be known that they were studying space flight problems. Belief grew that the Soviets could be expected to announce plans for an IGY satellite. At least one high official was concerned over the potential propaganda effect of such an announcement. Nelson A. Rockefeller, then a special assistant to President Eisenhower, attached a memorandum to the proposal in May, 1955, urging its approval and announcement sooner than the Soviets. The Rockefeller memorandum declared:[9]

> I am impressed by the costly consequences of allowing the Russian initiative to outrun ours through an achievement that will symbolize scientific and technological advancement to people everywhere. The stake of prestige that is involved makes this a race we cannot afford to lose.

The National Security Council recommended approval of the satellite program with the condition that it must not interfere with the urgent missile program.[10]

The U. S. plan was announced at the White House on July 29, 1955.[11] The announcement was a day ahead of that of the Soviets.[12]

In implementing the decision, there seems to have been little debate about the condition that the satellite program must not interrupt urgent work on missiles. This is hardly surprising in view of the intense concern that ballistic missiles might give the Soviets a global military advantage. But this condition helped insure that the U. S. satellite project could fail to fulfull the public expectations raised by the announcement. Apparently, there was little or no official anticipation of the possible U. S. public reaction should the Soviet Union be the first to orbit a satellite -- as was to be the case two years later.

Research and development teams of the Army, Navy and Air Force engaged in the development of military rockets and space planning were excluded from the IGY satellite project. Management responsibility was assigned to the Naval Research Laboratory. The IGY project, later named Vanguard, was assigned a lower priority than that of the ballistic missile programs.

From scientific and technical standpoints, the Vanguard program was a success. It achieved its assigned objective of orbiting a satellite during the International Geophysical Year.[13] But its latter-day reputation was ruined because it did not achieve an objective that was never assigned -- that of beating the Soviets to the launching of man's first artificial satellite of the earth. The reluctance to permit the use of military rockets in the U. S. IGY satellite program may well have been reasonable in 1955. This decision could have been reversed at some time between 1955 and 1957 without harm to the ballistic missile effort. A test rocket launched by the Army in September 1956 clearly demonstrated that it was capable of orbiting a satellite. But the Department of Defense was so intent on maintaining the policy adopted in 1955, that permission was withheld to launch the test rocket in 1956 until certification was received that its payload would not actually go into orbit. History may judge whether such rigidity was wise. But if Sputnik had not occurred in 1957, the course of the American space program probably would have been very different.[14]

THE NATIONAL AERONAUTICS AND SPACE ACT OF 1958

The news of the orbiting of Sputnik on October 4, 1957, led to national chagrin and alarm over U. S. security. The chagrin resulted from the public shock on discovering that another nation could lead this country in an achievement that seemed to symbolize leadership in science, technology and their applications. There were some aspects of similarity to the technological surprise at Pearl Harbor 16 years earlier.[15]

The immediate alarm over security resulted from the credence given by the satellite achievement to the announcement by the Soviets six weeks earlier that they had successfully flight-tested an intercontinental ballistic missile.[16]

The chagrin and alarm led directly to the decision -- embodied in the National Aeronautics and Space Act -- to undertake major activities in space. One of those sharing in the chagrin was the Majority Leader of the United States Senate, Lyndon B. Johnson, who was at his ranch in Texas when he received the news of Sputnik. During the evening of October 4, he telephoned a number of advisers and colleagues. The discussions resulted in plans for the Preparedness Investigating Subcommittee of the Senate Committee on Armed Services to undertake a special inquiry into satellite and missile programs.[17]

Ensuing public debate ranged over some of the most fundamental aspects of American life -- including education, industrial strength, military security and the national state of mind.[18] And as the debate continued, it spread around the world, sowing seeds of doubt about the future of U. S. leadership in non-Communist and uncommitted areas. Senator Styles Bridges, Republican of New Hampshire, declared: "The time has clearly come to be less concerned with the depth of the pile on the new broadloom rug or the height of the tail fin on the new car and to be more prepared to shed blood, sweat, and tears if this country and the free world are to survive."[19] Senator Alexander Wiley, Republican of Wisconsin, saw "nothing to worry us," but added it was "something to tell us to keep on our toes."[20] Senator Stuart Symington, Democrat of Missouri, said hearings before the Senate Armed Services Committee would help "the American people learn the truth."[21]

At his regular news conference on October 9, President Eisenhower said: "Our satellite program has never been conducted

as a race with other nations. Rather, it has been carefully scheduled as part of the scientific work of the International Geophysical Year." The President conceded that Sputnik had proved the Soviets had a "very powerful thrust in their rocketry." He added: "I see nothing at this stage of development that is significant . . . as far as security is concerned."[22]

"The key men in D. C. had not the imagination to understand what it would mean for the Soviet Union to launch its satellite first," commented Edward R. Murrow on a television newscast. "To find out, they had to be taken by surprise."[23]

"This is a grim business," wrote Walter Lippmann. "It is grim, in my mind, at least, not because I think the Soviets have such a lead in the race for armaments that we may be soon at their mercy. Not at all. It is a grim business because a society cannot stand still. If it loses the momentum of its own progress, it will deteriorate and decline, lacking purpose and losing confidence in itself."[24] "The launching of the satellite will have rendered a signal service to the cause of freedom only if we react as strongly and intelligently to its implications," said Vice President Richard M. Nixon. "Let us resolve once and for all that the absolute necessity of maintaining our superiority in military strength must always take priority over the understandable desire to reduce our taxes."[25]

Labor would make "every sacrifice necessary" for the success of an emergency program to outstrip the Soviet Union in missiles and satellites, said Walter Reuther of the United Auto Workers. "If it made the difference between success and failure in the struggle between freedom and tyranny, you would hear us say 'Just tell us how long and we'll go to work.'"[26]

"The mere fact that the Soviets can put a satellite into the sky . . . does not alter the world balance of power," said Lyndon B. Johnson. "But it does mean that they are in a position to alter the balance of power." "We have plant capacity that is superior in every respect," Johnson declared. "We can outproduce the Soviet Union in steel, electric power, alloys, aluminum, magnesium -- everything that could go into a satellite. There is no reason why we cannot catch up and outstrip anyone else -- providing we unite and decide to do it."[27]

A second Soviet Sputnik, this time carrying a dog named Laika, went into orbit on November 3. In quick succession, three actions were taken in the United States. The plans for the Preparedness Subcommittee inquiry were formalized on November 4.[28]

President Eisenhower announced on November 7 the appointment of Dr. James R. Killian, president of the Massachusetts Institute of Technology, as a full-time scientific adviser on the White House staff and chairman of a scientific advisory committee to the President.[29] And the next day, the Secretary of Defense, Neil H. McElroy, gave the Army and its German-born experts permission to launch a satellite with a military rocket.[30]

The United States was shocked further on December 6 by the failure -- displayed vividly on television -- of the Vanguard rocket as it exploded on the pad on its first attempted launching. The Sputniks and the Vanguard failure are said to have contributed to a decline in public support for the Eisenhower Administration.[31] As the Preparedness Subcommittee approached its hearings, some Democratic members wanted to seek partisan advantage openly. But Johnson restrained this tendency on the ground that nonpartisanship would prove to be the best politics in the end.[32]

The Vanguard shock appeared to have hardened the developing resolve of key individuals in government to take a major step to enable the United States to engage with the Soviets in the conquest of space.[33]

But the decision was complicated by a multiplicity of candidates among the military services and civilian agencies for responsibility for the space program. During this period views were aired by friends of all three military services, the Atomic Energy Commission and even the National Advisory Committee for Aeronautics. But while the public debate continued, Dr. Killian asked the Bureau of the Budget in December 1957 to undertake organizational and administrative planning for instituting the space program.[34] In common with many scientists throughout the nation, Dr. Killian and members of the President's Science Advisory Committee preferred a civilian-led program.[35] Scientists generally believed that a civilian space agency was more likely to be sympathetic to open science and university-based investigations. In addition, a number of those on the President's advisory committee worried privately about the economic and social power that might accrue to those is charge of space activities in the military services and industrial concerns, after the vast sums for space were added to the expenditures for weapon development. A separate space agency, they believed, would divide this power so that it might be more manageable.[36]

The planning began, therefore, with the assumption that a civilian agency would be charged with responsibility for research into the problems of flight and astronautics. A second objective, in line with general thinking in the Bureau of the Budget, was "to build upon existing institutions and to avoid increasing the total number of Federal agencies involved in aeronautics and space matters."[37]

One existing institution was the National Advisory Committee for Aeronautics (NACA), a Federal research agency with 8,000 employees in four laboratories in various parts of the country. The director, appointed by a national committee, was Dr. Hugh L. Dryden (1898-1965), a scientist with considerable understanding of the workings of the Federal government. The chairman of the national committee was James H. Doolittle (1896-), retired Air Force lieutenant general, who held a doctorate in aeronautics.

The NACA had developed close relationships with the military services during its 43-year history.[38] The normal pattern was that NACA would perform "in-house" government research, while the military services would contract with industry for the development and procurement of aircraft that applied the results. In the months after Sputnik, the possibility of NACA space activities was discussed and debated extensively within the agency staff and with members of the national committee. In January 1958, the agency cautionsly began to call public attention to its activities related to space and to urge extension into space of the pattern of military-NACA cooperation in aeronautics.[39]

At 10:48 p.m., on January 31, 1958, the first United States satellite, Explorer I, was launched into orbit from Cape Canaveral -- 84 days after permission was given. The Army used a Redstone that it had been keeping in readiness for the possibility that it might be used for such a purpose. The leader of the Army rocket team, Dr. Wernher von Braun (1912-), became a national hero.[40]

The Army's success validated the significance of having scientific and technical personnel "in house" in the civil service, rather than relying completely on industrial contractors. Within the next week it became evident that the thinking of Congressional leaders was moving in the direction of an independent space agency.[41]

William Finan, Assistant Director of the Bureau of the Budget for Organization and Management, headed a committee to draft legislation for the space program. Other members were Alan Dean of his staff; Kenneth McClure, assistant general counsel of the Department of Commerce; S. Paul Johnston of the Institute for Aeronautical Sciences, serving temporarily on Killian's staff; and Paul G. Dembling, legal adviser of the NACA.[42]

Among the items considered in the group's deliberations were the renaming of the agency to avoid mention of the national committee and the narrow implication of aeronautics, the retention of a policy board, the appointment of the agency head by the President with the advice and consent of the Senate, the authority to pay salaries competitive with private industry, the authorization to keep funds for expenditure beyond the year for which they were appropriated, the right to enter into contracts, leases and cooperative agreements with any agency, political subdivision, private person or persons, the authority to perform research and development, construct and maintain facilities, dispose of property and accept gifts, and specific authority for the President to transfer to the agency space activities being performed by other agencies. Dembling prepared the first draft of the bill, embodying these items, on February 25, 1958.

The draft became a committee working paper that was revised continually over the next five weeks. On March 4, the Bureau of the Budget sent the current version to Secretary of Defense McElroy as a courtesy.[43] On the following day, President Eisenhower approved the recommendations of his Advisory Committee on Government Organization, chaired by Nelson A. Rockefeller, that the "leadership of the civil space effort be lodged in a strengthened and redesignated National Advisory Committee for Aeronautics," and that appropriate legislation be enacted.[44]

Meanwhile, the President's Science Advisory Committee had been at work on a statement of the basic rationale of a space program. President Eisenhower approved the statement, entitled "Introduction to Outer Space," and released it on March 26. It said in part:[45]

> It is useful to distinguish among four factors which give importance, urgency and inevitability to the advancement of space technology . . . .
>
> The first of these factors is the compelling urge of man to explore and to discover, the thrust

of curiosity that leads men to try to go where no one has gone before. Most of the surface of the earth has now been explored, and men now turn to the exploration of outer space as their next objective.

Second, there is the defense objective for the development of space technology. We wish to be sure that space is not used to endanger our security. If space is to be used for military purposes, we must be prepared to defend ourselves.

Third, there is the factor of national prestige. To be strong and bold in space technology will enhance the prestige of the United States among the peoples of the world and create added confidence in our scientific, technological, industrial, and military strength.

Fourth, space technology affords new opportunities for scientific observation and experiment which will add to our knowledge and understanding of the earth, the solar system, and the universe.

The determination of what our space program should be must take into consideration all four of these objectives.

On the same day as the release of the Killian committee statement, the draft legislation was distributed officially to the Department of Defense and other agencies. Comments were requested by noon, Monday, March 31. President Eisenhower wanted to submit a bill to Congress prior to the forthcoming Easter recess.[46]

In a message to Congress on April 2, 1958, the President recommended the establishment of a civilian space agency: "A civilian setting for the administration of space function will emphasize the concern of our Nation that outer space be devoted to peaceful and scientific purposes."[47]

Also on April 2, the President directed the Department of Defense and the NACA to review ongoing space activities with the idea of transferring to the new agency those that were not peculiarly or primarily military. He noted in his memorandum that the legislative authority of the Department of Defense to carry out advanced space activities would expire in February 1959.[48]

While congressional committees were considering the legislation, scientific enthusiasm for the exploration of space was heightened by the unexpected results of an experiment on Explorer I. The instruments detected a zone of intense radiation, beginning at altitudes of about 500 miles above the Equator. The findings were confirmed by Explorer III, launched on March 26. James A. Van Allen and three colleagues announced them on May 1, 1958, at a joint session in Washington sponsored by the National Academy of Sciences and the American Physical Society.[49] Many scientists believed the discovery of the Van Allen radiation belt was the most significant of the International Geophysical Year.

The principal issue in the hearings, before special committees of both Houses, encompassed the relationship between military and civilian space activities and the mechanism for coordinating the two. The House committee favored the establishment of special liaison committees. The Senate committee preffered a policy board composed of Cabinet members and agency heads, chaired by the President. On the basic structure of the space agency, the House committee at first favored a multi-member commission, but swung over to a single Administrator, favored from the beginning by the Senate committee.[50]

Differing versions of the bill were passed by the House on June 2 and by the Senate on June 16, 1958. In late June or early July, Johnson called on Eisenhower. At this time, the President agreed to the establishment of a policy board, which eventually was named the National Aeronautics and Space Council.[51]

Within the Senate, Johnson found it necessary to exercise a great deal of persuasion to convince his colleagues of the wisdom of establishing a civilian space agency. Only after extensive negotiation was it possible to work out language that would assure several key Senators that the military would not be deprived of the powers needed to carry out appropriate military space research and development activities.[52]

A Senate-House conference committee agreed on July 15 on the final version of the bill, called the National Aeronautics and Space Act of 1958. Both houses passed the conference version and Eisenhower approved it on July 29, 1958.[53]

The final version provided that aeronautical and space activities would be directed by a civilian agency, "except that activities peculiar to or primarily associated with the development of weapon systems, military operations or the defense of

the United States (including the research and development necessary to make effective provision for the defense of the United States) shall be the responsibility of, and shall be directed by the Department of Defense." Authority to resolve any dispute over which agency should direct a specific project was assigned to the President.

The National Aeronautics and Space Act declared eight national objectives, as follows:

(1) The expansion of human knowledge of phenomena in the atmosphere and space;

(2) The improvement of the usefulness, performance, speed, safety, and efficiency of aeronautical and space vehicles;

(3) The development and operation of vehicles capable of carrying instruments, equipment, supplies, and living organisms through space;

(4) The establishment of long-range studies of the potential benefits to be gained from, the opportunities for, and the problems involved in the utilization of aeronautical and space activities for peaceful and scientific purposes;

(5) The preservation of the role of the United States as a leader in aeronautical and space science and technology and in the application thereof to the conduct of peaceful activities within and outside the atmosphere;

(6) The making available to agencies directly concerned with national defense of discoveries that have military value or significance, and the furnishing by such agencies, to the civilian agency established to direct and control nonmilitary aeronautical and space activities, of information as to discoveries which have value or significance to that agency;

(7) Cooperation by the United States with other nations and groups of nations in work done pursuant to this Act and in the peaceful application of the results thereof; and

(8) The most effective utilization of the scientific and engineering resources of the United States, with close cooperation among all interested agencies of the United States in order to avoid unnecessary duplication of effort, facilities and equipment.

The new agency was named the National Aeronautics and Space Administration (NASA), to be headed by an Administrator and a Deputy Administrator, both appointed from civilian life by the President with the advice and consent of the Senate.

The Space Council was composed of the President, the Secretaries of State and Defense, the NASA Administrator, the Chairman of the Atomic Energy Commission, one other government official, and three persons appointed by the President from private life with the advice and consent of the Senate.

The act provided that the United States would retain the title to all inventions made by persons employed on research and development contracts for NASA. However, the Administrator of NASA was authorized to waive rights of the United States on determination that such a waiver would serve the national interest.

Also provided in the National Aeronautics and Space Act was authority for NASA to appoint 260 individuals exempt from civil service classification.[54]

In his report on the activities of the second session of the 85th Congress, the Senate Majority Leader stated: "In the long view of history, possibly the most important step that we took . . . was to establish an agency to guide America's effort in the exploration of outer space."[55] Six years later, Mrs. Lyndon B. Johnson was to say in a television interview that the Space Act ranked second among her husband's accomplishments of which she was most proud.[56]

The National Aeronautics and Space Act required very little change during its first decade. There were few who did not regard it as a sound basis for proceeding with the job at hand.

To implement this national decision, it was necessary to establish a new agency of the government, begin its operations and plan its future development. For a government agency heavily engaged in activities in the public sector of the United States economy, a comprehensive set of external relationships is involved. For the National Aeronautics and Space Administration, these relationships included those with industrial contractors, universities and the scientific community, other government departments and agencies, Congress and the public.

Establishing

Building around the National Advisory Committee for Aeronautics organization, diverse governmental elements were brought together to form the nucleus of the new agency, which in turn became the organizational and physical base from which the new relationships were to grow. Few, if any, other government agencies were created by the transfer of as many units and programs of other departments and agencies. To the aeronautical and space-related traditions and skills of the NACA were to be added and established the necessary space capabilities.

The initial tasks were further complicated by the urgency of the need for immediate results. It was necessary to begin short-term programs, as well as to work toward the practical applications of space flight and longer-term technological developments. And from the very beginning there was an insistent demand by the public and its representatives in Congress that NASA develop a long-range plan.

President Eisenhower nominated Thomas Keith Glennan (1905-), to be the first Administrator of NASA. Glennan, president of Case Institute of Technology for the past 11 years, had served from 1950 to 1952 as a member of the Atomic Energy Commission. Dryden was selected as Deputy Administrator. The nominations were promptly confirmed by the Senate. The two assumed office on August 19. On September 25, Glennan declared that NASA would begin functioning on October 1, 1958.[57]

When the work of organizing the new agency began on its first day, NASA had 7,866 employees in its Washington headquarters and at four field centers.[58] The President on October 1 transferred

to the new agency responsibility for the Vanguard project. Over the next three months, about 200 employees moved from the Naval Research Laboratory to NASA. Also transferred at this time were several space projects begun earlier in the year by the new Advanced Research Projects Agency, which were being implemented by the Air Force.[59]

On October 14, Glennan requested the President to assign to NASA the Jet Propulsion Laboratory (JPL), operated by the California Institute of Technology under contract to the Army, and about half of the civil-service employees of the Development Operations Division of the Army Ballistic Missile Agency at Huntsville, Alabama. But the Army protested that the Huntsville group, headed by von Braun, was needed for essential missile programs. In the National Aeronautics and Space Council, a compromise was worked out under which JPL was assigned to NASA but the von Braun group would remain with the Army, responsive to NASA needs. On December 3, JPL and its 2,400 employees were transferred effective January 1, 1959.[60]

A year later, the Army missile work had progressed further, while it was encountering difficulty in obtaining funds for its space exploration work. This situation resulted from the Air Force victory of September 1959 in the interservice struggle for the principal role and mission in the management of long-range ballistic missiles and military space systems. The Army found it difficult to prove a military need for booster rockets of very high thrust.[61]

Some consideration was given to the possible transfer of the von Braun group to the Air Force. But the Air Force interest in acquiring such a major in-house capability was restrained by the expectation that the existence of such a group in its ranks would lead to tensions and controversy with the industrial contractors on which it relied for conduct of its missile and space programs. The Congressional support of the Air Force approach to program management had been a principal factor in the September decision.[62]

Following another review by the Space Council, President Eisenhower announced on October 21, 1959, that all 4,300 employees of the Development Operations Division at Huntsville would be transferred to NASA, unless Congress objected within 60 days after the beginning of the session in January, 1960. There was no objection and the transfer took full effect on July 1, 1960. This time, NASA was to be responsive to Army needs. A substantial

group of employees at Huntsville continued to work on missile programs for more than a year. On September 8, 1960, President Eisenhower dedicated the installation as the George C. Marshall Space Flight Center, in memory of the Army World War II Chief of Staff, who was later to serve as Secretary of Defense and Secretary of State under President Truman.[63]

Two NASA facilities were authorized by Congress in August 1958, a considerable enlargement of the facility at Wallops Island, Virginia, and a new installation at Beltsville, Maryland.

The Beltsville facility was named the Robert H. Goddard Space Flight Center in memory of the American rocket pioneer. Most of the Vanguard personnel transferred from the Naval Research Laboratory were assigned to the Goddard Center.

Thus at its beginning, the space agency brought together people with widely differing backgrounds from the staff of the civilian NACA, civilian units and individuals employed by the three military services and military personnel on detail.[64]

In addition, personnel were recruited vigorously from private industry and the universities. At the end of its third fiscal year, on June 30, 1961, the staff had grown to 17,471, including 88 military detailees. The scope of contracted activities was growing even faster. By 1961, four out of every five dollars appropriated to NASA supported contract operations.[65]

The initial NASA headquarters organization comprised two program offices in reflection of the fact that space activity was a special addition to the NACA role in research.* One program office was responsible for the non-project research and technology programs and the administration of the former NACA field centers. The other was responsible for space flight programs and three new installations. The space flight office was headed by Abe Silverstein, former assistant director of the Lewis Research Center. Following the decision to transfer the von Braun group to NASA, a third program office was established for launch vehicles and rocket engine development, headed by Maj. Gen. Don R. Ostrander, detailed to the space agency from the Air Force.[66]

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*See organization charts in Volume II, Appendix A-1.

The existence of this separate office for launch vehicle programs reflected a general belief that in this area was the principal handicap experienced by the United States in competition with the Soviet Union for achievement in space. Separate administration and budgeting of these programs was aimed at facilitating their progress independent of shorter-range program goals.

To facilitate relationships with the Department of Defense (DOD), the Aeronautics and Astronautics Coordinating board was established in 1960. It was headed by two co-chairmen, the Deputy Administrator of NASA and the Director of Defense Research and Engineering, and composed of an equal number of members in positions in the two agencies where they had the power to implement board decisions.[67]

Beginning the Space Program

One of the first programs begun by the new agency was aimed at manned space flight. The Air Force's Research and Development Command and Air Force contractors had long been studying the technical problems, but President Eisenhower assigned responsibility for the first manned satellite program to NASA shortly after he signed the Space Act.[68] On October 1, 1958, a coordinating committee composed of officials of NASA and the Advanced Research Projects Agency (ARPA) of the Department of Defense agreed on the objectives of a project: to achieve at the earliest possible date orbital flight and successful recovery of a manned satellite, and to investigate the capabilities of man in this environment. Administrator Glennan approved the plan on October 7.

Robert R. Gilruth, Assistant Director of the Langley Research Center, and 34 other employees formed the nucleus of a separate organization at Langley established on November 5 as the Space Task Group. On December 17, 1958, Glennan announced that the project would be named "Mercury."[69]

An early dilemma was resolved when President Eisenhower decided late in December 1958 that the pool of military test pilots in existence was a sufficient source to draw candidates for flight on the Mercury missions. Civilian astronauts were excluded. At a news conference on April 9, 1959, Glennan introduced the first seven astronauts selected, who were to become national heroes.[70]

An arrangement affecting the astronauts was to lead to controversy that continued for several years. In August 1959, the seven entered into a contract under which Life magazine obtained their personal stories for a sum of $500,000.[71]

As the full scope of the Mercury effort became apparent, the estimate of program costs increased. On February 19, 1959, Glennan told the House Space Committee that the costs for the first two fiscal years would total $128 million, "and before we have completed the first U. S. effort to put man in space, the bill will have exceeded $200 million." By October, 1959, the estimated costs for the first two years had increased to $152 million.[72] The estimate of the total program cost was $350 million at the end of 1959.[73] The final total was $400 million in costs to NASA and $33 million in costs incurred by the Department of Defense in addition to those reimbursed by NASA.[74]

Another early program decision was partly in response to Soviet moon-probe flight successes. Luna I (also called Mechta, Russian for Dream) was the first spacecraft launched into interplanetary space, in January 1959. Luna II made the first lunar impact in September 1959. Luna III in October 1959, was the first to swing around the moon and photograph its far side. Luna II and III coincided with Premier Khruschev's visit to the United States for a summit meeting with President Eisenhower at Camp David, Maryland.

Both within and without the United States government, the Soviet space achievements were recognized as having captured the imagination of the world. The resulting prestige supported Soviet foreign policy in many ways, some obvious and others less evident.

As the U. S. space program got under way, work was begun on probes into deep space that would show this country had similar capabilities. Initially, the plans focused on the exploration of interplanetary space, particularly the region between the earth and the two nearest planets, venus and Mars. An early policy paper of the National Security Council reflected this thinking.

But in July 1959, Administrator Glennan and his senior associates pointed out at a meeting with other Administration officials that the moon was available on a monthly basis. The two planets, on the other hand, could be reached only at intervals of about two years. They proposed to concentrate on lunar

activities to achieve the short-range objectives of the National Security Council policy paper. The NASA proposal was approved.[75]

Accordingly, nine space vehicles were assigned to lunar missions from October 1958 to December 1960, and only one to interplanetary space. Ironically, however, the single interplanetary mission was a great success, while none of the others reached the moon.[76]

The interplanetary spacecraft was Pioneer V, launched on March 11, 1960, into a path around the sun that ranged between the orbits of the earth and Venus. For the next 107 days, it was tracked and telemetered out to distance of 22,462,000 miles from the earth, setting a long-distance communication record that stood for more than two and a half years.[77]

Beginning in 1958, the Jet Propulsion Laboratory had oriented itself toward lunar and planetary exploration. NASA therefore assigned this area of responsibility to JPL, which in 1960 began work on two new lunar programs, Ranger and Surveyor, and Mariner, for exploring the neighboring planets.[78]

In similar manner, the Naval Research Laboratory group that had worked on the Vanguard program oriented itself toward near-earth unmanned exploration, a responsibility assigned to the Goddard Space Flight Center.[79]

The practical applications of space flight drew major attention. The three areas that appeared most promising were meteorology, communications and navigation. The first two were the responsibility of NASA, which assigned them to the Goddard center, while the Navy assumed responsibility for navigation satellites.

In meteorology, the TIROS (Television and Infra Red Observation Satellite) program was assigned to NASA, which carried it forward in cooperation with the Weather Bureau and the military services. **TIROS I**, launched successfully April 1, 1960, demonstrated the feasibility of transmitting cloud cover pictures from space to the meteorologist on earth.[80]

Within two years of its establishment, NASA encountered a major policy question arising from the possibility of commercial applications of space technology. The question was how to make best use of the potential of satellites for world communications. Demonstrations of the potential were carried out by the

military services and NASA. They occurred at a time when the demand for world communications was growing faster than industry could increase the supply. The number of overseas telephone calls involving the United States was increasing at a rate of about 15 percent a year, equivalent to a doubling every five years. There were comparable demands for transmission of data, written messages, still pictures and -- potentially -- for television.

In the fall of 1960, the American Telephone and Telegraph Company asked Administrator Glennan whether NASA could make rockets and launch services available at cost, so that it might conduct research aimed toward establishment of commercial space communications services. Glennan decided affirmatively and announced the new policy on October 12, 1960. He took the position that the government should also conduct research in this area. President Eisenhower on January 1, 1961, endorsed this point of view. He directed NASA to take the lead within the Executive Branch to advance this research and to apply its resources toward practical commercial applications as early as possible. Accordingly, NASA in early January 1961 requested industry proposals on a communications satellite program, later named Relay.[81]

During the first year of NASA's existence, industry voiced objections to the patent provisions of the National Aeronautics and Space Act. As a result of these objections and their contemplated effect on the ability to obtain competent contractors, NASA recommended to Congress that the Act be amended so as to leave the question of title to inventions to the discretion of the Administrator. The House adopted such a measure on June 8, 1960, but no action was taken by the Senate. Thus, the patent provisions in the Space Act remained unchanged.

In addition to short-term programs of space exploration and work toward practical applications, NASA began longer-range technological developments. One of the recommendations emphasized during the hearings of the Senate Preparedness Subcommittee beginning in November 1957 had been the development of a rocket generating a million pounds of thrust, five times that of the most powerful rockets required for the ballistic missile programs. The idea was to begin the lengthly efforts involved in bringing U. S. rocket power up to a level that would be competitive with the Soviets. Accordingly, the Advanced Research Projects Agency (ARPA), in 1958 authorized the beginning of two such programs.

One called for testing the concept of a cluster of eight liquid-fueled engines of the size then in existence, to develop total thrust of 1.5 million pounds. The other program called for a new single liquid-fueled engine of the same thrust.

The cluster project, later named Saturn, was originated by the Army rocket team at Huntsville, Alabama. ARPA authorized the Army to proceed on August 15, 1958.[82]

The single-engine concept had been under study by an Air Force contractor for several years. Funds were provided in early 1958 for an intensification of the studies, but the project was transferred to NASA when it came into existence in October. On December 17, 1958, in its first major procurement action, NASA selected a development contractor for the engine, called F-1.[83]

Another program begun in the same period to increase launch vehicle power was Centaur. On August 28, 1958, ARPA authorized the Air Force to begin work on an upper stage for the Atlas ICBM, which would take advantage of the higher efficiency of liquid hydrogen as a fuel. Previously, the liquid fuel most commonly used was kerosene. Contractors were selected in the fall of 1958. In July 1959, the program was transferred to NASA, which later assigned management to the Marshall Space Flight Center.[84]

Technical direction of the Saturn program was assigned to NASA in November 1959, in line with the decision under which the von Braun team was to be transferred. To gain the maximum benefit from the Saturn booster, a NASA-DOD committee headed by Abe Silverstein, NASA director of space flight development, recommended in December 1959 that its upper stages be fueled by hydrogen. Supplemental funds appropriated in early 1960 permitted selection of a contractor in May to begin development of a liquid hydrogen engine of 200,000 pounds thrust, called the J-2.[85]

The development of other advanced technology was emphasized. Areas receiving particular attention were the nuclear rocket and various means of generating electrical power in spacecraft.[86] And, at the same time, NASA continued the aeronautical effort inherited from NACA.

Planning for a Decade

A 10-year plan was developed in 1959 to bring together in an overall program the diverse activities that had been begun. It was presented to the Congress early in 1960. The object of

the plan was to order matters so that space flight missions might take advantage of more powerful rockets and advanced technology as they became available. But the plan encountered criticism from two directions. The Administration considered it too ambitious, while the Congressional leaders attacked it as too timid, particularly as Soviet achievements in space continued.

The first version of the plan assumed that the Saturn would be used as the launch vehicle for the manned space flight program to follow Mercury, and that manned circumlunar flight would take place in the 1966-68 period, with a permanent space station to follow in 1968-69. The manned lunar landing was considered to lie beyond 1970. The plan assumed that the NASA budget would rise to a maximum of about $1.6 billion in 1967.[87]

The House Space Committee greeted the plan with disdain. On July 3, 1960, a committee report stated in part:

> NASA's 10-year program in space is a good program, as far as it goes, but it does not go far enough. . . . In perfect candor, however, it may be said that this view is not unanimously shared by every member of the committee. . . .
>
> Recommendations . . . .
>
> (c) A high priority program should be undertaken to place a manned expedition on the moon in this decade. A firm plan with this goal in view should be drawn up and submitted to the Congress by NASA. Such a plan, however, should be completely integrated with other goals, to minimize total costs. . . . Particular attention should be paid immediately to long leadtime phases of such a program.[88]

Minor modifications were made in the plan in 1960, mainly to accommodate increases in estimated costs. In July, NASA announced the beginning of studies of a second-generation manned spacecraft, called Apollo. It was conceived at the time as a three-man-spacecraft that would be employed for earth-orbital and circumlunar flight.[89] In October 1960, the chief of NASA's manned space flight program, George M. Low, formed a small working group to make preliminary investigations of a program for manned lunar landing.[90]

President Eisenhower received in December a report on long-range plans for manned space flight from his Science Advisory

Committee. A panel headed by Dr. Donald Hornig of Brown University estimated costs as follows:[91]

Mercury	$ 350 million
Apollo earth-orbital and circumlunar	$ 8 billion
Manned lunar landing	$ 26 to 38 billion

On hearing these figures, the President asked why a lunar landing program should be undertaken. In the ensuing discussion, the journey was likened to Columbus' discovery of America. At this, according to one of the staff people present, the Chief Executive snorted: "I'm not about to hock my jewels."[92] In the budget message for fiscal year 1962, sent to Congress in January 1961, President Eisenhower stated: "Further testing and experimentation will be necessary to determine whether there are any valid scientific reasons for extending manned space flight beyond the Mercury program."[93] A decision on sending an American to the moon became the task of the next Administration.

During the first two and a half years after the National Aeronautics and Space Act, NASA made considerable progress in its early growth into an institution capable of dealing with the broad range of environmental factors inherent in operating with an annual budget in excess of a billion dollars. The necessary external relationships had begun to develop. Both Houses of Congress had established standing committees to deal with the space program. Activities moved forward on an urgent basis despite the skepticism of an Administration that lacked enthusiasm for a major space program. The resulting constraints had both positive and negative aspects. They enforced a degree of order in the early development of the agency. But they slowed matters unnecessarily, particularly in 1960. During this period, there was a continued controversy over the urgency and the scope of the space effort.[94] But the National Aeronautics and Space Act had set in motion a group of activities that assumed a momentum of their own.

EXPANSION AND ACCELERATION

With the advent of a new Administration, a third major decision on the United States Space program enabled it to grow to become a substantial force in national and international affairs. Building on and substantially adding to the institutional strength produced in the 34 months following the National Aeronautics and Space Act, President Kennedy proposed and the Congress endorsed a major expansion and acceleration. The focus of the new program was an effort to land a man on the moon and return him safely to earth

before the end of the decade, which entailed a major advance in the capability to build, test and fly large boosters and spacecraft on a frequent and continuing basis, and which would provide a number of options that could be exercised as needed. But the program also included a wide range of activities in space science, technology and their application to practical benefits and services on earth. The growth resulting from this decision brought NASA to an operating level in excess of five billion dollars a year.

Vice President Lyndon B. Johnson spearheaded the process which developed the overall plan for the President within 125 days after the new Administration took office. It was Johnson's first major task as chairman of the revitalized National Aeronautics and Space Council. The plan was endorsed by the Congress with little public debate less than 60 days later.

All the elements that contributed to President Kennedy's consideration and this rapid decision are not known, but there seems to have been a convergence of two principal viewpoints: the international competitive aspects of the space program and a desire to regain for the United States the image of technological leadership associated with space achievements. The Vice President and a number of Congressional leaders saw in the space program a means of providing the rocket and related technology that might be needed for national security in the future.[95]

The decision was reached under the prodding of repeated Soviet challenges, through a critical assessment by the management of the young space agency, in association with other departments and agencies, and in the light of budget and economic problems and international developments.

Repeated Soviet space achievements of 1958 through 1960, in addition to the lunar flights mentioned earlier, included the first unmanned flights in their man-in-space program.[96] Public concern over these Soviet challenges affected the 1960 election campaign. On the defense and space programs, Vice President Richard M. Nixon defended the policies of the Eisenhower Administration, while Kennedy and Johnson condemned them as inadequate.[97]

Following the election, Kennedy asked his Vice President-Elect to serve as his senior adviser on space policy and as chairman of the Space Council. Johnson's first assignment was to recommend a new Administrator for NASA. Administrator Glennan resigned, effective January 20, 1961, the final day of the Eisenhower Administration.[98]

Dr. Jerome Wiesner of the Massachusetts Institute of Technology, later to be designated as President Kennedy's special assistant for science and technology, headed an ad hoc committee that reviewed space policy and reported to the President-elect on January 12, 1961. The review "disclosed a number of organizational and management deficiences as well as problems of staffing and direction which should receive prompt attention from the new Administration."[99]

Johnson interviewed 19 men in the search for a NASA Administrator.[100] Ten days after his inauguaration, President Kennedy, at Johnson's recommendation, nominated James E. Webb (1906 -) an attorney and business executive who had previously held high positions in government, and who had devoted much of his time to public service activities.[101]

Reluctant at first to assume the post, Webb agreed after President Kennedy made it clear that his principal objective was to fill the post with an individual who could help develop answers to questions of policy and who could deal effectively with management problems. Webb accepted the appointment and immediately requested that Dryden be asked to continue as Deputy Administrator. The President agreed. He directed Webb to make a comprehensive review of the NASA program.[102] Webb was confirmed by the Senate on February 9, and sworn in on the 14th.

An early question for the new NASA Administrator involved relationships between NASA and its industrial contractors. Industry was doing an increasing volume of the work in the space program and its role was essential to the program's success. In the immediate background was the warning of President Eisenhower in his final speech in the White House:

> In the councils of government, we must guard against the acquisition of unwarranted influence, whether sought or unsought, by the military-industrial complex . . . .
>
> The prospect of domination of the nation's scholars by Federal employment, project allocations, and the power of money is ever present -- and is gravely to be regarded.
>
> Yet in holding scientific research and discovery in respect, as we should, we must also be alert to the equal and opposite danger that public policy could

itself become the captive of a scientific-technological elite.[103]

A few days after Webb took office, he was called by Dan Kimball, an old friend who had served as Secretary of the Navy in the Truman Administration and was President of Aerojet-General Corporation, a leading defense and space contractor. Kimball asked whether the new Administrator intended to be bound by the recommendations of source selection boards, composed of technical experts, in choosing contractors for major programs.

The Administrator replied that all agency decisions would by made in a proper relationship to all factors. He said that the technical aspects would be considered by boards which would be responsible for the evaluation of proposals made by contractors, but that the selection would be made through the application of all factors that should be considered by responsible officials of the government.[104]

Webb established a procedure under which each source evaluation board was given wide latitude in choosing the methods it would use in rating the various technical and other areas of contractor proposals, and under which the three senior officials of the agency sat together to review all aspects of the board's work. Each board was required to report fully on the method chosen for breaking down the contractor proposals for evaluation, the results of the evaluation and the evaluation in each category of the breakdown.

Experts from all related areas of the headquarters staff were present and were encouraged to question the board members virgorously to test the reliability of the board's methods and the validity of its findings. Then the three senior officials made their own evaluations of the methods and the findings, selected one or more contractors for negotiation of a contract, and announced their decision.[105]

Another issue that arose at this time followed a series of apparently inspired reports in the press that the military role in the development of space systems would become predominant under a change in space policy contemplated by the new Administration. The possibility of such a change disturbed many in Congress and particularly members of committees concerned with the civilian space program. Chairman Overton Brooks of the House Space Committee wrote a letter to the President on March 9, 1961.

Brooks cited the provisions of the National Aeronautics and Space Act that called for an independent civilian agency. He noted that military control of the space program would complicate the development of weather, communications and navigations satellites for non-military use. And he remarked on the world-wide interest in manned space flight, for which there was as yet no military requirement. Brooks concluded:

> If NASA's role is in any way diminished in favor of a space research program conducted by a single military service, it seems unlikely to me that we shall ever overtake our Soviet competition -- a competition which, by the way, has been particularly effective because of its public emphasis on scientific and peaceful uses of space.[106]

President Kennedy replied on March 23, "There is no basic disagreement between us." He said also:

> It is not now, nor has it ever been, my intention to subordinate the activities in space of the National Aeronautics and Space Administration to those of the Department of Defense. I believe, as you do, that there are legitimate missions in space for which the military services should assume responsibility, but that there are major missions, such as the scientific unmanned exploration of space and the application of space technology to the conduct of peaceful activities, which should be carried forward by our civilian space agency.

The Chief Executive noted that on the previous day he had nominated Dr. Edward C. Welsh, an economist who had served on Senator Symington's staff, as executive secretary of the National Aeronautics and Space Council. This position had never been filled previously on a full-time basis.[107]

Meanwhile, views from the scientific community were being heard. The Space Science Board of the National Academy of Sciences concluded after a review of the role of manned flight in the national space program that "scientific exploration of the moon and planets should be clearly stated as the ultimate objective of the U.S. space program for the foreseeable future."[108]

After considering these views and those of the NASA staff, Webb on March 17, 1961, sought Administration approval

for an addition of $308 million to the $1.1 billion budget requested by President Eisenhower for NASA in fiscal year 1962.[109]

The Bureau of the Budget recommended only $50 million additional for NASA. David Bell, Budget Director, said it was too early for the President to make a decision of such magnitude. Dryden replied, "Whether he likes it or not, he is going to have to consider it. Events will force this." At Webb's request the Budget Director arranged for the President to review the matter. Johnson, Webb and others were present at a meeting on March 22.[110]

Webb informed the President that the ten-year plan prepared by NASA under the previous Administration "was designed to go hand in hand with our military programs and permit a steady closing of the gap caused by Russian successes." But he said the decisions by President Eisenhower on the budget sent to Congress in January 1961, "emasculated the plan before it was even one year old, and unless reversed guarantees that the Russians will, for the next five to ten years, beat us to every spectacular exploratory flight."[111]

On the following day, President Kennedy met with Johnson, Wiesner, Bell and Welsh, and decided to support only the portion of Webb's request that covered launch vehicles and propulsion, which totaled $125.7 million for NASA and $16.1 million for the Atomic Energy Commission.[112]

A series of Soviet flights increased the space challenge in the first 83 days of the Kennedy Administration.[113] They reached a climax when Vostok (East) made a single orbit of the earth on April 12, 1961. In the craft was Yuri Alekseyevich Gagarin (1934-1968), a major in the Soviet Air Force, and the first human to depart from and return to the planet.[114] USSR scientists reported that Gagarin was able to preserve his creative functions and to perform diverse work activity in space.[115]

Great excitement and demands for action ensued in the United States. A day after the Gagarin flight, Webb and Dryden were called on to testify before the House Space Committee. In response to a question by Chairman Brooks, Webb said the budget as amended by Kennedy would "provide a solid rate of progress on an urgent basis." But he said it would not contain sufficient funding "to provide a national booster program at the earliest possible moment." He added:

> I would say . . . that the decision which we all have to face as a nation is whether we now expect to proceed as we did in connection with the atomic bomb, with a substantial number of efforts going on in parrallel, with all of the resources that may be required to do this. We have based this program on completing one step, evaluating it, using that knowledge to make the next step.

In response to a question by Representative Victor L. Anfuso, Democrat of New York, Webb said: "It does seem to me that what we are doing here in the United States is having a good hard look at how a great nation faces a great problem. This is not simply a matter of a recommendation by the Executive Branch, which you will then take and pass by lightly. You are performing a great public service here in providing a thorough public examination of the issues which must be decided, in which we must all participate in a thoroughly reponsible way. The President has submitted to you a program based on his evaluation of the total requirements of this government . . . .If subsequent information comes into play as we have seen as the result of the events of the last few days, then you obviously have to take that into account."

Several members of the committee indicated belief that NASA should be more aggressive in seeking increased funds. One of the strongest exponents of this view was Representative James G. Fulton, Republican of Pennsylvania, who asked what a manned lunar landing would cost. Webb replied, "Some people use a number as high as $40 billion . . . . Others say half that amount."[116]

On April 14, Representative David S. King, Utah Democrat, asked Dr. Robert C. Seamans, Jr., NASA Associate Administrator, whether the United States could land a man on the moon by 1967. Seamans replied, "My estimate at this moment is that the goal may very well be achievable."[117]

That afternoon, President Kennedy met with Webb, Dryden, Wiesner, Bell and others. The President asked what could be done to define U.S. aims and to work out a program to overcome the Soviet advantages in space. "There's nothing more important, he said.[118]

Meanwhile, the Congress had acted on a request by the President for a revision of the National Aeronautics and Space Act to make the Vice President, instead of the President, chair-

man of the National Aeronautics and Space Council.[119] On April 20, the day that the Congress completed action on the legislation, the President asked Vice President Johnson to take charge of an overall survey and to report as soon as possible. He posed the following questions:

> 1. Do we have a chance of beating the Soviets by putting a laboratory in space, or by a trip around the moon, or by a rocket to go to the moon and back with a man. Is there any other space program which promises dramatic results in which we could win?
>
> 2. How much additional would it cost?
>
> 3. Are we working 24 hours a day on existing programs? If not, why not? If not, will you make recommendations to me as to how work can be speeded up.
>
> 4. In building large boosters should we put our emphasis on nuclear, chemical or liquid fuel, or a combination of these three?
>
> 5. Are we making maximum effort? Are we achieving necessary results?[120]

Johnson asked Webb for answers to the President's questions. A NASA analysis indicated that the prospect for achieving one of the listed major goals in advance of the Soviets was not good up to the landing of a man on the moon and his safe return to earth. Even on this difficult goal, the analysis cautioned that the USSR could be ahead.[121]

In the conduct of his study, Johnson sought advice from businessmen and the views of experts inside and outside NASA. The Vice President also asked Congressional leaders for their recommendations. There was general agreement that some major action was warranted.[122]

As the study proceeded, Johnson became impatient with NASA officials, who tended to preserve a posture that they were presenting options for decision by higher authority.[123] Webb favored expansion and acceleration of the space program, but held back from proposing authorization of a program aimed at the manned lunar landing goal. "I was not going to be stampeded," Webb commented six years later. The Administrator had two principal reasons for his caution. One was uncertainty about whether the country would support such a program, which would

involve very substantial costs for almost ten years.

The other was the ability of the NASA organization to carry out the vast increased program that would be required. An opportunity for NASA to supply evidence on this point was provided by the first manned flight in the Mercury program, a suborbital mission for which astronaut Alan B. Shepard had been selected.[124]

But as preparations for the flight proceeded there was difficulty resulting from lingering doubts harbored by the scientific community. Since February, a panel of the President's Science Advisory Committee headed by Dr. Donald Hornig had been conducting an inquiry into the Mercury program. Medical specialists on this panel were concerned about the shortage of experiment results on animal flights in space, since only a few had been launched. In view of these doubts, the Hornig panel gave only a lukewarm endorsement to the Mercury flight plan.[125]

The flight took place on May 5, 1961. Several postponements had increased the suspense and the nation figuratively held its breath.[126] The success led to national elation, which supplied a strong impetus to the decision-making process. The Vice President pressed for action.[127]

Administrator Webb and Secretary of Defense McNamara, aided by senior members of their staffs, worked out on the weekend of May 6 and 7 the final details of a plan for expansion and acceleration. This was delivered on Monday morning to the Vice President. Johnson forwarded it to the President that afternoon and then departed on a round-the-world mission that kept him out of the country from May 11 to 24.[128]

During his absence, final details were worked out and the White House considered how best to present the program to the Congress. Webb followed up on Johnson's discussions with leading Congressmen. These increased his assurance that the program would be supported.

During this period, NASA reviewed its facility requirements for the program in the light of plans to move the Saturn booster from Huntsville, Alabama, to the Cape Canaveral launch complex, by way of the Tennessee, Ohio and Mississippi Rivers. The use of water transport permitted important economies in time and money. Further, the availability of the very large buildings built for aircraft construction during World War II at New Orleans (on the waterway) made it possible to utilize

these for an assembly facility. The large structures required for the Saturn and fabricated wherever contractor plants were located could be brought to this facility for final assembly into the giant boosters which could then be moved on to Cape Canaveral by water transport.

With these considerations in mind, NASA management approached the task of finding a site for the management, test and evaluation of the large spacecraft that would be flown by the Saturn boosters. Houston, Texas, was the only large city near this axis that fitted the evolving pattern. As the study of the alternatives proceeded, Webb informed President Kennedy and the President in turn informed Representative Albert Thomas, Texas Democrat who headed the Appropriations Subcommittee that handled the NASA budget. Later, Thomas told Webb the President had indicated approval of the Houston location, and that he, Thomas, had in turn agreed to support the President on certain other matters before his Subcommitte.[129]

The White House review evidently concluded that a major initiative in space should be undertaken. President Kennedy included the recommendation in a special message to the Congress on a series of "urgent national needs." The message included proposals on Communist activities among the uncommitted nations, economic and social progress in the United States and abroad, worldwide information activities, defense alliances, military and intelligence organization, civil defense and disarmament.[130]

One of the last questions was whether to specify a year for the lunar landing, which NASA's internal plans were projecting for 1967 or 1968. On the basis of its experience with target dates, NASA urged an "administrative discount" -- a more generalized statement that the landing would be made within the decade.[131]

In his message, delivered in person on May 25, the President declared:[132]

> I believe that this nation should commit itself to achieve the goal, before this decade is out, of landing a man on the moon and returning him safely to earth. No single space project in this period will be. . . so difficult or expensive to accomplish. . . .
>
> Let it be clear that I am asking the Congress and the Country to accept a firm commitment to a new course of action, a course which will last for many years and carry very heavy costs. . . . If we are to go only

halfway, or reduce our sights in the face of difficulty, in my judgement it would be better not to go at all. . . .

This decision. . . means a degree of dedication, organization and discipline which have not always characterized our research and development efforts. . . .

New objectives and new money cannot solve these problems. They could, in fact, aggravate them further unless every scientist, every engineer, every serviceman, every technician, contractor and civil servant gives his personal pledge that this nation will move forward with the full speed of freedom, in the exciting adventure of space.

The President requested a NASA appropriation of $549 million over and above the March recommendation, making a total of $1,784 billion. There was little debate in the Congress, which had talked itself out on space in the three and half years since Sputnik.

In addition to NASA witnesses, the Senate Space Committee followed suggestions by NASA that it hear testimony in support of the program from Dr. Glenn T. Seaborg, Chairman of the Atomic Energy Commission, and Roswell K. Gilpatric, Deputy Secretary of Defense. Written statements were given to the committee by Secretary of State Dean Rusk, Chairman Newton Minow of the Federal Communications Commission and Dr. Francis W. Reichelderfer, Chief of the Weather Bureau, Department of Commerce. The Senate vote was unanimous. The House completed Congressional endorsement on July 20, 1961, by a vote of 354 to 59. Thus was made the decision to proceed.[133]

Staccato Actions. To implement this decision, it was necessary to reorganize the space agency, upgrade its management, expand its field center and contractor base, begin the building of new facilities, arrange for greater university participation and press forward with those parts of the program under way.

Through the spring and early summer of 1961, the NASA staff examined the scientific, technical and administrative options. But Administrator Webb withheld approval of any major action in advance of the completion of Congressional action. This added time for a careful review and it permitted many of the initial steps to be carried out in staccato fashion over a period of only a few months.[134]

The first need was increased ability to deal with industrial contractors. At this time, the principal sources of NASA management personnel were the former NACA, the Navy Vanguard team, the Jet Propulsion Laboratory and the recently acquired von Braun team. All of these groups had traditions of in-house development that were in some degree of conflict with the policy, initiated by Administrator Glennan soon after the establishment of NASA, that greater responsibility should be assigned to contractors.[135]

Administrator Webb assigned to NASA's Office of Administration, and in particular to John D. Young, deputy director, the task of exploring alternative organizational concepts that would permit the agency to carry out its new responsibilities.

After four months of study of the alternatives and their implications and discussions with experienced executives within and outside NASA, Webb on September 24 approved a reorganization. It was intended to achieve the unification of major programs, better communications between headquarters and the field centers, functional management of activities carried out at more than one center, and flexibility in assigning and shifting missions and resources among the field centers and headquarters offices.

Four new headquarters program offices were established, reporting to the Associate Administrator, who served as general manager. The four were: manned space flight, space science, applications, and advanced research and technology. D. Brainerd Holmes, General Manager of the major defense systems division of the Radio Corporation of America, was selected to head the manned space flight office. Other appointments were made from within the NASA organization: Dr. Homer E. Newell, space science; Morton Stoller, applications, and Ira H. Abbott, advanced research and technology.

In addition, Webb took steps to strengthen the former NACA field centers, to increase their availability as a technical reserve, to be called on whenever there was a special need that could not easily be met by the field centers primarily devoted to the work with industry and the scientific community on space flight programs. Accordingly, Abe Silverstein was assigned to fill a vacancy as director of the Lewis Research Center.

For the relationships between the Washington headquarters and the field centers, two sets of organizational

reporting lines were established. Headquarters program and administrative offices were given responsibility for specific programs, projects and administrative activities, and for assuring that they were carried out properly by the field centers. On these matters, the personnel involved in the field centers were placed under the functional direction of the appropriate headquarters office. In the growing facility construction field and on institutional matters, however, the general management of each field center reported directly to the Associate Administrator.[136]

The purpose of this dual arrangement, Webb wrote later, was to strengthen Seamans' position as general manager, to assure that joint actions by Webb, Dryden and Seamans on matters related to the development of NASA's resource base would be kept in proper focus, to assure continuing evaluation of the performance and growth potential of senior personnel, and to retain flexibility that would permit adjustments of responsibilities of senior officials without embarrassment or great difficulty.[137]

In preparing to implement the program, Administrator Webb had two principal concerns, based on his fundamental approach to government. One was that it should be carried out as much as possible by existing institutions, strengthening them in the process. To this end, he urged that senior operating officials such as the Administrator of NASA, the Secretary of Defense, the Chairman of the Atomic Energy Commission and others should be held responsible for working together to assure that the program was conducted successfully and in accordance with overall national policies. Webb believed it would be a mistake to weaken existing agencies by assigning directive power to a coordinating agency such as the Space Council. But he and the Vice President worked closely together on major policy questions.

The Administrator's other concern was the development of sufficient institutional strength in NASA to enable the agency to manage a multi-billion-dollar program. He worked to establish a climate in which executives with varying backgrounds in government, industry and the universities would bring together in systematic fashion the diverse considerations affecting the complex program. Ultimately, his goal was management system under which many actions would be taken by force of habit and almost instinctively in the working of the system. Five years later, Webb said:

I think the forces of democracy are dynamic forces.

> They ought to be constructed organizationally so that they are like an airplane -- they're stable, they return to a predetermined course, and they don't have to depend on a hierarchical structure of decision. I wanted to construct a dynamically stable administrative machine for this agency.[138]

Even while the reorganization studies were in progress, a series of rapid-fire actions was begun to broaden the NASA institutional base and to contract for industrial and university support. The Houston location for the Manned Spacecraft Center was affirmed (after a last-minute appeal to President Kennedy by advocates of Boston). Sites were selected for other new NASA field installations in Florida, Louisiana and Mississippi. These, together with the existing activity in Alabama, formed a complex of institutions, linked by water transport, which was destined to be a major force in the development of the intellectual and other resources of the region.

During the same period, five prime contractors for Appollo were selected and the unmanned lunar exploration program was expanded to provide information needed in Apollo.[139]

It soon became evident that there was a management need to establish the manned space flight activities as a closely knit entity. In December 1961, a management council was established, chaired by the new program director, D. Brainerd Holmes, Members were the directors of the Marshall Space Flight Center, Wernher von Braun, and the Manned Spacecraft Center, Robert R. Gilruth, and the principal assistants to the three senior officials. In March 1962, the NASA installation at Cape Canaveral was established as a separate field center and its director, Kurt H. Debus, and his deputy also became members of the management council.[140]

As plans for the expanded space program unfolded, it became clear that NASA and its contractors would employ a significant amount of the nation's scientific and engineering manpower. To help replenish the supply, the agency developed a program under which grants would be made to universities that were able to increase the training of doctoral candidates in science and engineering. The first grants, announced on April 12, 1962, were to ten universities, for the support of ten students each. Administrator Webb forecast that the program would increase considerably in the future.[141]

While the expanded NASA space program was getting under way, work moved forward in aeronautics and on projects begun in previous years. Three major milestones were passed in this period. These were the first firings of the F-1 and J-2 engines, the first launch of the Saturn, and the orbital Mercury flight of John H. Glenn on February 20, 1962.[142]

The Glenn flight led to another great celebration. President Kennedy flew to Florida on February 23, carrying the astronaut's family in his plane, and carried them back to Washington three days later. There were parades in several cities, including a ticker-tape parade in New York in which the Vice President accompanied the Glenns. And on February 26, the astronaut addressed a joint meeting of Congress, arranged by House Speaker John McCormack.[143]

In addition to mobilizing resources for the lunar landing program, efforts were intensified toward the realization of practical applications of space flight. On June 15, 1961, President Kennedy had asked Vice President Johnson to have the National Aeronautics and Space Council make studies and recommendations of policy for the development and operation of communications satellite systems. After consultation with affected agencies of the of the government, the council recommended, and Kennedy approved on July 24, 1961, a policy under which private ownership of the United States portion of any communications satellite system was favored.[144]

Before taking this action, the Kennedy Administration reviewed the initial steps taken in this area by the Eisenhower Administration, during which NASA had agreed to launch a satellite for the American Telephone and Telegraph Company, with the company reimbursing the government for the costs. The Relay program moved forward and another program, Syncom, was instituted to provide for and the evaluation of various technical approaches. Relay was to be a satellite in low earth orbit, like that planned for the AT&T Telstar. The Syncom satellite was to be in a high orbit that would be synchronized with the 24-hour rotation of the earth.[145]

President Kennedy proposed on February 7, 1962, that Congress pass legislation to authorize the creation of a private system of communications satellites. Considerable controversy developed, leading to a major effort in Congress to substitute a government-owned satellite system. Following a Senate filibuster and the use of cloture to break it, a bill was passed

and on August 31 the President approved it as the Communications Satellite Act of 1962.[146]

In meteorology, NASA and other affected government agencies began the development of a plan for use of satellite information in the day-to-day operations of the weather services. This plan won initial Congressional approval in September 1961. Meanwhile the TIROS satellites continued to achieve flight success and proved particularly useful for locating and tracking hurricanes and typhoons, giving warnings that saved lives and property losses. Efforts continued in the Nimbus program to develop a more advanced weather satellite.[147]

During this period, several unmanned satellites returned a considerable volume of information on radiation, magnetic fields, meteoroids and other aspects of the space environment near the earth. This made it possible for space scientists to progress rapidly in their understanding of the relationships between the earth and the sun, including the sun's effect on weather. The advances in knowledge also helped increase the potential safety of manned flight in the space environment.[148]

To provide greater assurance that the Mariner unmanned planetary flights could be accomplished on schedule, NASA decided in early 1961 to change the planned launch vehicle. Originally, it had been planned that the Centaur would be employed. However, the Centaur was encountering difficulties in development. The Mariner missions were transferred to the Atlas-Agena B, a somewhat smaller vehicle developed by the Air Force, which was farther advanced.[149]

The effort to develop nuclear rockets was also emphasized. Even though these would not be required for the lunar landing, the work in this technology was continued to assure progress toward the ability to undertake more ambitious programs in the future. The joint NASA-AEC nuclear propulsion office in July 1961 selected two prime contractors for the development of the NERVA (Nuclear Energy for Rocket Vehicle Applications) engine. The ofjective was an engine that could be tested in flight while serving as the third stage of the Advanced Saturn (later designated the Saturn V) launch vehicle.[150] A contractor was selected in May 1962 for the development of RIFT (Reactor In Flight Test) vehicle that would be employed for the NERVA flight tests.[151]

Following the orbital flight of John Glenn, the door to

discussion of U.S.-Soviet space cooperation suddenly appeared to open. In a letter of congratulations to President Kennedy, Premier Nikita Khrushchev declared on February 21, 1962: "If our countries pooled their efforts -- scientific, technical and material -- to master the universe, this would be very beneficial for the advance of science and would be joyfully acclaimed by all peoples who would like to see scientific achievements benefit man and not be used for 'cold war' purposes and the arms race."[152]

Kennedy replied on the same day: "I hope that at a very early date our representatives may meet to discuss our ideas and yours in a spirit of practical cooperation."

It seemed that Glenn's demonstration of U.S. space capability had caused a change of heart on the part of the Soviet leadership toward such discussions. In the previous four years it had continually rebuffed proposals for cooperation by Presidents Eisenhower and Kennedy, as well as other officials of both Administrations.[153]

However, other international cooperative activities had been under way for several years. The United States made a formal offer to scientists of other nations in March 1959, at a meeting of the Committee on Space Research (COSPAR) five months after its establishment by the International Council of Scientific Unions. As a result, arrangements were made to launch British and Canadian satellites and other forms of cooperation were worked out with several dozen other nations. In November 1961, representatives of 28 nations participated in an international meteorological satellite workshop, held in Washington under the sponsorship of NASA and the Weather Bureau.[154] The first international satellite, the British Ariel I, was orbited successfully in April 1962.[155]

The rapid expansion of this period was illustrated by President Kennedy's budget of January 1962, which asked the Congress to appropriate $3.787 billion, about four times the amount appropriated two years earlier. It was estimated that 92 percent of the total would support work carried out under contract.[156]

Thus in a little over a year, the nation had arrived at, and had begun to implement, a decision of paramount significance that required the development of an ability to manage very large undertakings involving science and technology, where more

than 90 percent of the resources would be utilized in industrial or other non-governmental installations. Despite the speed, these actions were taken in a responsible manner, with consideration given to a wide variety of policy and technical factors. But a stormy period lay just ahead.

CONFRONTATIONS

Of the first five years of the National Aeronautics and Space Administration, the most critical was 1962. By this time, the full implications of the 1961 decision were becoming evident. Powerful resistance was stimulated as the program grew to be a major economic, social and intellectual force.

Some of the controversy focused on the mode of flight for the lunar mission, which was under consideration at the time. This flight-mode decision implied that the program would move into a new phase. When a large research and development program approaches such a phase transition, related policy questions must be considered as well as the technical aspects of the program decision. Quite a few such policy matters arose in the latter part of 1962.

Elements of external and internal stress included:

-- Sharp questioning of the proposed Apollo flight mode by a number of leading scientists, including the Chairman of the President's Scientific Advisory Committee.

-- A spectacular Soviet manned space flight achievement.

-- A challenge by friends of the so-called military-industrial complex to the idea of civilian management of the principal U.S. manned space flight program.

-- A possible threat to the future of space flight caused by unexpectedly intense radiation resulting from nuclear bomb tests.

-- A problem of defining the proper borderline between the public and private lives of astronauts.

-- An internal struggle over program priorities and the

departure of the head of the manned space flight program several months later.

All of these issues were decided during a period of international crisis punctuated by the October confrontation with the Soviet Union on missiles in Cuba.

The mode of flight for the Apollo mission was debated extensively within NASA and its family of contractors between mid-1961 and mid-1962. The 1961 decision to proceed with Apollo marked the conclusion of a phase of preliminary analysis of the possibility of a manned lunar landing program. From 1961 to 1962 was a period of program definition, during which systems analysis was used to select the flight mode and to decide several other technical questions of primary importance.

In mid-1961, the technical discussions focused on three major alternative flight modes. One alternative would have employed a very large launch vehicle with rockets burning either liquid or solid fuel to launch a spacecraft with auxiliary equipment on a direct flight to the moon and back to earth. The two other alternatives were calculated to reduce the required size of the launch vehicle. One involved a nuclear rocket in the final stage of the vehicle. The other called for rendezous in space.

NASA ruled out the nuclear rocket in mid-1961 after an analysis showed that it could not be perfected in time for use on a lunar landing mission before the end of the decade. As for rendezvous, it was felt that too little was known to rely on this technique. Thus there was a general assumption at the time that direct flight would be necessary.[157]

But as rendezvous was examined more intensively, the apparent technical difficulties tended to decrease. In addition, belief grew that rendezvous was an essential element in the development of space flight, regardless of whether missions were aimed toward earth orbit, the moon or elsewhere. NASA in October 1961 announced intensive studies of how rendezvous techniques could be employed to facilitate the lunar mission.[158]

In December 1961, NASA began a program to develop and fly a two-man spacecraft, later named Gemini. The principal objectives of this program were to carry out experiments involving rendezvous and docking, and to gain experience in flights of duration up to a week.[159]

The first ideas taken seriously about rendezvous involved operations in earth orbit.[160] But a bolder approach was investigated by John Houbolt, a researcher at NASA's Langley Research Center. Beginning in 1960, Houbolt had advocated a flight mode involving rendezvous in orbit about the moon. Many program officials were horrified on first hearing this suggestion. But as it was examined more carefully, the idea began to seem reasonable.[161]

By the time of the first meeting of the manned space flight management council in December 1961, the idea had gained considerable support within the program organization. Evidence of this support was supplied by the decision on the configuration of the Advanced Saturn (later named the Saturn V) launch vehicle for the lunar mission. A joint study of launch vehicle needs by NASA and the Department of Defense had recommended a month earlier that the first and second stages of the three-stage vehicle have four engines each.[162] But additional studies by NASA showed that adding a fifth engine in each stage would increase the power enough to provide the option of employing either earth-orbital or lunar-orbital rendezvous. The lunar mode gained its initial support among members of the former Space Task Group, projected to move to Houston as the Manned Spacecraft Center. Robert R. Gilruth, director of the new center, favored the additional engines.[163] The five-engine configuration was announced on January 10, 1962.[164]

But for assurance that a larger vehicle could be made available if needed for the direct flight, a contract was awarded in the same month to begin development of the M-1, a liquid-hydrogen-fuel engine of 1.2 million pounds thrust.[165]

By March 1962, the headquarters manned space flight office was also swinging toward lunar orbital rendezvous on the basis of the initial results of its studies. However, there was considerably more technical information available at that time on earth-orbital rendezvous. And so a somewhat tentative decision was made that earth orbital rendezvous should be the primary mode.[166]

As the studies progressed, however, technical judgments within the program management continued to move toward lunar orbit. In late spring, the manned space flight management council approved the plan unanimously and Director D. Brainerd Holmes recommended it formally to NASA general management.[167]

Despite the developing unanimity with in NASA, the outside scientific community harbored serious doubts. To a large extent, these doubts were comparable to the reactions of members of the NASA technical staff before they had studied the problem in depth.

While the issue was being debated, the Space Science Board of the National Academy of Sciences conducted a summer study at NASA's request at the State University of Iowa. The report of the study generally supported the unmanned space science programs of NASA, but indicated the existence of some reservations about the manned space flight program. The report urged that unmanned lunar exploration be increased in advance of final decisions on the design of the spacecraft for the manned lunar mission, and that plans be made to carry a scientist on the mission.[168] One of the scientists who questioned the lunar orbital approach was Dr. Jerome Wiesner, special assistant to President Kennedy and chairman of the President's Science Advisory Committee.[169]

In view of the controversy, Administrator Webb withheld binding commitment to the plan. In a statement on July 11, 1962, he said NASA was putting "major emphasis" on lunar orbit rendezvous. He added:

> In reaching this decision, however, we have acted to retain the degree of flexibility vital to a research and development program of this magnitude. Many of the modules and booster stages are interchangeable between the various modes open to us. If what we learn in the future dictates a further change in direction, we will be in a position to make it.

The Administrator directed additional studies, focused on possibilities that had not been as fully explored as other options. During the same three-month period as the studies, proposals for development of the lunar module -- the only major element of the lunar vehicle not yet under contract -- were to be received from industrial firms and evaluated. Thus this step postponed for three months the firm decision on the flight mode.

Also at this time, NASA made three other significant decisions on the definition of the Apollo program. One was to develop an intermediate Saturn vehicle, later called the Saturn IB, for earth-orbital flights of the Apollo spacecraft.

A second was that the lunar vehicle would be assembled in vertical position indoors in a specially constructed building three miles from the Florida launch site, and brought to the launch pad, still in a vertical position, by a crawler transporter. The third was to locate at Houston the center for control of manned space flights after the completion of the launch phase.[170]

The most serious controversy of 1962 followed a spectacular Soviet space flight. On August 11, Vostok III carried Cosmonaut Andrian Nikolaev into orbit. A day later, Vostok IV was launched with Cosmonaut Pavel Popovich. It was the first time that two spacemen had been in flight simultaneously. Nikolaev returned to earth after four days of flight, Popovich after three days. The two craft passed within 6.5 kilometers (4.03 miles) of one another. An erroneous report was published that they had achieved actual rendezvous and docking.[171]

Vigourous public and Congressional debate followed on the question of whether sufficient attention was being paid to the national security aspects of manned space flight, and whether a crash program under military management might be more appropriate. Statements were made by some professional military societies and elements of the trade press.

Representative George P. Miller, California Democrat and chairman of the House Space Committee, responded to these arguments in an address on the House floor on September 6.

Mr. Miller recognized the significance of the Soviet acheivement. But he argued that it did not necessarily signify either that the Soviets were about to land a man on the moon, or that they had a manned space weapons system in being. The committee chairman took note of the argument by Senator Howard Cannon, Democrat of Nevada, that the Air Force program to develop a Dyna-Soar spacecraft, recently renamed the X-20, should be emphasized. Just a few days previously, the Department of Defense had awarded a contract for the development of a new launch vehicle, the Titan III. One of its assignments was to be to launch the X-20. Mr. Miller said:[172]

> But it is not necessary to wait for the Titan III and the X-20 to demonstrate the feasibility of rapid launch capability, maneuverability in space, maneuverability during reentry, precision recovery with conventional landing, and re-use. NASA is already conducting a program, Project Gemini, designed to accomplish all of these objectives several years sooner

than will be possible with the X-20. The Gemini will be much lighter than X-20, will require a much smaller and less expensive launch vehicle, the Titan II, and will carry two men instead of one. . . . It appears that the critics of our space program are not asking that we do twice as much -- but that we do everything twice. . . .

It seems fairly well established that the real cause of all this squabble about the military-in-space stems from an in-house difference of opinion within the military establishment. The problem is not that our civil space program is retarding the military. On the contrary, it is enhancing it and will continue to do so in the future. The problem is that the military space enthusiasts have not been able to obtain all the green lights they want from their bosses.

President Kennedy was questioned sharply on the subject at his news conference on August 22, 1962. He conceded that the United States was still behind the Soviets. But he maintained that under the expanded program undertaken a year earlier the country would forge ahead before the end of the decade. When the controversy continued, the President decided to make a tour of space facilities at Huntsville, Alabama, Cape Canaveral, Houston, and St. Louis. At the same time, the Department of Defense announced that the United States would not undertake a program to place nuclear weapons in orbit.[173]

Kennedy was accompanied on the two-day tour by Vice President Johnson as well as leaders of Congress and his Administration. The highlight was an address to 35,000 persons gathered in the broiling sun on September 12 in Rice University stadium at Houston. The President declared:[174]

We have vowed that we shall not see space filled with weapons of mass destruction, but with instruments of knowledge and understanding. Yet the vows of this nation can only be fulfilled if we in this nation are first, and therefore we intend to be first.

In short our leadership in science and industry, our hopes for peace and security, our obligations to ourselves as well as others all require us to make this effort to solve mysteries, to solve them for the good

of all men and to become the world's leading spacefaring nation.

We set sail on this new sea because there is new knowledge to be gained and new rights to be won and they must be won and used for the progress of all people.

For space science like nuclear science and all technology has no conscience of its own. Whether it will become a force for good or ill depends on man, and only if the United States occupies a position of pre-eminence can we help decide whether this new ocean will be a sea of peace or a new terrifying theater of war.

I do not say that we should or will go unprotected against the hostile misuse of space any more than we go unprotected against the hostile use of land and sea. But I do say that space can be explored and mastered without feeding the fires of war, without repeating the mistakes that man has made in extending his writ around this globe of ours.

There is no strife, no prejudice, no national conflict in outer space as yet. Its hazards are hostile to us all. Its conquest deserves the best of all mankind and its opportunity for peaceful cooperation may never come again.

As the year proceeded, public confidence in the civilian space agency was enhanced by several major space flight successes. These include the launch of Mariner II toward Venus on August 27, the second and third Saturn flight tests, and the six-orbit Mercury flight of Astronaut Walter Schirra on October 3.

When Mariner II passed within 21,648 miles of Venus on December 14, 1962, it became the first spacecraft to return information from another planet. It obtained measurements of the planet's temperature, magnetic field and atmosphere.[175]

Two attempts were made to launch Soviet spacecraft toward Venus, but neither was ejected successfully from a parking orbit about the earth. At the request of Congressional leaders, Administrator Webb disclosed these and several other Soviet failures in attempts to launch spacecraft toward Venus and Mars.[176]

Following the NASA successes, the demands for a crash military manned space flight program died down. However, the furor focused attention on the question of whether the space agency's organization was configured to facilitate the flow of technical and management information between NASA and the Department of Defense. On November 20, 1962, NASA appointed Admiral Walter F. Boone (USN, Ret.) as deputy associate administrator for defense affairs.[177]

An unexpected dispute revolved around results of an explosion of a 1.4 megaton nuclear bomb in space 250 miles above the Central Pacific Ocean on July 9, 1962, in a project called Starfish. To the surprise of scientists, the natural radiation belt was artificially increased to a far greater degree than had been anticipated. Measurements made with satellites in the first weeks and months afterward indicated that the lifetime of the increased radiation would be several years. Between October 22 and November 1, 1962, the Soviet Union carried out three nuclear explosions at higher altitudes in space with comparable effects.

The artificial increase in the radiation belts damaged several unmanned satellites and led to concern over the possibility of interference with manned and unmanned exploration of space. Comprehensive study by NASA's Goddard Space Flight Center disclosed that the most dangerous portion of the radiation decayed fairly rapidly and only the less energetic was long lived. However, some of the artificial radiation did persist for several years.[178]

Another vexing problem was the establishment of a proper borderline between the public and private lives of the astronauts.[179] Because of the contstant pressure for articles, messages, endorsement of causes, Etc., by the astronauts, NASA decided in May 1962, to make special administrative arrangements under which astronaut affairs would be supervised by the Houston center, in coordination with NASA headquarters.[180]

Astronaut Donald K. Slayton, relieved from space flight status because of a heart murmur, was appointed coordinator of astronaut activities. Later, he was to take a civilain post as director of flight crew operations for the Manned Spacecraft Center.

In September 1962, a second group of nine test pilots was selected as astronauts. The previous restriction to military

candidates was lifted and the new group included two civilians.[181]

During the same month, NASA announced several changes in policy regarding the astronauts' sale of accounts of their personal experiences. Their privilege to do so was reaffirmed as consistent with similar opportunities enjoyed by many other individuals in the service of the government. But the new policy provided for review of all such agreements by the Administrator of NASA.[182]

As the events of 1962 unfolded, the U.S.-Soviet competition in space became even more closely related to the Cold War. On June 5, President Kennedy remarked on this in a private conversation with Astronaut Scott Carpenter and Walter C. Williams, director of operations for Project Mercury, during their visit to the White House following Carpenter's orbital flight.

As Williams remembered the conversation in 1964, President Kennedy felt that there were three ways to compete with the Soviets. One was nuclear war, which the President said no one wanted unless in retaliation. The second was economic competition, which was under way but would take a long time. The third area of competition was in space. The President said the superiority of technology in space was quite clear and could be evaluated by anyone. This, Williams recalled that Kennedy said, was why he believed the space program was so important, despite its great expense.[183]

Four months later, the successful Mercury flight by Astronaut Walter Schirra came only 13 days before the President learned of the existence of indisputable evidence that Soviet missiles were being installed in Cuba.[184]

As the national and international significance of the manned space program became more evident, officials of the Office of Manned Space Flight intensified their arguments for higher priority. Director D. Brainerd Holmes of the manned space flight office proposed that a request be made for a supplemental appropriation of $400 million for fiscal year 1963 to speed the manned lunar landing effort. Directors Wernher von Braun of the Marshall Space Flight Center and Robert R. Gilruth of the Manned Spacecraft Center also pressed this point.

Administrator Webb knew the Budget Director and the President were unwilling to support such a request. He himself believed it would not contribute to the development of long-range, stable Congressional support for the space program. In his view, the leaders of Congress had high respect for an agency that could execute programs in an orderly fashion, funding for a year at a time, avoiding such emergency actions as supplemental budget requests, which further complicate the already complex budget process. In addition, he wanted to emphasize the necessity for Congress to assume its full responsibility to act on the regular budget. Accordingly, the Administrator decided to seek any needed increased funding in the regular budget for the following year. Officals of the manned space flight organization did not accept this reasoning. They wanted to request the funds while they thought the climate was favorable.

After failing to gain support for a supplemental appropriation, Holmes suggested that funds might be reprogrammed into the manned space flight program from other NASA programs.

Webb was even more opposed to this suggestion. He believed that any serious diversions from funds that had been appropriated for other programs would seriously reduce the effectiveness of the science, technology and applications areas and the NASA field centers, and weaken the agency's basic capability. He viewed the continued strength of this capability as the reason for NASA's existence.[185]

Meanwhile, NASA affirmed the decision to adopt the lunar orbital rendezvous mode for the Apollo lunar mission. On November 7, 1962, a contractor was selected for the development of the lunar module.[186]

Within the next two weeks, reports of the disagreement had found their way into the public prints.[187] On November 21, the matter reached the White House. Vice President Johnson and senior NASA officials met with President Kennedy to review the question of a supplemental appropriation and the budget for the coming year. D. Brainerd Holmes was among those present.

As Associate Administrator Seamans recalled later, President Kennedy remarked that the manned lunar landing was the most important U.S. objective. Administrator Webb disagreed, arguing that the objective was to become pre-eminent in space.

The Administrator said he would not take responsibility for a program that was not a properly balanced one.[188] The President asked Webb to write a paper on the issue, "so that I can really see whether we're working together or not."[189]

The NASA Administrator replied in a nine-page letter reflecting the views of Drs. Dryden and Seamans as well as his own. He declared: "The objective of our national space program is to become pre-eminent in all important aspects of this endeavor and to conduct the program in such a manner that our emerging scientific, technological, and operational competence in space is clearly evident."

Pre-eminence, the letter continued, requires:

-- Scientific investigations and observations of the the earth, the sun, the moon, the planets and the stars.

-- Advancing technology in such areas as rocket thrust and efficiency, spacecraft internal power, instruments, life support systems and the ability to communicate over long distances.

-- Operational competence that permits launch into exact orbits, maneuver and rendezvous, landings on the moon and the planets, and reentry in the earth's atmosphere, employing improved processes of fabrication, inspection, assembly and check-out, and equipment with increased lifetime and reliability.

Conduct of the program, Webb said, requires continual uprating of the competence of government centers, industry and the universities, as well as effective working relationships with foreign countries. He continued:

> The manned lunar landing program provides currently a natural focus for the development of national capability in space, and, in addition, will provide a clear demonstration to the world of our accomplishment in space. The program is the largest single effort within NASA, constituting three-fourths of our budget, and is being executed with the utmost urgency. All major activities of NASA, both in headquarters and in the field, are involved in this effort, either partially or full time... . .

The manned lunar landing program, although of highest

> national priority, will not by itself create the pre-eminent position we seek. The present interest of the United States in terms of our scientific posture and increasing prestige, and our future interest in terms of having an adequate scientific and technological base for space activities beyond the manned lunar landing, demand that we pursue an adequate, well-balanced space program in all areas, including those not directly related to the manned lunar landing. We strongly believe that the United States will gain tangible benefits from such a total accumulation of basic scientific and technological data as well as from the greatly increased strength of our educational institutions. For these reasons, we believe it would not be in the nation's long-range interest to cancel or drastically curtail on-going space science and technology development programs in order to increase the funding of the manned lunar landing program in fiscal year 1963.

The Administrator noted that the total in the budget for hardware development and flight missions not part of the manned lunar program totaled $400 million, just the amount of the shortage in the latter program, and that only a small fraction of the total could be realized from a cancellation at that time. "However, even if the full amount could be realized, we would strongly recommend against this action," he declared.

The Administrator noted that NASA had provided information to the Bureau of the Budget on what could be accomplished at various budgetary levels running from $5.2 billion to $6.6 billion for fiscal year 1964 -- compared with $3.7 billion appropriated for fiscal year 1963. Webb expressed reasonable confidence that he could work with the Congressional committees to obtain support of a budget at the $6.2 billion level. But he said the NASA leaders would give their best efforts to effective presentation and use of the funds if Kennedy preferred to request a supplemental appropriation for the current year.[190]

In the end, President Kennedy decided not to request a supplemental. In his budget for fiscal year 1964, the President requested $5.7 billion in spending authority for NASA.[191]

In the latter part of 1962, NASA survived a series of tests of its ability to meet the responsibilities entailed in the 1961 decision. The next significant test would be the establishment of ability to manage such a program effectively as the Apollo program entered a new phase.

Consolidating and Managing. When the manned lunar landing program began, a principal difficulty in its management resulted from the fact that two of the field centers working in the manned space flight area tended to overshadow the headquarters manned space flight office. The past achievements of the Marshall Space Flight Center in Huntsville, Alabama, and the Manned Spacecraft Center in Houston, Texas, had earned for them reputations of technical competence and skill. Even though the leading officials of the Office of Manned Space Flight had individual records of accomplishment, the organization as an entity was essentially unknown and untried. The third field center, the Launch Operations Center at Cape Canaveral, had previously earned some degree of prestige as a division of the Marshall Space Center, but its development as a separate NASA center did not get fully under way until it attained independent status in March, 1962.

The headquarters Office of Manned Space Flight grew rapidly in 1962 and 1963 to become the largest organizational unit in NASA headquarters. But even though the size of the staff reached 450, it was hard put to provide the necessary technical and administrative support for the management of this rapidly growing enterprise.

Consequently, the new office proceeded cautiously in exercising authority in coordinating the efforts of the field centers, to avoid the possibility of hampering or interfering with activities under way.[192]

To provide support for the headquarters office, two major contractor activities were established in early 1962. The first such contractor activity was established to support the systems analysis and systems engineering of the overall program. At the request of Administrator Webb, the American Telephone and Telegraph Company agreed to form a special subsidiary, Bellcomm, Inc., which worked intimately with the manned space flight office in providing these services. The second special contractor activity was arranged with the General Electric Company for integration analysis, reliability assessment and checkout of the overall space vehicle for the Apollo mission, including both the launch vehicle and the spacecraft. In addition to headquarters support, this contract provided an assured body of test measurements at all stages of equipment checkout.[193]

These special contracts led to a degree of tension within NASA and its hardware prime contractors. The problem resulted from concern that Bellcomm and General Electric might have some authority or influence over the civil service staff of the field centers, or over other contractors. Holmes went to some pains to deny this, declaring that the two contractors provided technical support and that technical and administrative decisions were made within the government.[194]

In testimony before Congressional committees in early 1963, Holmes said that management of the manned space flight program was its principal challenge.[195] Problems that drew particular attention in this period included the establishment of systems to keep the headquarters office informed about current difficulties in the vast and growing program, the organization of the headquarters office, and the assignment of key program personnel in the field centers.[196]

Early in 1963, Administrator Webb appointed Dr. Mervin J. Kelly, retired president and chairman of the board of Bell Telephone Laboratories, as chairman of a management advisory committee for the manned space flight program.[197]

From April 1 to 5, 1963, the committee visited the Office of Manned Space Flight and its three field centers. It found that a staff of 10,500 -- 380 in the headquarters office, the others in the centers -- was engaged in the conduct of the program. The total budget (excluding headquarters salaries and expenses) was $2.2 billion for the current fiscal year, and $3.7 billion was requested for the year beginning July 1, 1963. It found a complex management structure under which the field center directors had considerable freedom of maneuver and the Office of Manned Space Flight was able to exercise some control. The principal recommendation, communicated orally to Webb and Holmes, was that some way be found to bring the headquarters office and the three field centers into a relationship that would be marked by greater teamwork.[198]

On May 15 and 16, 1963, a Mercury spacecraft carrying Astronaut L. Gordon Cooper circled the earth 22 times, remaining aloft for 34 hours and 20 minutes in the longest U.S. flight to that time. The mission achieved all of its objectives.

The Cooper flight drew even larger radio and television coverage than previous Mercury flights, and the activities at Cape Canaveral were seen on European television as the result

of transatlantic transmission by a communications satellite, Relay I. The public interest in the flight led to a more extensive series of post-flight public celebrations that had been expected.[199]

On May 19, Associate Administrator Seamans answered a question at the post-flight news conference by saying that, in view of the apparent success of Cooper's mission, it was quite unlikely that another Mercury flight would be conducted. He said the manpower could be used to get on with the Gemini and Apollo programs. A spacecraft and a launch vehicle had been procured as a back-up for the Cooper flight in the event of difficulty. The spacecraft had been modified so that it was capable of supporting an astronaut in orbit for three days.[200]

The astronauts and some of their associates at the Manned Spacecraft Center were unhappy over the NASA headquarters decision. Six astronauts had an opportunity two days later to seek to have the decision overruled. President Kennedy invited the six to a cocktail party at the White House. The astronauts made no secret of the fact that they had recommended another Mercury flight.[201] The following day, however, the President said at a news conference that the decision on the flight schedule would be made by NASA, and that he would not intervene.[202]

In a news release issued on June 12, 1963, NASA announced that the Mercury series of space flights had been concluded with the Cooper flight. The Mercury hardware on hand and the personnel of the Mercury team would be utilized in other NASA programs. The announcement continued:

> In the realignment of the NASA manned space flight programs, the Office of Manned Space Flight, as well as the NASA Centers responsible for parts of the programs, will be realigned to permit Mr. Brainerd Holmes, Director of the Office of Manned Space Flight, to return to a position in industry within the period of two years which was understood to constitute his obligation for government service at the time of his appointment.[203]

The coincidence of the announcements on Mercury and the resignation led to belief in some quarters that Holmes had supported the astronauts' recommendation of another flight. This was not so. Holmes had recommended against it. The highest ranking official who favored the flight was Walter Williams, director of operations at Houston.[204]

BEGINNING THE FINAL PHASE

The last of the five decisions dealt with in this chapter was the one to proceed into the final phase of development and operations in the Apollo program. This had been made in the Executive Branch by the time President Johnson assumed office in November 1963. But the Congressional endorsement was at best tentative. In its action on the NASA budget for fiscal year 1964, Congress reduced the Administration request by $600 million -- more than 10 percent.

In arriving at this fifth decision, NASA reviewed the status of the manned lunar landing program and its value was re-examined from scientific and military viewpoints. The final phase of Apollo called for the approval of designs of the numerous systems, sub-systems, components and parts of the flight and ground equipment and the fabrication of test models. During the months following the decision to adopt the lunar orbital mode of flight, the prime contractors had made considerable progress in establishing system designs and selecting subcontractors for the major subsystems. The subcontractors had proceeded in turn with the establishment of detailed designs, work schedules and cost estimates. These were reviewed at successively higher levels of the organization, to determine whether all of the planned flight tests were necessary for success. Dr. Joseph F. Shea, deputy director for systems in the manned space flight office, was among those who advocated elimination of some flights to save both time and money, arguing that there would be no ill effect on the program.

Administrator Webb asked Associate Administrator Seamans to make a full review of the technical, schedule and cost status of the manned lunar landing program following D. Brainerd Holmes' decision to resign. The results did not disclose any reason for serious doubt that the lunar landing could be achieved around the end of the decade. The cost estimates were continuing to mount. But the aggregate estimate was still below the $20 billion figure Administrator Webb had given to Congress two years earlier as the lower of two possible totals.[205]

Another dual Soviet space flight renewed the external challenge. The fifth Soviet Vostok spacecraft was placed in orbit on June 14, 1963, with Cosmonaut Valery F. Bykovsky aboard. Two days later, Vostok VI was launched with Cosmonaut Valentina V. Tereshkova, who became the first woman in space.

As in the dual mission of the previous year, the Soviets said the orbital paths crossed within a few miles of one another, but no attempt was made at rendezvous and docking.

Both spacecraft returned safely to earth on June 19. Thus the Soviets retained their lead over the United States in experience with long-duration manned space flight. Bykovsky's five days were more than three times the duration of Cooper's flight. Even the Soviet woman, Tereshkova, had been in space for longer than all American astronauts.

Oddly enough, the celebrations following the Cooper mission coincided with a decline in public enthusiasm for the space program. There seemed to be a relaxation in the public mood following the successful outcome of the Cuban missile crisis of October 1962. Previous support for the space program had been based in part on fear that the Soviets might be able to make some military use of their superiority in space technology. The fear appeared to have lessened in 1963.[206]

The absence of excitment over the Soviet spectacular seemed to encourage critics of the manned lunar landing program and its schedule. The public and Congressional argumentation increased in the summer of 1963. In a sense, this controversy served to fill the vacuum left by the absence of public debate in 1961. The renewed questioning stinulated reviews of the scientific and military significance of the program.

On June 10 and 11, 1963, the Senate Space Committee invited leading scientists to give their views. Generally, the scientists agreed that exploration of the moon was a valid scientific goal and that manned exploration would be more effective than that carried out by remote control with instruments alone. But several witnesses expressed doubts about the pace of the program. They said that if the projected date of the lunar landing were delayed beyond 1970, the costs might be decreased and there might be time for additional unmanned flights to determine conditions on the lunar surface affecting the design of the equipment for the manned flight. Some witnesses indicated belief that Apollo was a "crash program" and that they were opposed to this aspect.[207]

Two weeks after Brainerd Holmes' resignation, Administrator Webb's office asked him to consider the questions being raised about the program pace and to express his views on them. It was felt that he might be able to do so with some degree of

detachment. The program director replied in a six-page memorandum, dealing with the relation of the pace to technology, costs and the motivation of participants. He said:

> The pace of the United States program was not established on the basis of a narrow, single-minded, closed-end program limited to manned lunar landing. We are providing also for general technological advance and for a national capability that will enable us to go in many possible directions in space -- a capability that will make the United States truly pre-eminent. . . .
>
> The pace of the program does not place unreasonable strains . . . . Any research and development program stretches the state of the art to some degree . . . . But the advancement of technology required to accomplish the goals of Project Apollo is well within our reach . . . .
>
> The cost of a major research and development program is roughly the sum of three major factors as follows: (1) a constant factor that designates work that must be done and facilities that must be constructed, regardless of the pace at which the program is conducted; (2) an operating burden, which designates costs that are relatively fixed and therefore almost in direct proportion to the length of the program; and (3) a time-saving factor, which includes funds expended for such purposes as overtime, parallel paths of development, the purchase of hardware and facilities beyond those required for a slower-paced program, and the provision of duplicate personnel complements for launch preparations and associated efforts.
>
> If a research and development program is conducted on too short a time scale, the time-saving factor will become excessive and the total cost will rise. Similarly, if the time scale is stretched out over too long a period, the accumulated operating burden will become excessive, and the total cost will also rise. Somewhere between these extremes there is a time scale at which these opposing factors balance and the total cost is at a minimum . . . .
>
> We have failed thus far to find any evidence that any excess of time-saving expenditures over the operating burden is adding significantly to the total cost

of the program. In our judgment, . . . the present pace of Project Apollo is quite close to the optimum . . . .

Participants are most highly motivated when extremely tight but achieveable deadlines are set. The time required to do a job in research and development often expands in relation to the time available . . . . If the time is extended over too long a period, participants lose motivation and their sense of urgency.

Holmes concluded:

This program has been under way for more than two years. It has generated a momentum of its own. Even if we were to find that some other pace would have been a more desirable one to have selected, a major change in pace would have to be carefully considered in view of the attendant inefficiencies which would accrue by virtue of the change itself. This country learned through its experience with the missile programs of the 1950's of the waste involved in the continual changing of the scope and objectives of research and development, and the repeated starting and stopping of programs. A good R&D team takes time to organize; it is terribly wasteful to disband such a team after it has learned to work together.[208]

The military significance of the program was reviewed by the National Aeronautics and Space Council, which met on July 17 and 31, 1963. Following the second meeting, Vice President Johnson advised President Kennedy that the ability and experience obtained in the Gemini and Apollo programs would have military value. In a memorandum concurred in by all Council members, Johnson said:

NASA's manned space flight program will contribute competence in rendezvous technique, in control and guidance systems, in life protection measures, and in improvement in propulsion. All of these have military significance and can materially contribute to military control in space.

The space program is expensive, but it can be justified as a solid investment which will give ample returns in security, prestige, knowledge and material benefits.[209]

By mid-summer, the Executive Branch had decided to proceed with the Apollo program and to find out whether the Congress and the public would support the maintenance of the overall schedule under which the lunar landing was to be accomplished within the decade.

In implementing this decision, Administrator Webb sought to develop in the manned space flight program an executive group that could manage the development of large systems and would have the full confidence of the Department of Defense and the Air Force, in addition to their colleagues within NASA. His first choice to fill the vacancy at its head, Dr. Ruben F. Mettler, president of Space Technology Laboratories, Inc., a subsidiary of Thompson Ramo Wooldridge, Inc., was endorsed by Secretary of Defense McNamara and senior officers of the Air Force. Mettler declined but suggested the appointment of Dr. George E. Mueller, vice president of Space Technology Laboratories in charge of research and development. Webb agreed and the appointment was announced on July 23, effective September 1.[210]

The next area of attention was NASA organization. The 1961 organization had filled the need of flexibility as the agency expanded and accelerated its activities, moving through the definition and design phases of the Apollo program. For the final phase of Apollo, more stability would be needed. Consequently, Administrator Webb sought to delegate greater responsibility to the line officials one level below the agency's general management.

Effective November 1, 1963, NASA headquarters was reorganized to give the heads of major programs institutional authority over the field centers principally associated with their programs, in addition to the program authority they had held previously. With the new authority, they were given new titles of associate administrators for these major program areas, but were expected to base their institutional management actions on plans worked out with the headquarters functional staff, which also served NASA general management.[211]

In the manned space flight program, Dr. Mueller took steps with Webb's approval to strengthen relationships with the field centers, major industry contractors, and the scientific community. The Manned Space Flight Management Council was realigned to become in effect a board of directors for the program with membership restricted to the Associate Administrator

for Manned Space Flight, the field center directors, and one or two principal deputies of each. Executive groups were established for the Gemini and Apollo programs, comprised of senior corporate officials of the prime contractors and the four principal members of the Management Council. A Science and Technology Advisory Committee for manned space flight was established under the chairmanship of Dr. Charles Townes, provost of the Massachusetts Institute of Technology. A special division of the Office of Space Science and Applications was established for support of the manned space flight program.[212]

Two changes were made in the Apollo program to reduce overall costs and to permit firmer definition of program specifications, schedules and cost estimates. One was the adoption of a policy under which,insofar as possible, space vehicles would be flown with all stages and spacecraft modules operational beginning with the first flight. The previous practice had called for gradual buildup under which only the first stage would be operational, then two stages and so on. The other change eliminated plans for manned flight tests of the Apollo spacecraft and the Saturn I launch vehicle, deferring these for more than a year to the flights of the Saturn IB.[213]

On October 18, 1963, selection of a third group of 14 astronauts was announced, bringing the total number to 30.[214]

In addition to the Apollo schedule and priority, congressional debate concentrated in 1963 on Soviet cooperation and a plan to establish a NASA field center for electronics research.

For discussions with Soviet authorities on possible cooperation, President Kennedy in 1962 had appointed Deputy Administrator Hugh L. Dryden of NASA as his representative. Academician A.A. Blagonravov was named as the Soviet representative. In meetings at New York and Geneva, the two officials developed a limited initiation of cooperative activities in space meteorology, geomagnetic observations and experiments with a passive communications satellite, Echo II. The "information barter" type of agreement was worked out by June 1962. But another six months passed before the Soviet government approved it and several years went by before it was implemented. In June and July 1963, Sir Bernard Lovell, director of the Jodrell Bank radio astronomy observatory in England, visited scientists in the Soviet Union. On his return, Sir Bernard wrote to Dr. Dryden that Soviet scientists had said

that they had rejected, for the time being, any support for plans for a manned lunar landing. The letter, which became public, was interpreted in some quarters as indicating the NASA program could be slowed.[215]

The international climate had improved in the summer of 1963 with the agreement on a treaty to ban nuclear tests. On September 20, 1963, President Kennedy proposed at the United Nations that the world make "the most of this moment and the momentum" through additional agreements, including a joint manned lunar landing program.[216]

The President's speech was interpreted by many Congressional leaders as a move away from support of the concept of achieving pre-eminence in space. The House of Representatives reacted on October 10, 1963, with an amendment to the NASA appropriation bill barring any such agreement without Congressional approval. The Senate agreed with the House. In its final form, the provision forbade the expenditure of any part of the appropriation for participation in a manned lunar landing program carried out jointly with any other country without the consent of Congress.[217]

Considerable controversy on the new electronics center had been under way since January, when President Kennedy proposed in his budget for fiscal year 1964 that it be established in Boston. The location and -- to a lesser extent -- the necessity of the center were debated extensively. NASA felt there was a need because, during the first five years of the space program, the greatest single cause of failure in spacecraft and rockets was difficulty in electronics. The agency had asserted that existing government facilities, either within or outside of NASA, could not properly meet the need. NASA stated that dozens of potential sites were considered during an extensive evaluation process. Boston was preferred because of its proximity to electronics research-oriented graduate-level educational resources, as well as an established science-engineering community in the area.

Critics from other regions of the country maintained that their areas should have been selected. Some contended that Senator Edward M. Kennedy of Massachusetts, brother of President Kennedy, had influenced the selection.

Amendments to delete the $3.9 million initial appropriation for the center were defeated in the House votes on the NASA authorization and appropriation. However, the authorizing

legislation required NASA to submit to the Congressional committees a detailed report on the need, nature and location of the center, and prohibited expenditure of the funds until 45 days afterward.[218]

In its action on the budget for fiscal year 1964, Congress made a substantial cut in the requested appropriation. The $5.712 billion request was reduced to 5.1 billion by the time the House and the Senate had completed work on the authorization and appropriation bills in December 1963.[219]

In terms of program growth, this decision brought the NASA expenditure level to $4.17 billion for the fiscal year that ended in June 1964. Two years of continued stressful growth remained ahead before the expenditure total was to reach its peak 40 percent higher than 1964.[220] But in five years, NASA had succeeded in extablishing a new agency of government that carried out extensive activities in the private sector of the economy, carrying to completion several major programs, planning a decade of activities, expanding and accelerating in response to the Soviet challenge and the resulting public and Congressional demands, surviving severe tests of its ability to grow, initiating construction of new facilities valued at $3 billion, and organizing for full implementation of the manned lunar landing program. It had created a strong, capable in-house technical and managerial staff. And it had established effective working relationships with industry, the scientific world, and the regions and communities of the country in which the program was conducted. Altogether, NASA had developed in five years into an agency of the government that could carry out its assigned tasks and hold its own in dealing with external forces.

As autumn leaves fell, the debate continued on Apollo and cooperation with the Soviets. On November 14, 1963, Vice President Johnson took up the question in an address at Huntington Beach, California. He said:

> Today in our land -- and in the world -- there are those who argue for the view that we should not push forward into new realms or new enterprises unless there is clear and compelling evidence of competition from other nations and other systems. I beleive the American people reject the concept that their future -- or the future of freemen everywhere -- shall be defaulted to the vision and ambition of the totalitarians.

We refuse to accept so negative a doctrine that we are not to interest ourselves in space unless the Communists are interested in space. We cannot live as freemen if for the sake of our own comfort, convenience and complacency, we permit ourselves to become slaves to the limitations, the deceptions or the guile of the Communist system and its leadership . . . .

Our national purpose in space is peace -- not prestige.

Our foremost objective is not to send a man to the moon but to bring a greater measure of sunlight into the lives of men on earth . . . .

We have the country we have -- our cause of freedom has the strength it has -- because we have always maintained faith and confidence in the future and in our own ability to control it for the good of men.[221]

During the next week, President Kennedy undertook a trip in which he made stops at three space installations, the NASA and Air Force launch sites at Cape Canaveral, Florida, and the Air Force Aerospace Medical Health Center at Brooks Air Force Base, Aan Antonio, Texas. Vice President Johnson accompanied the President on most of the journey.

During the visit to Cape Canaveral on November 16, the Chief Executive was especially impressed with the Saturn I vehicle and its power. It was then being prepared for its first orbital flight. He was struck by the fact that the payload, for the first time, might exceed the maximum weight placed in orbit by the Soviets. The President mentioned this on several occasions during his speeches in the next few days.[222]

At the aerospace center in San Antonio on November 21, President Kennedy drew on Irish lore for an analogy to the challenge in space. He said:

Frank O'Connor, the Irish writer, tells in one of his books how, as a boy, he and his friends would make their way across the countryside; and when they came to an orchard wall that seemed too high to climb, too doubtful to try, too difficult to permit their journey to continue, they took off their caps and tossed them over the wall -- and then they had no choice but to follow them.

My friends, this nation has tossed its cap over the wall of space -- and we have no choice but to follow it. Whatever the difficulties, they must be overcome. Whatever the hazards, they must be guarded against . . . . We will climb this wall with both safety and speed -- and we shall then explore all the wonders and treasures that lie on the other side.[223]

The next day, shots rang out in Dallas.

NOTES TO CHAPTER I

1. Eugene M. Emme, History of NASA, Volume I, Dawn of the Space Age, 1957-61, in progress. A list of NASA histories, published and in progress, is contained in Volume Two, "Bibliographical Note."

2. Chart I-1, "Key Events in the Manned Lunar Landing Program" illustrates the interrelationship of events in major research and development programs.

3. G. A. Tokaty, "Soviet Rocket Technology," in Emme, E. M. (ed.). The History of Rocket Technology, (Wayne University Press, 1964), pp. 280-281. Tokaty fled the Soviet Union for the West in 1948.

4. See, for example, the statement by Dr. Vannevar Bush, Director of Scientific Research and Development, in December, 1945, that "such a thing is impossible and will be impossible for many years." U.S. Senate, Special Committee on Atomic Energy, Hearings, Atomic Energy, November 27-30 and December 3, 1945, pp. 179-80.

5. A summary of rocket developments preceding the 1955 decision can be found in Appendix B-I-1. The flavor of events in this period is well preserved by Joseph and Stewart Alsop in The Reporter's Trade, (Reynal & Co., 1958) especially pp. 59-63 and 197-200, and Dwight D. Eisenhower in The White House Years: Mandate for Change, 1952-56, (Doubleday, 1963) pp. 445-58. Harry S. Truman did not discuss the subject in his two-volume memoirs, published by Doubleday in 1955 and 1956.

6. Lloyd V. Berkner, Oral History Research Project, Columbia University, interview by Jay Holmes, June 4, 1959, pp. 22-24, 26. Obituary, New York Times, June 5, 1967. Walter Sullivan's Assault on the Unknown, (McGraw-Hill, 1961), is an authoritative and very readable account of the IGY. See also The International Geophysical Year and Space Research, a staff report of the Select Committee on Astronautics and Space Exploration, House of Representatives, 1959.

7. In the years after World War II, a flood of information -- fact, fantasy and fiction -- on space flight was carried by the media. Science fiction began to become respectable in this period. Also, see Willy Ley's Rockets, Missiles and Space Travel: Second Revised Edition; (Viking, 1961) pp. 331-33; Arthur C. Clarke, The Exploration of Space, (Harper, 1951), which was a Book-of-the-Month selection in 1952.

8. Constance M. Green and Milton Lomask, Vanguard, A History, in press, (comment edition in NASA Historical Archives) Chapter II.

9. Ibid. Green and Lomask attribute this information to privileged sources and interviews. They report also that Rockefeller argued that the United States should promptly announce to the world that it was embarked on a scientific project whose results would be made available to all nations. To fend off any Soviet attempt to label the satellite a threat to peace, he is said to have urged that the announcement stress at the same time that military missions were not involved. He argued that the United States must publicize its plans quickly, lest the Soviets claim already to have a satellite or to be working on one with a shorter timetable for launching. And he proposed that the United States pursue work on a more sophisticated type of satellite concurrent with the development of a small, simple one, so that the USSR could not undercut American prestige by putting a bigger or more impressive body into orbit on the heels of the American satellite. The memorandum was sent with the Defense Department studies to the Secretary of the Treasury, the directors of the Central Intelligence Agency and the Bureau of the Budget, the Chairman of the Joint Chiefs of Staff, and then the National Security Council.

10. House of Representatives, Select Committee on Astronautics and Space Exploration, Hearings, Astronautics and Space Exploration (Hereafter cited as House Select Committee Hearings) April 15-May 12, 1958, p. 293. House of Representatives, Committee on Appropriations, Subcommittee on Department of Defense Appropriations, Hearings, Department of Defense Appropriations for 1960, Part 6, April 14-24, 1959, p. 68. C. C. Furnas, memorandum for Assistant Secretary of the Air Force (R&D) "Scientific Earth Satellite Program," January 9, 1956 (copy in NASA Historical Archives).

11. Green and Lomask, op. cit., Chapter II. The original plan was to identify the rocket to be employed in the announcement of the project. But after the Department of Defense appointed

a committee to select the rocket it became evident that this would take some time. Following meetings with Waterman and Herbert Hoover, Jr., Under Secretary of State, Eisenhower was persuaded that it would be unwise to allow the Soviets to announce their satellite program first. The U.S. announcement was made at the White House by Waterman, Detlev Bronk, president of the National Academy of Sciences, and James C. Hagerty, the President's press secretary.

12. Eugene M. Emme, Aeronautics and Astronautics, An American Chronology of Science and Technology in the Exploration of Space, 1915-1960, NASA, p. 78.

13. As might have been expected from the previous achievements of the Naval Research Laboratory, good progress was made in the development of scientific instrumentation, the network of radio tracking and data-acquisition stations, and the computing equipment for orbital calculations. But there were problems with costs and the development of the three stages of the Vanguard rocket. Eleven attempts were made to place a satellite in orbit; only three succeeded. Originally, the U. S. National Committee for the IGY estimated the program cost at between $15 and $20 million. In its report to the White House, the Department of Defense deliberately doubled this figure, applying what has come to be called the "administrative discount" in evaluating the cost and difficulty of new research and development programs. Events were to show that a much greater "discount" should have been applied. The final total was $95 million. The scientific and technical legacy of Vanguard included:

--The beginning of the shift in the primary concern of Cape Canaveral from ballistic missiles to space flight.

--Second and third stages of the rocket that were held over for use in other programs. Modified only slightly, they were still in use in 1968.

--The first satellites in which there was a long coast period between stage firings, which made circular orbits possible.

--New details about the shape of the earth, learned from the precise measurement of the Vanguard satellite orbits.

--The first use of solar cells to generate electrical power in space.

Green and Lomask, op. cit., provide an authoritative and recent account of the Vanguard program. John P. Hagen tells the story as seen by the program director in "Viking and Vanguard," a chapter in The History of Rocket Technology, ed. Emme. See also "Three Years in Space," Missiles and Rockets, March 13, 1961, p. 13.

14. Of course, other factors than security were involved in the decision and the implacable resistance to any suggestion that it be changed. One was President Eisenhower's strongly held belief that an extension of the missile race into space would threaten world peace. General Eisenhower restated this view when interviewed by Eugene M. Emme and Constance M. Green on November 1, 1966. Another factor was interservice rivalry. The Air Force was in the ascendancy because of its management of the principal ballistic missile programs and the private-sector support resulting from its policy of giving contractors wide scope. The Navy was associated with the existing management arrangements for Vanguard. The Army, in contrast, did much of its development work "in-house" in military arsenals and contracted to a considerably less degree than the Air Force.

Dr. Clifford C. Furnas, a member of the committee charged with selecting a rocket for Vanguard, wrote later that the committee considered a joint Army-Navy project but decided that "breaking the space barrier would be an easier task than breaking the interservice barrier." U. S. Senate, Preparedness Investigating Subcommittee, Hearings, Inquiry into Satellite and Missile Programs, November 25, 1957-January 23, 1958 (hereafter cited as Preparedness Subcommittee Hearings), pp. 319-21. Another factor, difficult to measure with any degree of accuracy, was that of feelings in the United States against the use of the former German engineers and scientists who had been enemies in World War II. The first 40 in the group headed by Dr. Wernher von Braun had just become American citizens on April 15, 1955. Green and Lomask, op. cit., Chapters I and IV. Erik Bergaust, Reaching for the Stars, (Doubleday, 1960) p. 172.

15. For a thorough analysis of the public reaction to Sputnik and subsequent Soviet achievements in space, see Vernon Van Dyke, Pride and Power; The Rationale of the Space Program, (University of Illinois Press, 1963) especially pp. 5-38 and 267-76. Also, Richard Witkin (ed.) The Challenge of the Sputniks (Doubleday, 1958).

16. The first full-range flight of the U.S. Atlas ICBM was more than a year in the future.

17. Gerald W. Siegel interview by Jay Holmes, June 25, 1968 (copy of interview notes in NASA Historical Archives). Among the Senators called by Johnson were Richard B. Russell of Georgia and Stuart Symington, fellow Democrats, and Styles Bridges of New Hampshire, Republican.

18. An immediate reaction was a public demand for more funds for education. One response to this demand was the National Defense Education Act, approved by President Eisenhower on September 2, 1958. Dwight D. Eisenhower, The White House Years: Waging Peace, 1956-61, (Doubleday, 1965) pp. 241-43.

19. New York Times, October 6, 1967.

20. Ibid.

21. Ibid.

22. Dwight D. Eisenhower, Public Papers of the Presidents, 1957, (GPO, 1958) p. 735. Waging Peace, p. 211.

23. Department of State, Public Opinion Summaries (No. 3136), (weekly), October 7, 1957, to November 7, 1957.

24. Newspaper column, October 10, 1955, reprinted in Clinton Rossiter and James Lare (eds.), The Essential Lippman, (Random House, 1963), pp. 66-68.

25. New York Times, October 16, 1957.

26. New York Times, October 21, 1957.

27. Lyndon B. Johnson statements at Tyler, Texas, October 18, 1957, and Austin, Texas, October 19, 1957 (in NASA Historical Archives).

28. Chairman Johnson said: "The objective of this inquiry is not to fix blame or to put anybody on trial. The objective is to determine what steps can be taken to strengthen our position and restore the leadership we should have in technology. The question of who is to blame is far less important than the question of what is to be done." Statement November 4, 1957 (in NASA Historical Archives).

29. Eisenhower, Waging Peace, pp. 212, 224. Enid C. B. Schoettle, "The Establishment of NASA," in Sanford A. Lakoff, Knowledge and Power (Macmillan -- The Free Press, 1966), p. 190.

30. Eisenhower reports in Waging Peace, pp. 210-11, that he had directed Secretary of Defense Charles E. Wilson on October 8, 1957 to have the Army prepare its Redstone as a backup for the Navy Vanguard. But this was Wilson's last full day in office and the order was not immediately relayed through channels.

31. Gabriel A. Almond, "Public Opinion and the Development of Space Technology," in J. M. Goldsen (ed.) Outer Space in World Politics (Praeger, 1963) pp. 92-93. For other aspects of public opinions on space developments in this period, see "Satellites, Science and Public Opinion: A Report of a National Survey on the Public Impact of Early Satellite Launchings," (Survey Research Center, University of Michigan, 1959).

32. Rowland Evans and Robert Novak, Lyndon B. Johnson, The Exercise of Power, (New American Library, 1966) pp. 204-09.

33. Johnson's speech of December 10, 1957, at Dallas is a good example of the thinking at that time. He said: "Every American is going to have to pitch in. We need workers, farmers, professionals, technicians, businessmen. We must call back from retirement our senior citizens and we must call for higher efforts from our children in the schools.

"There is only one type of person we can do without. And that is the man or woman who says: 'It cannot be done.'

"We can outthink, outwork, and outdo Soviet scientists, workers, and production men. We can even handle communist spies.

"The only person who can defeat us is the American who spends his time explaining why he cannot deliver the goods.

"If heads must be knocked together, let's do it.

"If more money is needed, let's spend it.

"If more resources are needed, let's use them.

"If more hours are needed, let's work them.

"Let us do whatever it takes to preserve our country and our freedoms." Text in NASA Historical Archives.

34. Schoettle, op. cit., pp. 187-232.

35. Such views were expressed by a number of scientific groups and scientific leaders during the fall and winter of 1957 and 1958. For example, the Rocket and Satellite Research Panel of the National Academy of Sciences and the American Rocket Society issued a statement on January 4, 1958, explaining that: "The military services are basically operating agencies, not research ones. The research talent of any branch of the military services is almost inevitably turned toward helping meet short-term, limited objectives. Such a point of view would assure the failure of a National Space Establishment in its broad mission -- which is truly a national one, far beyond the mission of any one of the services, or the Department of Defense taken as a whole."

A similar proposal was made by the National Society of Professional Engineers on February 14, 1958. The U. S. National Committee for the IGY on February 14 prepared a lengthy report of the objectives of a continuing program of scientific research in outer space.

U. S. Senate, Special Committee on Space and Astronautics, Compilation of Materials on Space and Astronautics (Hereafter cited as Senate Compilation of Materials) No. 1, March 27, 1958, pp. 17-44.

36. Privileged sources. A related point of view was expressed in a best-selling book published in 1958. "As matters now stand," wrote John Kenneth Galbraith, "we have almost no institutions that are by central design and purpose directed to participation in modern scientific and technological progress and its large-scale application. We have no organization capable, for example, of taking on the large-scale development of atomic power generators or radically new departures in passenger-carrying aircraft in advance of knowledge that these will be commercially feasible. Much has been accomplished by research and development, not immediately subject to commercial criteria, under the inspiration of military need. This has done more to save us from the partial technological stagnation that is inherent in a consumers' goods economy than we imagine. But it is also a narrow and perilous prop, and it has the further effect of associating great and exciting scientific advances with an atmosphere of fear and even terror." The Affluent Society, (Houghton Mifflin), pp. 354-55.

For Scientists' views on classification, see I. I. Rabi, "The Cost of Secrecy," Atlantic Monthly, August, 1960; Panel on Basic Research and Graduate Education, President's Science Advisory Committee (chaired by Glenn T. Seaborg), "Scientific Progress and the Federal Government," Science, Volume 132, December 16, 1960; American Association for the Advancement of Science Committee on Science and the Promotion of Human Welfare (chaired by Barry Commoner), "Science and Human Welfare," Science, Volume 132, July 8, 1960.

37. U. S. Senate, Special Committee on Space and Astronautics, Hearings, National Aeronautics and Space Act, (Hereafter cited as Senate Hearings on Space Act) Part 2, May 13-15, 1958, pp. 281-82.

Apparently, the planning was begun before President Eisenhower had firmly decided to support a civilian agency. But he had already indicated that he believed military and civilian space activities should be considered and justified separately. In a speech at Oklahoma City on November 13, 1957, the President

had said, "if the project is designed solely for scientific purposes, its size and cost must be tailored to the scientific job it is going to do. If the project has some ultimate defense value, its urgency for this purpose is to be judged in comparison with the probable value of competing defense projects." Dwight D. Eisenhower, Public Papers of the President, 1957-58, GPO, 1958 and 1959, p. 234.

Seven years later, Eisenhower wrote: "Information acquired by purely scientific exploration could and should, I thought, be made available to all the world. But military research would naturally demand secrecy. The highest priority should go, of course, to space research with a military application, but because national morale, and to some extent national prestige, could be affected by the results of peaceful space research, this should likewise be pushed, but through a separate agency." Waging Peace, p. 257.

38. Three NASA laboratories were located at military airfields: Langley Air Force Base, Virginia; Moffett Field, California; and Edwards Air Force Base, California.

39. Doolittle and Dryden succeeded in restraining some of the enthusiasm of the NACA's "Young Turks," who were bent on an aggressive campaign to sell the agency's space potential. Dryden memorandum to Eugene Emme, "The NACA-NASA Transition, October 1957 to October 1958," September 8, 1965. Robert L. Rosholt, An Administrative History of NASA, 1958-63, (NASA SP-4101, 1966) pp. 8, 34-35. Schoettle, op. cit., p. 219.

On January 16, 1958, the National Committee approved a proposal under which space research and development would be carried out by the military services and the NACA along the same arrangements as had been the case for aeronautics. The National Science Foundation, in collaboration with the National Academy of Sciences, would provide financial support for scientific activities. U. S. House of Representatives, Select Committee on Astronautics and Space Exploration, Report, The National Space Program, May 21, 1958, pp. 110-115.

40. The launch vehicle was a modification of the Jupiter-C, based on the Redstone, which had been developed under the Jupiter missile program, for testing the re-entry of nose cones into the atmosphere. The Jupiter-C had been tested in flight beginning in September 1956. The satellite was produced by the Jet Propulsion Laboratory, an Army installation at the California Institute of Technology. It used the Vanguard tracking, telemetry, and orbit-computation systems plus an Army missile tracking and telemetry network called microlock. The

scientific instruments were selected by the National Academy of Sciences. The IGY satellite committee transferred to Explorer an experiment that had been developed by Dr. James A. Van Allen of the State University of Iowa for a Vanguard satellite, but which Van Allen had designed also to fit in the Jupiter-C nose cone.

The Redstone was delivered to Cape Canaveral on December 20. By January 17, 1958, it was erected on the launch stand. Installation of the upper stages began a week later and everything but the weather was in readiness by January 27. High winds continued for four days. Green and Lomask, op. cit., Chapter XI. Sullivan, op. cit., pp. 92-94.

41. For several weeks there had been indications that the space program might be established in the Department of Defense, reporting to the Secretary, separate from the three services. Plans were announced on December 5, 1957, for a 1958 reorganization, in which an Advanced Research Projects Agency would be established. Rosholt, op. cit., p. 7 (N). At the close of the first phase of its hearings on January 23, 1958, the Senate Preparedness Subcommittee was noncommital on the organization question, citing as one of 17 urgent pending recommendations the acceleration and expansion of research and development programs and the improvement of control and administration "within the Department of Defense or through the establishment of an independent agency." Senate Compilation of Materials, No. 2, April 14, 1958, p. 207.

The development of Senate sentiment for a civilian agency was evidenced when that body refused on February 6 to agree with the House on an amendment to a military construction bill, which would have authorized the new Advanced Research Projects Agency to contract for research or weapon development. A compromise reached in the Senate-House conference provided authority to engage in advanced space projects but limited to a year, which ended in February 1959. Ibid., pp. 1-30, 203-10, 247-49.

42. Senate hearings on Space Act, Part 2, May 13-15, 1958, pp. 252-533

43. Paul G. Dembling, Notes and Drafts of the National Aeronautics and Space Act, February-June 1958 (in NASA Historical Archives). Dryden's instructions to Dembling were to assist in preparing legislation in advance of the President's decision on assignment of the space mission.

44. Rosholt, op. cit., pp. 8-10. The recommendation to the President was signed by Rockefeller, Killian and Percival Brundage, Director of the Bureau of the Budget.

45. Senate Compilation of Materials, No. 1, March 27, 1958, pp. 45-53. The full text of the PSAC Statement is in Appendix B-I-2.

46. Senate hearings on Space Act, Part 2, pp. 280-81.

47. Senate Compilation of Materials, Part 2, April 14, 1958, pp. 79-83.

48. Dembling, op. cit.

49. J. A. Van Allen, G. H. Ludwig, E. C. Ray and C. E. McIlwain, "Observation of High Intensity Radiation by Satellites 1958 Alpha and Gamma," Jet Propulsion 28, 1958, pp. 588-92. Sullivan, op. cit., pp. 108-35.

50. Alison Griffith, The National Aeronautics and Space Act: A Study in the Development of Public Policy, (Public Affairs Press, 1962) pp. 21, 46-52; Schoettle, op. cit., pp. 246-61. Mary Stone Ambrose, The National Space Program; Phase I: Passage of the National Aeronautics and Space Act of 1958, M. A. dissertation (American University, 1960) pp. 103-07. At one point during the hearings, Dr. Killian visited Gerald W. Siegel, counsel to the Senate Democratic Policy Committee who was serving and counsel to the special committee. Killian pleaded with Siegel to eliminate the policy board, arguing that it was an affront to the President. Siegel had to reply that Johnson was adamant on this point. The Majority Leader believed that if the President did not take responsibility for space policy a continuation of Vanguard failures would be inevitable. Siegel, op. cit.

51. Schoettle, op. cit., pp. 257-59. (However, the description of Senate-House staff contacts on p. 259 should not be entirely relied on; it contains several errors in identification of Congressional staff personnel.)

52. Siegel, op. cit.

53. Griffith, op. cit., pp. 90-96.

54. P. L. 85-568, July 29, 1958. The provision for "excepted positions" was a key to NASA success in recruiting qualified personnel from outside the government. Text of the National Aeronautics and Space Act is in Appendix B-I-3.

55. Griffith, op. cit., p. 97.

56. Marc Kremers, notes on Mrs. Johnson's interviews with Nancy Dickerson, NBC-TV, August 23, 1964. First on the list was Mr. Johnson's services as Texas chief of the National Youth Administration in the 1930's.

57. Emme, Aeronautics and Astronautics 1915-60, pp. 100-01. Glennan biography, released by NASA January 19, 1960. Apparently, Dryden was passed over for the post of Administrator because of Congressional beliefs, especially in the House, that he was too conservative. In his testimony, he said he would proceed cautiously in manned space flight. As for a proposal by von Braun to launch a man on a ballistic flight atop a Redstone missile, he said it was "about the same technical value as the circus stunt of shooting the young lady from the gun." After this statement drew criticism, he modified it to say that the Redstone flight "may be justified as part of a very comprehensive program." House Select Committee Hearings, April 15-May 12, 1958, pp. 117, 415-16, 420, 470-71, 892-93, 950-56. House Select Committee Hearing, Authorizing Construction for NASA, pp. 9-15; see also Fulton's ironical remark to Dryden on p. 21.

58. First Semiannual Report to the Congress of the National Aeronautics and Space Administration, June 24, 1959, p. 38. (Henceforth, these will be cited as First (Second, Third, etc.) Semiannual Report). The centers were the Langley Research Center, Hampton, Va.; the Lewis Research Center, Cleveland, Ohio; the Ames Research Center, Moffett Field, California; and the High Speed Flight Station, Edwards Air Force Base, California. The Langley Research Center operated a pilotless aircraft research station at Wallops Island on the Atlantic coast of Virginia. The Lewis Research Center operated the Plum Brook Research Facility, where a large nuclear reactor was under construction, at Sandusky, Ohio.

59. Rosholt, op. cit., pp. 44-45. The Vanguard employees also included a small contingent at Cape Canaveral and those at tracking stations in several Latin American Countries.

60. Ibid., pp. 45-47. See First Semiannual Report, p. 64, for the membership of the Space Council at that time. Council meetings were frequently arranged to coincide with meetings of the National Security Council, in view of the overlapping membership of the two bodies.

61. Jay Holmes, "Fund Shortage Delays Saturn Program," Missiles and Rockets, October 19, 1959.

62. Ford Eastman, "Pressure Rising for Service Unification," Aviation Week, September 7, 1959, p. 30. Robert Hotz, "Growing Pressure for Real Unification," editorial in Aviation Week, September 14, p. 21; "USAF-Industry Relations," p. 25. "USAF Gains Major Role in Transfer of ARPA Programs," Aviation Week, September 28, 1959, pp. 27-28. "Air Force Gets Bulk of ARPA Space Projects," Missiles and Rockets, September 28, 1959.

63. David Akens, Historical Origins of the George C. Marshall Space Flight Center, NASA, 1960, pp. 69-80, 89-92.

64. The Wallops Island station, where the NACA had been operating, was expanded to include the neighboring Chincoteague Naval Air Station, deactivated in 1959. The Beltsville facility was on surplus land obtained from the Department of Agriculture. Eisenhower announced on April 23, 1959, the appointment of Richard E. Horner, Assistant Secretary of the Air Force for Research and Development, as Associate Administrator, the third-ranking official of NASA, effective June 1. Horner, who remained with the space agency until August 1960, was one of several senior civilian officials who moved from the Air Force. Arrangements were also made for the detailing of military personnel to the space agency under an agreement between NASA and the Department of Defense, Army, Navy and Air Force, approved by Eisenhower on April 13, 1959. Rosholt, op. cit., pp. 45, 79, 104.

65. Fifth Semiannual Report, pp. 164-66. The personnel total did not include the 2,700 employees of the Jet Propulsion Laboratory.

66. The Office of Advanced Research Programs was headed by John W. Crowley, Jr. until July 1959, when he was succeeded by Ira H. Abbott. The Goddard center, the Wallops station and the Jet Propulsion Laboratory were assigned to the space flight office. The Marshall center was assigned to the launch vehicle office. Both offices had contingents at Cape Canaveral. The Jet Propulsion Laboratory occupied a place in the NASA structure similar to that of the field centers staffed by civil service employees, although it was operated by Cal Tech under a contract with NASA. Chapter IV contains material covering the relationship between JPL and NASA.

67. Fourth Semiannual Report, p. 227; see also NASA/DOD joint release, "Aeronautics and Astronautics Coordination Board Actions Outlined," NASA No. 61-3, January 12, 1961.

68. At a hearing before the House Select Committee on August 1, 1958, Robert R. Gilruth made the first presentation of NASA manned space flight plans. This indicates that President Eisenhower's formal decision on the man-in-space mission was in the last three days of July. Informally, however, the President's decision had been anticipated earlier.

69. NACA and NASA thinking about manned space flight had begun to develop a short time after Sputnik. At an NACA conference on aeronautical research on October 15, 1957, Maxime A. Faget of the Langley laboratory announced that he would spend no more time on advanced winged vehicles. In view of recent events, he said, he proposed to begin to work on a project to orbit a man as soon as possible. In the months that followed, a number of NACA researchers followed Faget's lead. They turned their attention to examination of how a ballistic missile might place a wingless capsule in orbit and return it through the atmosphere to a safe landing. A general consensus developed that this would be simpler and faster than orbiting a winged vehicle.

Glennan and Roy Johnson, Director of ARPA, agreed in September 1958, that their two agencies would cooperate in developing a man-in-space program. The coordinating committee, headed by Gilruth, agreed that the most reliable available boost system would be used, that retro-thrust would be applied for descent from orbit, that parachutes would be deployed following the vehicle's slowing by aerodynamic drag, and that recovery on land or water would be possible. Loyd S. Swenson, Jr., James M. Grimwood and Charles C. Alexander, This New Ocean; A History of Project Mercury (NASA SP-4201, 1966) pp. 71-132. The Space Task Group grew rapidly. In January 1961, it was established as separate field installation. The staff on June 30, 1961, totaled 794. Fifth Semiannual Report, pp. 152, 166.

70. Criteria for selection were: age under 40, height less than 5 feet 11 inches, excellent physical condition, bachelor's degree or equivalent, graduate of test pilot school, 1500 hours total flying time and qualified jet pilot. Preliminary service record checks by the Pentagon revealed that 110 men on active duty appeared to be qualified. The final selection of seven was recommended by a committee headed by Charles J. Donlan, assistant director of the Space Task Group. Swenson, Grimwood and Alexander, op. cit., pp. 129-31, 159-65. Astronauts are listed in Volume Two.

71. This arrangement had its origin a day or so before the selections were announced when Walter T. Bonney, NASA director of public information, visited C. Leo DeOrsey, a Washington attorney who represented a number of sports and entertainment

personalities. Bonney told DeOrsey that he had been receiving inquiries involving the prospective astronauts' private interests, which he felt should be handled by a private attorney. He asked DeOrsey to represent the seven. DeOrsey agreed, but stipulated that it would be without compensation, either for services or for expenses. Bonney arranged that DeOrsey and the astronauts were introduced at a dinner at the Pentagon. The astronauts agreed that their personal stories would be sold together, rather than in separate transactions. DeOrsey discussed the matter with John A. Johnson, NASA general counsel, and an attorney representing the Department of Defense. C. Leo DeOrsey, Statements at NASA news conference, "Mercury Astronauts Decline Gift Homes," Release No. 62-82, April 3, 1962. See also Edwin Diamond, The Rise and Fall of the Space Age, (Doubleday, 1964) pp. 81-98. President Kennedy approved a similar arrangement for the astronauts with Field Enterprises.

72. U. S. Senate, Committee on Aeronautical and Space Sciences (henceforth referred to as Senate Space Committee) report, Project Mercury: Man-in-Space Program of the National Aeronautics and Space Administration, December 1, 1959, pp. 17-19.

73. C. Paul Means, "Mercury Must Get More Money -- Or Slip," Missiles and Rockets, January 11, 1960, p. 30.

74. Swenson, Grimwood and Alexander, op. cit., pp. 643-46. The Atlas, first U. S. ICBM, was selected as the booster for orbital flight. A successful flight test, boosted by an Atlas in September 1959 verified the heat shield and spacecraft design for re-entry into the atmosphere, and the procedures for recovery at sea. But on the first launch of an Atlas and an unmanned Mercury spacecraft on July 29, 1960, the vehicle exploded 65 seconds after liftoff. The problem was solved by strengthening the front end of the Atlas; this was verified in the successful second Mercury-Atlas flight test on February 21, 1961. But on a third flight test on April 25, 1961, the Atlas booster failed again.

Plans were incorporated in the program for short-range training flights boosted by the Army's Redstone. Unmanned flight tests began successfully on December 19, 1960. The second flight test carried a chimpanzee named "Ham," into space and back safely on January 31, 1961. But there were several malfunctions in the Redstone vehicle -- lengthened from 77 to 85 feet for the Mercury program. Corrections were verified in a booster development flight on March 24, 1961. On April 29, 1961, the spacecraft was qualified for manned flight in a successful test of its abort system, on the last of a series of unmanned flights employing a specially developed, relatively low-cost

cluster of solid-fuel rockets, called the Little Joe. Swenson, Grimwood, and Alexander, op. cit., pp. 272-79, 286-301, 310-22, 326-31, 335-38.

75. Those present were Dr. George B. Kistiakowsky, who had succeeded Killian as special assistant to the President for science and technology, Gordon Gray, special assistant to the President for national security affairs, Karl G. Harr, Jr., special assistant to the President for security operations coordination, Charles A. Sullivan of the Department of State, Foster Collins of the Central Intelligence Agency, and the three top officials of NASA, T. Keith Glennan, Hugh L. Dryden and Richard E. Horner. T. Keith Glennan, memorandum for file, July 24, 1959, with attachments: Participants 23 July meeting, and excerpts from the Preliminary U. S. Policy on Outer Space for use at the 23 July meeting.

76. The lunar vehicles were as follows:

Thor-Able, August 17, 1958, exploded after 77 seconds of flight.

Pioneer I (Thor-Able), October 11, 1958, traveled 70,000 miles (30% of the distance to the moon) and fell back to earth.

Pioneer II (Thor-Able), November 8, 1958, third stage failed to ignite.

Pioneer III (Juno II), December 6, 1958, traveled 63,000 miles and fell back.

Pioneer IV (Juno II), March 3, 1959, achieved escape velocity, passed within 37,300 miles of the moon and entered solar orbit.

Atlas-Able I, September 1959, exploded on launch pad during test.

Atlas-Able II, November 26, 1959, fairing fell off nose just as second stage ignited.

Atlas-Able III, September 25, 1960, upper stage failed.

Atlas-Able IV, December 15, 1960, exploded after 74 seconds of flight.

77. Pioneer V discovered that there is an interplanetary magnetic field, that radiation intensity varies greatly during magnetic storms, and that the earth's magnetic field extends at times out to a distance of 65,000 miles. "Pioneer V Found Radiation Belt Past Van Allen Belts," Missiles and Rockets, July 18, 1960, p. 85. The record was exceeded by the U.S. Mariner II, which reached Venus in December 1962.

78. The new programs were planned to use the more powerful launch vehicles based on the Atlas ICBM, which were just becoming available. Ranger was to make rough landings on the moon,

Surveyor was to carry retro-rockets large enough for soft landings, and Mariner was to fly by Venus and Mars. JPL-Industry Conference Proceedings, Jet Propulsion Laboratory, California Institute of Technology, November 18, 1960.

79. Building on the discovery of the radiation belts by Explorer I, a number of other early U.S. satellites orbited by NASA and the military services obtained details of the radiation, magnetic and meteoroid environment in space near the earth. These results were supplemented by the reports from Sputnik III, a 3,000-pound Soviet satellite orbited May 15, 1958. W. Hess, C. Mead and M. P. Nakada, Significant Achievements in Particles and Fields 1958-64, NASA SP-97, GPO, 1966.

80. The TIROS program originated from early studies conducted in laboratories of the U.S. Weather Bureau, the Army, the Navy, and the Air Force. The first experiment in satellite meteorology was part of the mission of Vanguard II, orbited in Feburary 1959. The second was on Explorer VII, launched in October 1959.

The first efforts to develop a satellite fully devoted to weather observation were begun by the Army and transferred to ARPA in April 1958. A year later, the program was shifted to NASA. The TIROS pictures were used both for weather forecasting and for weather research. TIROS II, on November 23, 1960, continued these observations and also carried infrared instruments that showed it was possible to measure the temperatures on earth and at the top of clouds. Senate Space Committee staff report, Meteorological Satellites, March 29, 1962, pp. 26-36; Richard Chapman, Tiros-Nimbus; Administrative, Political and Technological Problems of Developing U.S. Weather Satellites, the Inter-University Case Program, Inc., unpublished draft, March 1966, in NASA Historical Archives, pp. 35-40.

81. Dwight D. Eisenhower, Public Papers of the Presidents, 1960-61 (GPO, 1961), pp. 889-90. Jay Holmes, America on the Moon, (Lippincott, 1962) pp. 147-61. The first communications experiment was carried out successfully with an Atlas ICBM, placed in orbit by the Air Force in December 1958. The Army's Courier I satellite, orbited in October 1960, showed that the problem of crowded radio channels could be overcome by transmitting signals to a satellite, which would record them and retransmit in the neighborhood of the recipient.

Still another communications experiment was carried out successfully with a balloon 100 feet in diameter, composed of thin plastic covered with aluminum foil. The balloon satellite, called Echo I, was the first object in space to be easily visible

from the earth. Echo I was folded in a manmade small package when launched on August 12, 1960, and was inflated after it achieved orbit. Radio signals were transmitted to the satellite, which reflected them back to earth.

Eisenhower's last budget, transmitted to the Congress on January 16, 1961, included an estimate of $10 million in anticipated income from private industry for launching of satellites. On January 19, 1961, the Federal Communications Commission approved a request by AT&T that a new frequency band be set aside for satellite communications. When the Radio Corporation of America was selected as contractor for the Relay satellite, Administrator Webb re-affirmed Glennan's decision to make rockets and launch services available to AT&T at cost, agreeing to launch on a re-imbursable basis the Telstar satellite which had been developed by AT&T.

82. Akens, op. cit., pp. 58-60, Saturn Illustrated Chronology, (NASA Marshall Space Flight Center, May 15, 1965) p. 1.

83. Rocketdyne Division North American Aviation, Inc., news release, "F-1 Engine Background," February 4, 1960.

84. House of Representatives, Committee on Science and Astronautics (henceforth referred to as House Space Committee), Subcommittee on Space Sciences, Hearings, Centaur Program, May 15 and 18, 1962, p. 2. The ability to work with large quantities of liquid hydrogen, which boils at 423° below zero Fahrenheit -- just 36° above absolute zero -- had emerged from research conducted in the 1950's by the Atomic Energy Commission, the National Bureau of Standards and the NACA. "U.S. Liquid Hydrogen Stream Swells," Missiles and Rockets, August 17, 1959, pp. 21-22. The program was transferred to the Lewis Research Center in 1962.

85. Akens, op. cit., pp. 61, 63; Fifth Semiannual Report, p. 64. Pending the availability of the J-2 engine, plans were developed for a smaller second stage, designated S-IV, which would employ engines of the type used in the Centaur. The significance of these early decisions to begin the development of the F-1 and J-2 engines was only to emerge in the later planning and scheduling of the manned lunar landing program. It became evident that these early starts made it possible to target the program in the decade. This illustrates how such developments can begin in advance of the full definition of their ultimate need.

86. Rover, the nuclear rocket program, was begun in 1955 by the Atomic Energy Commission in cooperation with the Air Force, aimed at developing a nuclear reactor that would raise hydrogen gas to a high temperature and expel it through a nozzle generating thrust. The Air Force participation was transferred to NASA in 1958. In September 1960, NASA and AEC agreed to establish a joint Nuclear Propulsion Office that would consolidate the work carried out in the two agencies. Harold B. Finger of NASA was appointed to manage the office, with Milton Klein of AEC as his deputy.

Other technology development included nuclear, solar, and chemical devices to generate electrical power, investigation of materials that would retain their strength under very high and very low temperatures, and devices to simulate on earth the conditions of space flight. Senate Space Committee, Hearings, NASA Scientific and Technical Programs, February 28 and March 1, 1961, pp. 91-110, 421-41.

A number of technological advances in the military missile and space programs in this period influenced the course of the civilian space program. Principal among these were the first recovery of a satellite from orbit -- Discoverer XII on August 11, 1960 -- the first restart of a rocket in space -- the Ablestar stage that orbited a Navy Transit satellite on April 13, 1960 -- and the beginning of development of the Titan II ICBM which employed fuel and oxidizer that could be stored in liquid form at ordinary temperatures and ignited on contact with each other. "Major Missile/Space Developments During 1960," Missiles and Rockets, December 19, 1960, pp. 34-35.

87. Eugene M. Emme, "Historical Perspectives on Apollo," Journal of Spacecraft and Rockets, (April 1968) p. 373. James E. Webb, letter to Senator Clinton P. Anderson, July 9, 1964. House Space Committee, Hearings, Review of the Space Program, January 20 - February 5, 1960. See also George M. Low, NASA History interview by Addison M. Rothrock, Eugene M. Emme and Jay Holmes, May 1, 1964, pp. 3-6, for details of early planning for advanced manned flight programs.

88. House Space Committee report, Space, Missiles and the Nation, released July 3, 1960, p. 55.

89. NASA - Industry Program Plans Conference, July 28-29, 1960, pp. 80-84. The booster for earth-orbital flight was to be the first version of the Saturn, then called the C-1. For circum-lunar flight, it was expected that an advanced model of the Saturn, called C-2, would be used.

90. George M. Low, memorandum for Director of Space Flight Programs, October 17, 1960; Low interview by Rothrock, Emme and Holmes, pp. 8-9.

91. President's Science Advisory Committee, Report of the Ad Hoc Panel on Man-in-Space, December 15, 1960.

92. Privileged sources.

93. Eisenhower, Public Papers of the Presidents, 1960-61, (GPO, 1961) p. 972.

94. For example, see Frank Gibney, "The Missile Mess," Harper's, January 1960, pp. 38-45, and Graham DuShane, "Difficult Decisions," editorial in Science, Vol. 132 (October 21, 1960).

During the years immediately following Sputnik, opinion in the United States consolidated in support of space exploration. Indications could be found in surprising places. For example, in Allen Drury's novel Advise and Consent (Doubleday, 1959) an expedition to the moon forms a vital part of the denouement. And in the board game Careers, which became popular in the late 1950s, a landing on the moon is depicted as the ultimate success.

95. A consensus view of a number of persons in NASA who have observed these events.

96. The first flight was on May 15, 1960. The next flight, carrying two dogs, returned them safely to earth in August 1960. Senate Space Committee, staff report, Soviet Space Programs, May 31, 1962, pp. 104-17.

97. Missiles and Rockets magazine invited the two Presidential candidates to state their views on the defense and space programs. Their replies:

Kennedy: "We are in a strategic space race with the Russians, and we have been losing, . . . control of space will be decided in the next decade. If the Soviets control space they can control earth, as in past centuries the nation that controlled the seas dominated the continents . . . . This is the new age of exploration; space is our great New Frontier." October 10, 1960, pp. 12-13.

Nixon: "If the Eisenhower Administration had not long ago recognized that we were in a strategic space race with Russia, our space record would not be as creditable as it is today . . . . The program calls for launching and operation of a permanent manned space station . . . in the period 1966-67 . . . . The moon landings are presently scheduled for the period 1970-71. It is entirely possible that this target date will be advanced." October 31, 1960, pp. 10-11.

98. Holmes, America on the Moon, p. 189. White House news release, December 29, 1960.

99. The report was classified. The unclassified version that was released recommended strengthening of the role of the Space Council, improved management of the military and civilian space programs, and a review of space objectives in view of the experience of the previous two years. Other portions, not released, dealt with the military applications of space and included comments that were reported to be even more critical of NASA.

News Release, Report to the President-elect of the Ad Hoc Committee on Space, January 12, 1961. See also Brooks letter to Kennedy, infra, note 106.

100. Lyndon B. Johnson, Presidential Documents, March 21, 1966, November 2, 1968.

101. Webb had served on the staff of the House Rules Committee in the early 1930s, and in the Truman Administration for three years as Director of the Budget and three years as Under Secretary of State. In industry, he had spent seven years with the Sperry Gyroscope Company, rising to vice president in 1943, eight years with Kerr-McGee Oil Industries of Oklahoma City (five of them as president of an associated company, Republic Supply Company) and eight years as a director of McDonnell Aircraft Company of St. Louis. He was a reserve officer in the U.S. Marine Corps and a naval aviator. At the time of his appointment as NASA Administrator, he was president of Educational Services, Inc., an enterprise based at the Massachusetts Institute of Technology, chairman of the Municipal Manpower Commission and chairman of the Meridian House Foundation. He was also a trustee of the Committee for Economic Development. Wiesner telephoned Webb in Oklahoma City on January 27, 1961, to ask whether he would be interested in the post. Webb's biography is in Volume Two.

102. Webb's first reaction was that he should not accept the post and that the President should seek a scientist or an engineer. On Monday, January 30, he went to the office of the Vice President, where he found Dryden. While waiting to see the Vice President, Webb asked Philip Graham, publisher of the Washington Post, how he could get out of the line for the post. Graham told Webb his only hope was Clark Clifford, a Washington attorney who had served in the Truman Administration. Webb telephoned Clifford, who laughed and said: "Don't ask me to help you; I recommended you." The conversation with Graham

took place while Johnson was meeting with Frank Pace, president of the General Dynamics Corporation, who had served in the Truman Administration as Secretary of the Army and Budget Director. Following the discussions, including a long talk with Dryden, and the telephone call to Clifford, Webb agreed to go with Johnson to meet with the President.

Hugh L. Dryden, NASA History interview by Walter Sohier, Arnold Frutkin and Eugene Emme, March 26, 1964. Webb remarks at NASA-OSSA senior council meeting, January 26, 1968. Comments on draft of this chapter, November 1, 1968. John M. Logsdon, "We Should Go to the Moon." Project Apollo and National Decision Making, New York University Ph. D. dissertation, 1968, Chapter III.

Webb's first major decision after he assumed office on February 14, 1961, was to request Dr. Robert C. Seamans, Jr., to continue as Associate Administrator. Foreword to Roshold, op. cit., February 3, 1966, p. iv. Seamans (1918-), chief engineer of the Missile Electronics and Controls Division, Radio Corporation of America, and a former professor at Massachusetts Institute of Technology, had been appointed to the No. 3 NASA post by Administrator Glennan. NASA News Release, No. 60-230, July 19, 1960. He was a Republican. Interview by Jay Holmes, July 1961.

103. Dwight D. Eisenhower, Public Papers of the Presidents, 1960-61, GPO, 1961, pp. 1035-40. Text in Appendix B-I-4. Cf. Howard Margolis, "Ike's Farewell Address," Science, Volume 133, January 27, 1961, p. 263.

104. Webb remarks at meeting of NASA Management Advisory Committee, January 29, 1968.

105. Webb foreword to Rosholt, op. cit., pp. v-vi.

106. Webb comments on earlier draft of this chapter, November 1, 1968. Overton Brooks, letter to President Kennedy, March 9, 1961. Problems revolving around relationships with the Department of Defense developed during Webb's first week in office. In the preparations for the second flight of the Mercury-Atlas vehicle, changes had been made in the Atlas as the result of studies by NASA. The Air Force declined to assume responsibility for the success of the flight. Assured by the NASA staff that the changes were proper, Webb authorized the flight to proceed. The Air Force protested to Kennedy but he ruled that NASA was responsible. The flight was carried out successfully on February 21. Webb interview by John M. Logsdon, December 15, 1967, in NASA Historical Archives.

On February 23, 1961, Webb and the Deputy Secretary of Defense, Roswell Gilpatric, signed a letter of understanding

in which neither NASA nor the Department of Defense would initiate the development of a launch vehicle without written acknowledgement of the other agency. NASA Management Instruction NMI 1052-22, March 17, 1961.

At a meeting on February 24, Secretary of Defense McNamara indicated to Webb that he favored an acceleration of the NASA programs, particularly with respect to large boosters. Webb memorandum for record, "Conference with McNamara," February 24, 1961.

107. John F. Kennedy, letter to Overton Brooks, March 23, 1961.

108. Space Science Board, Man's Role in the National Space Program, March 27, 1961. The board, headed by Dr. Lloyd V. Berkner, reached its conclusions on February 10 and 11, 1961, and Berkner communicated it to Webb a few weeks later. The written report was submitted to NASA the next month.

109. Webb letter to Bureau of the Budget, March 17, 1961. During the last months of 1960, Administrator Glennan authorized several studies of NASA's plans. Following a meeting of the senior NASA staff in October at Williamsburg, Virginia, the group headed by George Low was asked to expand the scope of its studies of a manned lunar landing program. The Low report was presented to Glennan in early January and submitted in writing on February 7, a week before Webb took office. Dryden interview by Sohier, Frutkin and Emme.

Also on March 17, Webb announced in a speech before the American Astronautical Society that he was reviewing the rate at which progress could be made toward the "next intermediate goal of manned space flight, the manned space station." He intended this as a signal that he favored a bigger program. See also Rosholt, op. cit., p. 190, and Logsdon, op. cit., Chapter II.

110. Dr. E. C. Welsh, interview by Jay Holmes, May 1961; Dryden, op. cit., Logsdon, op. cit. Webb comments November 1, 1968.

111. James E. Webb, Administrator's Presentation to the President, March 21, 1961.

112. Welsh, op. cit.

113. Other flights in this period were: February 4, Sputnik IV, 14,292 pounds, which set a record for total weight in orbit that was to stand until January 1964; February 12, a similar spacecraft

in a similar orbit, from which it launched a 1,419-pound spacecraft toward Venus, but radio contact with the probe was lost during the first few days; March 9, Spacecraft IV, the fourth flight test of the manned spacecraft, carrying a dog and other biological specimens, reported recovered in the predetermined area of the Soviet Union; March 25, Spacecraft V, again carrying a dog, and again recovered in the predetermined area. Aeronautical and Astronautical Events of 1961. (NASA report to the House Space Committee, June 7, 1962) pp. 80-81. Dryden said it appeared that Sputnik IV failed in an attempt at Venus, and that the February 12 launch was of a backup vehicle. Interview by Jay Holmes, February 15, 1961.

114. Tass announcements, released April 12, 1961, by the Soviet Embassy in Washington: "Soviet Astronaut in Orbit," "While in Orbit," "Man Safely Back from First Flight in Space," "Soviet Astronaut Yuri A. Gagarin." Holmes, America on the Moon, pp. 83-102. Gagarin died in the crash of a jet plane during a training flight on March 27, 1968.

115. Anonymous, The First Man in Space, (translations of Soviet press reports in a pamphlet published by Crosscurrents Press, Inc., 1961) pp. 46-48.

116. House Space Committee, Hearing, Discussion of Soviet Man-in-Space Shot, April 13, 1961, p. 31.

117. House Space Committee, Hearings, 1962 NASA Authorization, Part I, March 13-April 17, 1961, p. 376.

118. Also present was Hugh Sidey, correspondent for Time-Life magazines, who published accounts of the meeting. John F. Kennedy, President, (Atheneum, 1963) pp. 120-23, Life, April 21, 1961, pp. 26-27. Hugh L. Dryden desk calendar. James E. Webb, interview by John M. Logsdon, December 15, 1967 (in NASA Historical Archives).

119. The legislation was sent to Congress on April 10, passed by both Houses by April 20, and approved by Kennedy on April 25. The change also eliminated the four appointed members, leaving only the Secretaries of State and Defense, the NASA Administrator and the AEC Chairman, and placed the Council organizationally in the Executive Office of the President. Logsdon, op. cit., Chapter IV.

120. John F. Kennedy, "Memorandum for Vice President," April 20, 1961. Text is in Appendix B-I-5.

Another factor making for a warm spring was the disastrous attempted invasion of Cuba. The invasion force went ashore at the Bay of Pigs on April 17. During the night of April 18 and the early morning of April 19, President Kennedy decided not to commit American military forces openly to the rapidly collapsing situation.

Some scholars and other commentators have speculated on how the Bay of Pigs might have contributed to Kennedy's decision to undertake a lunar landing program. But it remained for future investigators to examine whether the worldwide reaction to the Gagarin flight influenced Kennedy's initial decision to permit the Bay of Pigs operation. The chronology of these events suggested a relationship, but hard evidence was unavailable. See comments by Emme in "Historical Perspectives on Apollo," p. 379 (N). Also Logsdon, op. cit., Chapter IV.

121. Untitled and unsigned NASA memorandum, April 22, 1961, which starts: "I. Do we have a chance of beating the Russians?" (in NASA Historical Archives). Theodore C. Sorenson, Kennedy, (Bantam Books, 1966) pp. 590-91.

122. Logsdon, op. cit. See also the portion of the Departmental Histories Project prepared by the Executive Secretary of the National Aeronautics and Space Council.

123. Dryden interview by Sohier, Frutkin and Emme, p. 18. See also Leonard Mandelbaum, unpublished paper, "How the United States Decided to Go to the Moon," September 1967 (in NASA Historical Archives).

124. Webb interview by Logsdon, December 15, 1967.

125. Ibid. Mae M. Link, Space Medicine in Project Mercury, (NASA SP-4003, 1965), pp. 114-25; Swenson, Grimwood and Alexander, op. cit., pp. 325, 331, 347-51; Low interview by Rothrock, Emme and Holmes, pp. 21-26.

126. With more than 400 representatives of the news media at Cape Canaveral, concern developed in Washington about the circus atmosphere resulting from the intense coverage. In response, Administrator Webb issued a statement on May 1, which said in part:

> This program from its inception has been operated in the belief that the public has a right to know what this country is doing in the space field . . . . This has been so because we operate in a democratic society where our failures are known as well as our successes . . . . The recent Soviet flight was already successfully in progress before announced and neither details nor the scientific data collected are yet available.
>
> NASA has not attempted to encourage press coverage of the first manned Mercury Redstone flight. It has responded to press and television requests . . . .

James E. Webb, statement released by NASA, May 1, 1961. Webb letter to Dr. Vannever Bush, May 15, 1961.

The news media had requested representation in the blockhouse and the control center, so that they could report events immediately, without awaiting an official announcement. The flight operations staff resisted this on the ground that the presence of the press would interfere with the conduct of the mission. A compromise was worked out under which a public affairs officer, John A. Powers, an Air Force lieutenant colonel assigned to NASA's Space Task Group, would make announcements to the news media from the control center. These were carried live by radio and television. Walter C. Williams, interview by Addison Rothrock, Jay Holmes, and Eugene M. Emme, March 25, 1964. At the end of 1961, the editors of the Associated Press voted that the leading news story of the year was that of man in space, Washington Star, December 27, 1961, p. A-2.

In a Presidential report, the United States Information Agency said at year's end:

> The policy of 'openness' observed in both U. S. manned space flights during the year dramatized the basic difference between the American open society and the Soviet closed society, and drew widespread approval from commentators throughout the free world. The availability of full information about the events through all news media, together with the presence of foreign correspondents -- who gave first-hand, on-the-spot coverage -- enabled overseas audiences to achieve a high degree of self-identification with one of the greatest adventures of our time.

President's Report to the Congress, U. S. Aeronautics and Space Activities 1961, pp. 89-90. This and subsequent annual reports will be cited henceforth as President's Report to Congress (year).

127. On May 8, Shepard and his fellow astronauts were honored in Washington at a White House ceremony, a parade down Pennsylvania Avenue, receptions by the House and Senate, and a State Department Luncheon. Swenson, Grimwood and Alexander, op. cit., pp. 352-62.

128. Logsdon, op. cit.

129. James E. Webb, oral comments on draft of this chapter, November 1, 1968. Also important was the reduction of travel in the event of need to return the booster from Cape Canaveral for rework. Webb kept Vice President Johnson informed of these discussions. See his "Memorandum for the Vice President," May 23, 1961.

130. John F. Kennedy, Special Message to the Congress on Urgent National Needs, May 25, 1961. Text of the portion on space is in Appendix B-1-6. At the same time, Kennedy turned down a recommendation by the Council of Economic Advisers and Secretary of Labor Arthur Goldberg for a substantial public works program to stimulate the national economy. One author has written that this decision was one of the worst defeats suffered by Dr. Walter Heller during his service as council chairman. The economists believed that the expenditures in the space and other programs proposed in the May 25 message would be insufficient stimulus to avoid a recession. However, the question became moot in the summer of 1961, when the Berlin crisis and other international developments led to additional military expenditures. Hobart Rowen, The Free Enterprisers: Kennedy, Johnson, and the Business Establishment, (Putnam's 1965) pp. 169-72.

131. Sorensen, op. cit., p. 591; Logsdon, op. cit.

132. In addition to the lunar landing effort, the message called for intensification of NASA's work on weather and communications satellites, the joint NASA-AEC work on nuclear rockets, and the Air Force program to develop large solid-propellant booster rockets.

133. Holmes, op. cit., pp. 204-05; Joseph Turner, "A Matter of Perspective," editorial in Science, Vol. 133, June 16, 1961, p. 1883. For an example of the rationale of the decision, see Hugh L. Dryden's letter of June 22, 1961, to Senator Robert S. Kerr, text in Appendix B-I-7. Senate Space Committee, Hearings, NASA Authorization for Fiscal Year 1962, June 7-12, 1961. The actual appropriation was $1.672 billion -- $112 million less

than requested. However, NASA obtained a supplemental appropriation the following spring, which brought the total to $1,824 billion. See Section A-V, "NASA Financial Data," in Volume Two.

134. Webb interview by Drs. Harvey, Suojanen, Messrs. Wooten, Murtaugh, Kirkpatrick, Close, March 16, 1968, p. 62 (In NASA Historical Archives).

135. Holmes, America on the Moon, pp. 206-12.

136. President's Report to Congress, 1961, p. 29. Aeronautical and Astronautical Events of 1961, pp. 48-49.

137. Webb's introduction to Rosholt, op. cit., pp. iv-v. Webb comments on draft of this chapter, November 1, 1968.

138. Webb interview by Charles Atkins and Eugene M. Emme, September 9, 1966 (in NASA Historical Archives), pp. 10, 18. One example of reliance on existing institutions was a decision to employ the Army Corps of Engineers to manage NASA's multi-billion dollar construction program. Webb comments November 1, 1968.

139. The new sites were:

--An extension of the government reservation at Cape Canaveral, Florida, adding about 85,000 acres to the north and east of the Air Force Missile Test Center, for a fivefold increase in its size, for launch of the lunar mission.

--A 1,000-acre site 15 miles southeast of Houston for the Manned Spacecraft Center, which incorporated the former Space Task Group at Langley Field, Virginia.

--The government-owned Michoud Ordnance Plant on the eastern edge of New Orleans, with 1,800,000 square feet of manufacturing space, for the fabrication of large launch vehicle stages.

--A 13,500-acre site in southern Mississippi, 40 miles east of New Orleans, for the test firing of large launch vehicle stages. In addition, NASA planned to acquire easement rights to about 128,000 acres as a buffer zone surrounding that site, where private farming, lumbering, grazing and mineral operations would be possible, but residents would be moved out.

The four locations formed a complex of facilities at warm water ports, with access to the sea, where it would be possible to work outdoors most the year.

Prime contracts were awarded for the development of the Apollo spacecraft (except for the lunar landing stage); for

the Apollo guidance and navigation system; and for the three stages of a powerful new launch vehicle, the Advanced Saturn (later named the Saturn V).

In the unmanned Ranger lunar program, plans were made to carry a television camera on the spacecraft so that pictures of potential landing sites could be transmitted to earth just before impact. President's Report to Congress, 1961, pp. 10-11, 14, 29-30. See also Stephen B. Oates, "NASA's Manned Spacecraft Center at Houston, Texas," Southwest Historical Quarterly, January 1964. Also Loyd S. Swenson, "The Fertile Crescent," ibid., January 1968.

140. Sixth Semiannual Report, p. 139. House Space Committee, Subcommittee on Manned Space Flight, Hearings, 1963 NASA Authorization, March 6-April 10, 1962, pp. 548-49. Seventh Semiannual Report, p. 135.

141. NASA News Release, No. 62-86, "NASA Begins Training Program at Ten Universities," April 12, 1962.

142. The firings of the complete F-1 engine began in July 1961, at a ground test stand at Edwards Air Force Base, 31 months after the contractor was selected in December 1958. The first firing of the J-2 engine was in April 1962, 23 months after the contractor was selected. The Saturn flight on October 27, 1961, demonstrated the feasibility of clustering eight liquid-fueled engines. It occurred 38 months after the program was initiated by the Advanced Research Projects Agency of the Department of Defense.

The Mercury manned orbital flight followed a second sub-orbital flight by Virgil H. (Gus) Grissom in July 1961, an unmanned Mercury-Atlas flight in September that verified the correction of the vehicle structural problem, and an orbital flight carrying a chimpanzee, Enos, in November. Glenn achieved all test objectives in his mission. During three orbits in the course of five hours, he demonstrated manual control of spacecraft orientation, and made observations of the earth, clouds and stars. He also found a mystery -- small objects resembling fireflies that swirled around the spacecraft just after it emerged into sunlight from the shadow of the earth. Later Mercury flights found evidence that these particles emanated from the spacecraft itself. President's Report to Congress, 1961, pp. 8-11. President's Report to Congress, 1962, p. 13.

143. New York Times, February 23 and 27, 1962. In his statement following the Glenn flight, President Kennedy coined a phrase when he said space is "the new ocean."

144. The policy provided conditions, however, that:
--New services are made available as soon as practicable.
--The system is global in scope.
--Foreign participation is possible.
--Non-discriminatory access by carriers and effective competition are provided.
--The U.S. government conducts and encourages research, supervises international agreements, controls launching of U.S. spacecraft and assures effective use of the radio-frequency spectrum.
President's Report to Congress, 1961, p. 105.

145. Ibid., pp. 15-16. However, the line in the Eisenhower budget calling for $10 million from private industry was deleted. Telstar, launched successfully on July 10, 1962, demonstrated the feasibility of live transatlantic television programming, telephone conversations and other communications.

146. Ibid., pp. 125-35. See also Jack Posner, Implementation of the Communications Satellite Act of 1962, Ph. D. dissertation, American University, 1967.

147. Representatives of NASA, the Weather Bureau of the Department of Commerce, the Department of Defense and the Federal Aviation Agency agreed in April 1961, on an initial plan. It provided that the Weather Bureau create a new organizational unit to operate the system and that the Department of Commerce contract with NASA for development, procurement, ground support and launch of the satellites. The Weather Bureau would integrate the information from satellites with other information in the preparation of weather forecasts. An agreement between NASA and the Department of Commerce in January 1962, was the first step toward bringing the system into being.

Successful TIROS satellites were launched in July 1961 and in February, June and September 1962. Senate Space Committee, Hearings, NASA Authorization for Fiscal Year 1962, pp. 221-56. President's Report to Congress, 1961, pp. 17, 55-57. President's Report to Congress, 1962, pp. 18, 63-66.

148. Perhaps the most noteworthy were NASA's Explorer X, XI, and XII in March, April and August 1961, the Navy Injun I in June 1961, and the Soviet Cosmos III, in April 1962. Explorer XII, Injun and Cosmos III provided significant data on the James Van Allen radiation belt. Explorer X carried very sophisticated instruments to measure magnetic fields between the earth and the moon. Hess, Mead and Nakada, op. cit.

Explorer XI measured gamma rays. Its findings, showing the absence of one type of gamma ray in space, enabled scientists to discard one of the hitherto possible explanations of the origin of the universe, a version of the so-called "steady state" theory. President's Report to Congress, 1961, pp. 12-13.

149. Ibid., p. 14.

150. A series of successful ground tests was conducted in 1960 and 1961 at the Nevada test site of the Atomic Energy Commission, generating thrust from gaseous hydrogen that passed through a nuclear reactor. In early 1962, tests were begun with a reactor and liquid hydrogen. Ibid., pp. 19-20, 45. President's Report to Congress, 1962, p. 27.

151. NASA and the Atomic Energy Commission cooperated on several other projects to employ nuclear energy in space. However, the first such use of nuclear energy was achieved in a project involving cooperation between the AEC and the Navy. On June 29, 1961 a small plutonium-238 fueled thermoelectric generator was orbited as a power source for the Transit IV-A navigational satellite. President's Report to Congress, 1961, pp. 20-21, 43-44; 1962, pp. 27-28, 49-51.

152. Senate Space Committee, staff report, Documents on International Aspects of the Exploration and Use of Outer Space, 1954-62, May 9, 1963, pp. 232-33.

153. Ibid., pp. 52-223.

154. Arnold W. Frutkin, International Cooperation in Space, (Prentice-Hall, 1965). H. C. Van deHulst, "International Space Cooperation," Bulletin of the Atomic Scientists, May-June 1961.

155. President's Report to Congress, 1962, pp. 15, 111.

156. "NASA Fiscal Year 1963 Estimates, Appropriation Summary," released at NASA news conference, January 17, 1962.

157. Robert C. Seamans, Memorandum to directors, Launch Vehicle Programs and Advanced Research Programs, "Broad Study of Feasible Ways for Accomplishing Manned Lunar Mission," May 25, 1961. Memorandum for the Administrator, "Meeting with the Director of the Bureau of the Budget," July 24, 1961. Also see George M. Low, "Manned Space Flight," in Proceedings of the First National Conference on the Peaceful Uses of Space, Tulsa, Oklahoma, May 26-27, 1961. (NASA, 1961) pp. 31-38.

158. Aeronautical and Astronautical Events of 1961, pp. 54, 77. One of the first major appointments made in the manned space flight office was that of Dr. Joseph F. Shea as deputy director for systems. Shea had been engaged in studies of rendezvous techniques with a contractor for the Air Force.

159. President's Report to Congress 1961, pp. 9-10. The program objectives were broadened later to extend flight duration to two weeks and to include manned activity outside the spacecraft, maneuvers with the combined vehicle after rendezvous and docking with an unmanned target vehicle, and additional experiments.

160. For example, see "Orbital Work Can Aid Moon Landing," Missiles and Rockets, May 29, 1961, p. 24. Also House Space Committee report, Space Orbital Rendezvous, August 15, 1961.

161. One of the early doubters was Maxime A. Faget of the Space Task Group, who was asked to study the lunar orbital approach for the February 1961 report of the group headed by George Low. Faget found the Houbolt plan to be highly questionable at that time. A year later, he was one of its strongest proponents. In November 1961, Houbolt wrote a long letter out of official channels outlining his plan to Associate Administrator Seamans. The letter, referred to the manned space flight office, was one of the first documents received by Shea as he undertook the systems analysis. Low interview by Rothrock, Emme and Holmes, pp. 11-16.

162. Nicholas E. Golovin, Memorandum to Associate Administrator, "Principal Recommendations of LLVPG," November 3, 1961.

163. Low, op. cit., pp. 27-32. The NASA studies were conducted by Eldon W. Hall of the headquarters office, with the support of Marshall Space Flight Center. Melvin Savage, comments on draft of this chapter, August 16, 1968. John H. Disher, comments on draft of this chapter, September 12, 1968.

164. The configuration: first stage, five F-1 engines, total thrust 7,500,000 pounds; second stage, five J-2 engines, total thrust 1,000,000 pounds; third stage, one J-2 engine, thrust 200,000 pounds. It was calculated that this vehicle would be able to place 220,000 pounds in orbit about the earth or to launch 90,000 pounds on a trajectory toward the moon. NASA News Release 62-4, "Advanced Saturn Configuration," January 10, 1962.

165. Aeronautical and Astronautical Events of 1961, p. 54; President's Report to Congress, 1961, p. 11; Astronautical and Aeronautical Events of 1962, (NASA report to the House Space Committee, June 12, 1963) p. 8.

The effort to develop the M-1 engine continued for three years. In his budget message to the Congress on January 25, 1965, President Johnson said the project was being terminated for economy reasons. By that time, there was no expectation that a larger vehicle than the Saturn V would be needed in the foreseeable future.

166. House Space Committee, Subcommittee on Manned Space Flight, Hearings, 1963 NASA Authorization, March 6-April 10, 1962, p. 463.

167. More than a million man-hours of technical studies preceded this decision. House Space Committee, Hearings, 1964 NASA Authorization, March 6-June 6, 1963, pp. 148-50.

168. National Academy of Sciences -- National Research Council, A Review of Space Research, Publication 1079, 1962, pp. I-7--T-29. The report declared:

> Scientists should recognize that Apollo is the first phase in a continuing engineering enterprise that will ultimately enable man to move about in space and provide him with the capacity for conducting his scientific investigations. It must always be remembered that as the earlier phases of the Apollo program proceed, engineering for the craft and for man will always assume the highest priority and the engineers must be protected in their ability to do their jobs. As the engineering tasks are accomplished, however, scientific investigations and missions will also be phased into the program; and, as flexibility and sophistication are achieved, scientific investigations will become the primary goals.
>
> Appreciation of these concepts is of critical importance to the acceptance of the current Apollo program by scientists throughout the country. The proper exposition of these

concepts by the federal government should go far toward allaying misunderstandings of the Apollo program which are currently prevalent among many members of the scientific community.

169. Robert C. Seamans, NASA History interview by Walter Sohier, Addison S. Rothrock and Eugene Emme, March 27, 1964, p. 17. D. Brainerd Holmes, memorandum for James E. Webb, August 15, 1962. Time, September 21, 1962, p. 22. For a comprehensive account of the development of this controversy, see John M. Logsdon, "NASA's Implementation of the Lunar Landing Decision," NASA Historical Note No. 81 (confidential).

170. NASA News Release, "NASA Outlines Apollo Plans," July 1962. The decision was based on conclusions that lunar orbital rendezvous had these characteristics in comparison with alternative modes:

--It provided a higher probability of mission success and essentially equal mission safety.
--It promised mission success some months earlier.
--The anticipated cost was 10 to 15 percent lower.
--It required the least amount of technical development beyond existing commitments, while significantly advancing the national technology.

Also see House Space Committee, Hearings, NASA Lunar Orbit Rendezvous Decision, July 12, 1962.

Descriptions of the lunar orbital rendezvous mission, the Apollo spacecraft, the Saturn launch vehicles, and the major associated ground facilities, together with the reasons for their selection, can be found in Appendix B-I-11, "NASA Facts -- Manned Space Flight." The decisions received a favorable reception in Congress. In the summer of 1962, $3,6741 billion was appropriated to NASA for the fiscal year ending June 30, 1963. This was about 3% less than the amount requested. See NASA financial data, Appendix A-V, in Volume Two.

171. The two spacecraft were in similar but not identical orbits. The Soviets reported later that the flight program had called for the two to pass within a distance of 5 kilometers (3 miles) a short time after launch. Their analysis of the data disclosed that the actual minimum distance was 6.5 kilometers (4.03 miles). Because of the slight difference in the orbits, they gradually drifted apart. A. A. Blagonravov, Investigations of the Upper Atmosphere and Outer Space Made in the USSR in 1962, Report to COSPAR, Warsaw, (June 1963) pp. 24-39, 49-50.

172. Congressional Record, September 6, 1962, pp. 18670-74. "U.S. Disputes Magazine Report that 2 Vostoks joined in Space," New York Times, August 21, 1962; Newsweek, October 8, 1962, p. 102.

173. "Kennedy to Tour Space Facilities," New York Times, September 6, 1962, p. 32.

174. "Transcript of Kennedy Remarks on Space Challenge," New York Times, September 13, 1962. Text in Appendix B-I-8.

175. President's Report to Congress, 1962, pp. 15-16.

176. James E. Webb, Letter to Senator Kerr and Representative Miller, September 5, 1962. The Administrator said he had obtained the information from "appropriate agencies of the government."

177. Agreements on two major issues between NASA and the Department of Defense were reached two months later. One of the two permitted NASA to assume management responsibility for its new launch area based at Merritt Island, to the north of Cape Canaveral. The other provided for DOD participation in the Gemini program.

NASA continued to manage the program, but the DOD took part in development, pilot training, pre-flight checkout, launch operations and flight operations. The agreement provided that neither NASA nor the DOD would initiate any major new programs in near-earth manned space flight without the consent of the other. It was agreed also that a relatively modest amount of DOD funding would be provided for Gemini. Joint NASA-DOD news release, "Atlantic Missile Range Agreement," January 23, 1963. House Space Committee, Subcommittee on Manned Space Flight, Hearings, 1964 NASA Authorization, pp. 129-30. See also testimony by Secretary of Defense McNamara in House Appropriations Committee, Subcommittee on DOD Appropriations, Hearings, Department of Defense Appropriations for 1964, February 6-12, 1963, pp. 173-75, 257-58, 367-90, 475-81. Also John Hunt, "Inner Space Race," Commonweal, January 18, 1963, p. 429.

178. W. Hess, G. Mead and M. P. Nakada, Significant Achievements in Particles and Fields, 1958-64, (NASA SP-97, 1966) pp. 40-44. A. W. Schardt and A. G. Opp, "Particles and Fields," in Significant Achievements in Space Science 1966, (NASA SP-155, 1967) pp. 243-45.

Tempers of high government officials on occasion grew short in dealing with this problem. At one point in the discussion of Starfish at a White House meeting, Associate Administrator Seamans detected what he believed to be a condescending attitude toward the capabilities of the civilian space agency. His adrenalin rising, Seamans told Presidential Assistant McGeorge Bundy on September 4, 1962, that the Goddard Space Flight Center could produce and launch a satellite within 60 days to measure the changes in the radiation belt, if desired. Bundy said it was desired, and arranged for appropriate priority for the project. The satellite, Explorer XV, was placed in orbit on October 27, 1962, at the height of the Cuban crisis. Seamans interview by Sohier, Rothrock and Emme, March 27, 1964, p. 21.

179. The public rejoicing over American achievements in space, coming at a time of international tensions, led to their being hailed as national heroes. Another national celebration had followed the second Mercury orbital flight by Astronaut M. Scott Carpenter, which on May 24 duplicated the three-orbit mission of John Glenn.

In April, a furor had resulted when it was disclosed in the news media that the Houston Home Builders Association had offered seven homes to the Mercury astronauts in Houston, the new location of the Manned Spacecraft Center. Study by the NASA general counsel's office determined that there was no legal bar to acceptance of the offer.

But as a matter of policy, NASA advised the astronauts that acceptance of the houses was not considered to be in the best interest of all concerned. The agency specified, however, that the final decision should be made by the seven men. The astronauts, in consultation with their unpaid attorney, C. Leo DeOrsey, decided to decline the offer with gratitude. "Mercury Astronauts Decline Gift Homes," NASA news release 62-82, April 3, 1962.

180. Memorandum, Associate Administrator to Robert R. Gilruth, "Astronaut Activities," May 31, 1962.

181. Astronautical and Aeronautical Events of 1962, p. 191.

182. The policy provided also:

--A second news conference after each space flight to permit representatives of the news media to question astronauts in depth on all phases of the flight.

--A specific prohibition against the advertising of any stories as "exclusive" when the stories were not exclusive,

or were exclusive only in part. The policy required the contracting publication to provide a method, acceptable to NASA, for avoiding this inference.

"NASA Outlines Astronaut Policy," NASA News Release 62-197 and 62-198, September 16, 1962. See also Diamond, The Rise and Fall of the Space Age, pp. 82-95; and Newsweek, October 8, 1962, pp. 30-31.

183. Walter C. Williams, NASA History interview by Rothrock, Emme and Holmes, March 25, 1964, p. 3.

184. On the same day, Schirra and his family were scheduled to visit President Kennedy. The ominous news, however, placed heavy pressure on the President's time. He kept the appointment and others previously scheduled to avoid hinting at a crisis. But later that morning he began meetings with advisers that were to culminate six days later in the public confrontation. Sorenson, op. cit., pp. 752-809. Robert F. Kennedy, "Thirteen Days: The Story About How The World Almost Ended," McCall's, November, 1968, pp. 6-9, 148-52, 164-73.

185. James E. Webb, comments at NASA staff meetings, January - March 1968. Comments on draft of this chapter, November 1, 1968.

186. "Grumman Selected to Build LEM," NASA News Release 62-240, November 7, 1962. On reviewing the studies of additional alternatives completed in October, NASA management concluded that they disclosed no reasons why the tentative decision should not be affirmed. In the meantime, the proposals by industrial contractors indicated confidence and the opposition in the scientific community appeared to have lessened somewhat.

187. Time, November 23, 1962, p. 15.

188. James E. Webb, statement at NASA staff meeting, January 1968. Comment on draft of this chapter, November 1, 1968.

189. Seamans interview by Sohier, Rothrock and Emme, March 27, 1964.

190. James E. Webb, letter to President Kennedy, November 30, 1962. The text of this letter is in Appendix B-I-9.

191. The Budget in Brief, 1964 Fiscal Year, GPO, 1963, p. 64. Chairman Robert S. Kerr of the Senate Space Committee developed a

plan under which his committee would take up the NASA authorization sooner than the House Committee, and would recommend a $6 billion figure, $290 million higher than the amount requested by the President. But the Senator died of a heart attack on January 1, 1963. No attempt was ever made to carry out his plan. Webb comments at meeting of NASA Management Advisory Committee, January 11, 1968.

192. For example, the headquarters office did not inject itself to any great degree into the Mercury, Gemini and Saturn I programs, but concentrated most of its technical attention to the planning of the Apollo lunar mission and the necessary flight hardware and ground facilities. The formal relationships with the field centers were the responsibility of officials subordinate to the director of manned space flight.

The spacecraft and flight missions office under George M. Low dealt with the Manned Spacecraft Center. The launch vehicles and propulsion office under Milton W. Rosen dealt with the Marshall Space Flight Center and the Launch Operations Center.

In the first year of its existence, the Office of Manned Space Flight had direct line authority only over program activities in the field. Administratively the centers at Houston and Huntsville reported to the Associate Administrator, Dr. Robert C. Seamans, Jr., under a plan which required them to meet the needs of the program offices using funds allocated by the program offices. However, when the Launch Operations Center was established it was placed administratively under the director of manned space flight.

In November 1962, D. Brainerd Holmes was given a second "hat" under which he was to serve as Deputy Associate Administrator for the three manned space flight centers, replacing the direct line to Seamans. It was Webb's plan for him to use the same headquarters staff that had served Seamans in these areas so that the Webb-Dryden-Seamans team and Holmes would have a common staff resource in administrative areas. However, only a very limited amount of staff effort was devoted by Holmes to this responsibility before the summer of 1963. Webb comments on draft of this chapter, November 7, 1968. (Some of the information and commentary in this section is drawn from the experience of the author as a staff assistant to the director of manned space flight from November 1962 until November 1963, and as secretary of the Office of Manned Space Flight staff meeting from 1962 to 1967).

193. James E. Webb, Memorandum to D. Brainerd Holmes, January 5, 1962. Statement regarding selection of a contractor for overall checkout of the project Apollo space vehicle, March 12, 1962. In October, 1961, the General Electric Company had offered to form an industry team to support NASA in the Apollo program. In a letter to Webb, G. E. Chairman Ralph J. Cordiner said Douglas Aircraft Corporation, Grumman Aircraft Engineering Corporation and Space Technology Laboratories, Inc., had been joined with G. E. to form the projected industry team.

The responsibility for supervision of the Bellcomm contract was assigned initially to Dr. Joseph F. Shea, deputy director for systems in the manned space flight office. However, beginning in early 1963, the president of Bellcomm, Inc., attended the regular weekly staff meetings of the office, symbolizing his direct access to the director. Supervision of the General Electric contract was the responsibility of James E. Sloan, director of integration and checkout.

194. Strengthening of associations with the scientific community on the flight investigations to be carried out on the manned missions was also of concern to the program management. In early 1963 a working group was formed, consisting of personnel of the offices of space sciences and manned space flight. It was headed by Dr. Eugene Shoemaker, a geologist in the Office of Space Sciences. House Space Committee, Subcommittee on Manned Space Flight, Hearings, 1964 NASA Authorization, March 6 - June 6, 1963, pp. 131, 144-48, 217-18. See Chapter IV for a more full account of these liaison groups.

195. The program official said that analysis up to that time had indicated that everything proposed to be done in Apollo was well within the short-term growth capacity of the technology, assuming that the assumptions regarding the space environment were correct. Ibid., pp. 132-33.

196. In November 1962, the Office of Manned Space Flight began holding monthly reviews of all aspects of the program. Generally the review took one full day. The director of each major portion of the program in the headquarters office was required to present to Holmes the status of his area of responsibility, using charts that followed a standard program-wide format. On some occasions during the first year of these reviews, field center personnel were present; on other occasions they were not. These program reviews were in addition to the monthly meetings of the manned space flight management council, which lasted one or two days.

In March 1963, NASA reorganized the Office of Manned Space Flight to establish two major divisions headed by deputy directors. The integration and checkout office was placed under the systems division, headed by Shea. All other elements except the director's staff were placed under a programs division, headed by George M. Low. In April, Milton W. Rosen was assigned to the defense affairs office as senior scientist. He was succeeded in the launch vehicles and propulsion office by Captain Robert F. Freitag (USN, ret.).

On March 17, 1963, Charles W. Mathews was appointed as manager of the Gemini program at the Manned Spacecraft Center. Mathews, a former member of the NACA staff, had been associated with the Mercury program since the formation of the Space Task Group. He succeeded James Chamberlin, who was assigned to advanced research work. On April 3, 1963, Charles W. Frick resigned as manager of the Apollo spacecraft project office at the Manned Spacecraft Center to return to industry. He had held the post since January 1962. Robert O. Piland was appointed as acting manager.

197. James E. Webb, memorandum for Drs. Dryden and Seamans, December 27, 1962; memorandum for Dr. Seamans, December 28, 1962, letter to Dr. Mervin J. Kelly, January 9, 1963, NASA News Release No. 63-67, "Management Advisory Committee for Manned Space Flight Program," April 3, 1963. Others on the committee were: Dr. Hendrik W. Bode, vice president of Bell Telephone Laboratories; Major General James McCormack (USAF, ret.), vice president of Massachusetts Institute of Technology; Dr. Arthur E. Raymond, retired senior vice president of the Douglas Aircraft Company, and Dr. Hector R. Skifter, chairman of the board of Airborne Instruments Laboratory, and vice president of Cutler-Hammer, Inc.

198. Clyde B. Bothmer, "Agenda for the Management Advisory Committee for Manned Space Flight," March 18, 1963. Presentation charts used by D. Brainerd Holmes, April 1, 1963. Bothmer, draft memorandum, "Activities of the Management Advisory Committee for Manned Space Flight, April 1-5, 1963." Major questions raised by the committee included:

--Will it be effective to have the program and institutional sides of the manned space flight program tied together by the techniques of giving Holmes "two hats?"

--Does the creation of two deputies within the office provide an organizational climate in which Holmes will have more time for his institutional job?

--Have the relationships between NASA and the Air Force been effectively resolved?
--Do the directors in the manned space flight office serve in a staff capacity or do they have some line authority over the centers?
--What is the relationship among the centers at the time of launches?
--Will the scientific aspects of the Apollo program be fully exploited?
--Does the scheduling system originated in headquarters meet the needs of the field centers and is it an effective management tool?

199. The public enthusiasm probably was heightened by the dramatic fact that Cooper overcame problems during the flight. He encountered difficulty with the automatic system for controlling spacecraft orientation. But he was able to orient the spacecraft for re-entry to the atmosphere with manual controls by observing the lights of Shanghai, China, as he flew over at night. Astronaut John Glenn, aboard a ship in the Sea of Japan, used voice radio to give Cooper the signal for firing the retro-rockets. "Relay I Transmits MA-9 Activities to Europe," NASA News Release No. 63-104, May 14, 1963. New York Times, May 22, 1963, pp. 1, 20.

200. NASA, "Transcript, MA-9, Press Conference." Cape Canaveral, Florida, May 19, 1963, p. 10.

201. "Astronauts Push for Another Flight," New York Times, May 22, 1963, pp. 1, 19; Walter C. Williams, interview with Rothrock, Emme and Holmes, pp. 17-18. Glenn, the seventh Mercury astronaut, was unable to return from Japan in time for the White House party.

202. Astronautics and Aeronautics 1963, (NASA SP-4004, 1964) p. 208.

203. NASA News Release, "Holmes Returns to Industry as Mercury Concludes," June 12, 1963.

204. Walter C. Williams, op. cit., p. 18. However, Administrator Webb believed that Holmes should not have authorized the expenditure of funds to modify the spacecraft for a three-day flight without bringing the matter up for consideration by the Webb-Dryden-Seamans group. Holmes finalized his decision to resign following a meeting in New York with Dr. Mervin Kelly.

Edwin Diamond, in The Decline and Fall of the Space Age, observes (p. 89) that Holmes' resignation rated only brief mention in the New York Times, but that the transfer of Lt. Col. John A. (Shorty) Powers to a less prominent public affairs post in NASA received page-one treatment the following month.

At a ceremony on September 5, 1963, Administrator Webb presented to Holmes the NASA medal for outstanding leadership, with a citation that called attention to his role in forging a manned space flight organization in the formative period of the Apollo program, dedicated to advancing the United States toward the goal of pre-eminence in space. Holmes joined the Raytheon Company in Waltham, Massachusetts, as senior vice president.

205. As the full import of the required effort in Gemini and Apollo became evident, some members of the program management began to wonder whether it would be possible to meet some of the schedules. Particular concern was felt for the workload at the Manned Spacecraft Center and its contractors, with the Gemini flights to be carried out while Apollo spacecraft development and testing was under way. The development of the Saturn launch vehicles was farther advanced because of the head start obtained in the 1958-61 period. See Note 192, last sentence.

206. "2 Russians Land in Asia after Space Trip," New York Times, June 20, 1963. After this mission, there was little U.S. public alarm of the kind that followed the first Soviet dual mission.

207. Senate Space Committee, Hearings: Scientists' Testimony on Space Goals, June 10-11, 1963.

208. Philip T. Drotning, memorandum for D. B. Holmes, June 25, 1963. D. B. Holmes, memorandum to Philip T. Drotning, July 12, 1963. Texts in Appendix B-I-10.

209. James E. Webb, appointment calendar for 1963. Lyndon B. Johnson, letter to President Kennedy, July 31, 1963. Text in Appendix B-I-11.

210. Webb's introduction to Rosholt, op. cit., pp. vi-vii. NASA News Release 63-162, July 23, 1963. Webb comments on draft of this chapter, November 1, 1968. Mettler made another vice president of the firm, Dr. E. B. Doll, available as a NASA consultant for several months to assist on organizational matters.

211. House Space Committee, Subcommittee on NASA Oversight, Briefing on NASA Reorganization and Project Mercury Summary, October 8, 1963. Webb comments on draft of this chapter, November 1, 1968.

The institutional responsibilities were new for two of the three program associate administrators, but in manned space flight, the new title merely combined the two "hats" held by Brainerd Holmes into a single position. At the same time, however, the Office of Manned Space Flight was reorganized to focus responsibilities on major program and institutional areas.

212. Under the new organization the major divisions of the office were program offices for Gemini, Apollo and advanced manned missions, and institutional offices for program control, management operations, space medicine and field center development. The Apollo and Gemini program offices were organized on a functional basis, with divisions for systems engineering, test, program control, reliability and quality, and operations, rather than according to elements of hardware. Counterpart offices organized in the same manner were established in each field center, and provisions were made for free communications among offices with the same function at the various locations. The prime contractors were also asked to organize their project offices in similar fashion. Another change was a realignment of the General Electric contract to reliability assessment and production of checkout equipment for the field centers. In the previous spring, the company had also been selected to provide support for the Mississippi Test Facility. The plans under which GE would support the headquarters office in integrating the space vehicle were dropped.

Dr. Joseph F. Shea was transferred from NASA Headquarters to fill the vacant position of manager of the Apollo spacecraft office at the Manned Spacecraft Center.

See Jay Holmes, "Minutes of Special Staff Meeting (NASA Office of Manned Space Flight) October 24, 1963" and "NASA Realigns Office of Manned Space Flight," NASA News Release 63-241, October 28, 1963.

213. "NASA Announces Changes in Saturn Missions," NASA News Release 63-246, October 30, 1963. House Space Committee, Hearings, 1965 NASA Authorization, Part 1, February 4-7, 1964, pp. 154-56; Part 2, February 18-March 10, 1964, pp. 409, 430.

214. The group, including 12 military men and two civilians, had a greater scientific flavor than those selected previously. One of the 14, Major Edwin E. Aldrin, Jr., USAF, held a doctor

of science degree in astronautics. About half of the others were working toward doctorates or held masters' degrees. "New Astronauts Show Strong Academic Backgrounds," Missiles and Rockets, October 28, 1963.

215. Frutkin, International Cooperation in Space, pp. 92-113. See also, Joseph Whelan, "The Press and Khrushchev's 'Withdrawal' from the Moon Race," Public Opinion Quarterly, Summer 1968, pp. 233-50.

216. Washington Post, September 21, 1963, p. 1; To the extent that NASA officials were consulted on this proposal, they advised against it. Arthur M. Schlesinger, Jr., in A Thousand Days, (Houghton Mifflin, 1965) describes (pp. 919-20) how he and a State Department official, Richard Gardner, developed the idea. NASA preferred a policy of conducting international negotiations quietly rather than making major proposals in the glare of publicity. See also Eugene B. Skolnikoff, Science, Technology and American Foreign Policy, (M.I.T. Press, 1967) p. 37, and Frutkin, op. cit., pp. 1-9, 114-31.

The Kennedy offer was a shock to supporters of the Apollo program who regarded it as a U. S. cold war activity. Comments in the press and in Congress interpreted the offer as an indication that the Administration had lost interest in pressing forward with Apollo. In a letter to Representative Albert Thomas, Democrat of Texas, President Kennedy denied this implication. He said:

"This great national effort and this steadily stated readiness to cooperate with others are not in conflict. They are mutually supporting elements of a single policy . . . .

"In my judgment, therefore, our renewed and extended purpose of cooperation, so far from offering any excuse for slackening or weakness in our space effort, is one reason the more for moving ahead." Letter to Thomas, September 23, 1963.

217. Independent Offices Appropriation Act of 1964, PL 88-215. The provision on the joint manned lunar landing program was contained also in the bills for 1965 (88-507), 1966 (89-128) and 1967 (89-555).

218. Appendix to the Budget of the United States Government for the Fiscal Year Ending June 30, 1964, (GPO, 1963), p. 786. In the field centers that came to NASA from the National Advisory Committee for Aeronautics, there was a considerable degree of expertise in propulsion, materials, structures, and other technical areas of significance to space flight, but there was not as much

strength in electronics. In October, 1961, an electronics and controls division was established in the headquarters Office of Advanced Research and Technology. In July, 1962, NASA established a Northeastern Operations Office at Boston. One of the assignments of that office was to investigate how NASA could best make use of the skills in electronics found in the universities and industrial firms in that area.

Astronautical and Aeronautical Events of 1962, pp. 115, 131. Astronautics and Aeronautics, 1963, index references to Electronics Research Center.

House Space Committee, Electronics Research Center, (Report of NASA), January 31, 1964, pp. iii-xii.

219. See Note 217.

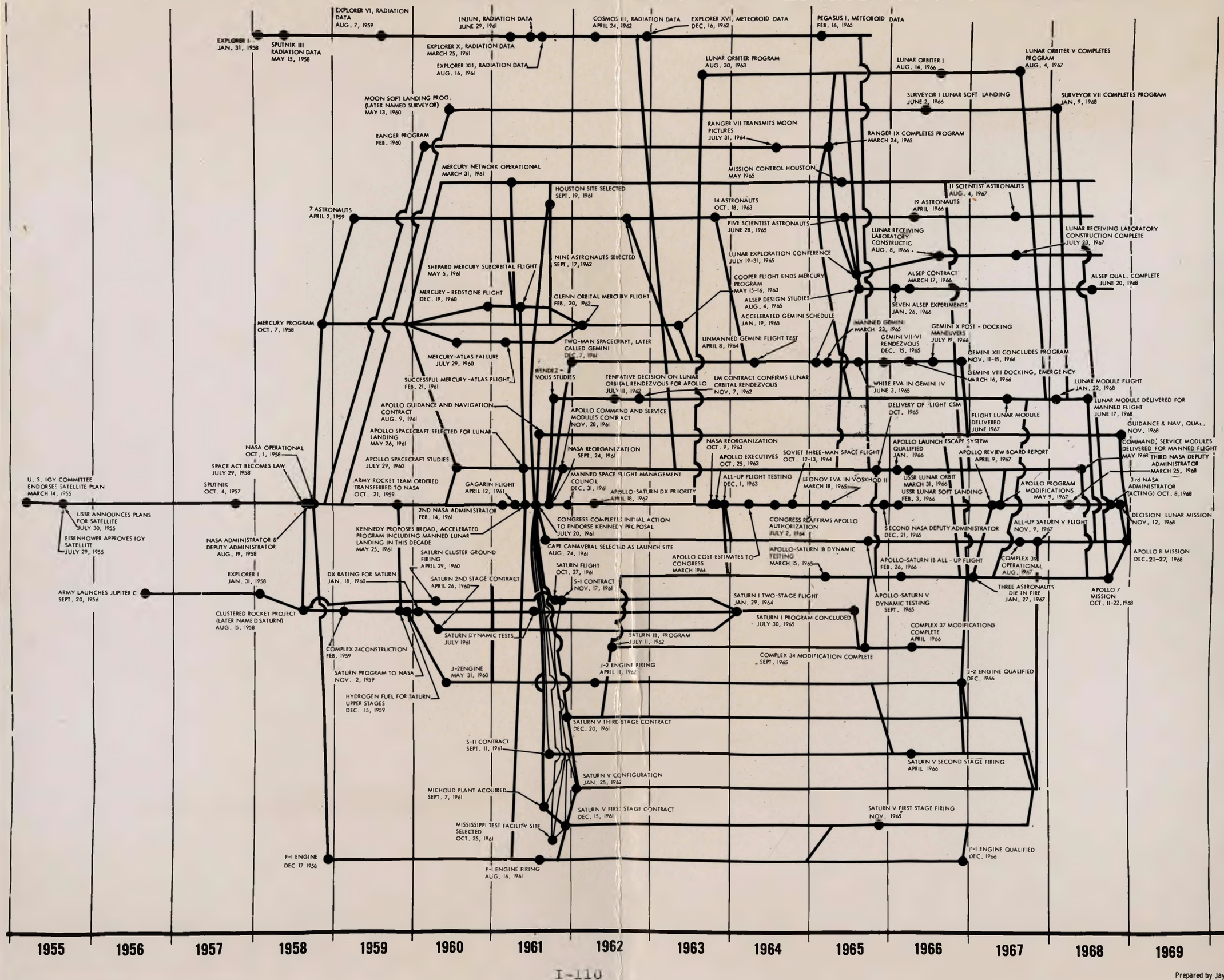
220. The difference between expenditures and appropriations resulted from a lag between the two that characterizes many rapidly growing programs.

221. Congressional Record, November 19, 1963, p. A 7163.

222. Congressional Record, December 4, 1963, pp. 22094, 95, 97, 98. Kennedy also had in mind the economic impact of the space program. In a slip of the tongue during a speech honoring Congressman Albert Thomas at Houston on November 21, 1963, he mentioned the "payroll" rather than the "payload" of the Saturn rocket (p. 22094).

223. Ibid., p. 22094.

KEY EVENTS IN THE MANNED LUNAR LANDING PROGRAM



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