CHAPTER 2: The Commitment to Space

"I can recall watching the sunlight reflect off of Sputnik as it passed over my home on the Chesapeake Bay in Virginia," Dr. Robert R. Gilruth recalled to the audience at the Sixth International History of Astronautics Symposium meeting in Vienna, Austria, in 1972. "It put a new sense of value and urgency on the things we had been doing. When one month later the dog, Laika, was placed in orbit in Sputnik II, I was sure that the Russians were planning for man-in-space."[1] The American response grew from an unusual concatenation of events—a Russian satellite and a dog in orbit, a NACA Pilotless Aircraft Research program, the presence of a large assemblage of German rocket scientists in Huntsville, Alabama, and the sudden unemployment of a Canadian fighter production team. Congress, with NACA/NASA assistance, provided leadership in devising the manned space programs and set the stage for the bold scheme to land an American on the Moon.

In the summer of 1958, as Congress deliberated space legislation, Dr. Hugh Dryden, NACA's Director, called Gilruth and Abe Silverstein, the director of the Lewis Research Center, to Washington to begin formulating a spaceflight program. Silverstein and Gilruth shuttled back and forth from their home offices, usually spending four or five days a week in Washington. For several months, Silverstein noted later, Gilruth's interests had quickly moved in the direction of "manned spaceflight."[2]

Gilruth assembled a small group of associates and advisors, including Max Faget, Paul Purser, Charles W. Mathews, and Charles H. Zimmerman of the Langley Laboratory; Andre Meyer, Scott Simpkinson, and Merritt Preston of the Lewis Laboratory; and many others on an "as needed" basis. He brought in George Low and Warren North from Lewis and Charles Donlan from Langley to help polish the plan in the late summer. The product of these intensive sessions was much more than an organizational format for a work project; it was an engineering design for putting an American in space. As Gilruth said, "we came up with all of the basic principles of Project Mercury," including a pressurized capsule with a blunt face and a conically shaped afterbody containing a contour-shaped couch, to be launched variously by an Atlas or a Redstone, and including a special cluster design proposed by Paul Purser and Max Faget, to be called the "Little Joe," to test an emergency escape device and a water-landing parachute system.[3]

Congress, meanwhile, was deliberating the Eisenhower administration's legislation, introduced by Lyndon B. Johnson and Senator Styles Bridges, calling for the creation of NASA. Hearings were being conducted before the Senate Select Committee on Space and Astronautics, chaired by Johnson, and the House Select Committee on Aeronautics and Space Exploration, chaired by Congressman John W. McCormack.

In July 1958 before final approval of the NASA legislation, Gilruth, with Silverstein and Dryden, presented the concept for manned spaceflight to Dr. James R. Killian (Scientific Advisor to the President) and the President's Scientific Advisory Board. Gilruth and Dryden subsequently appeared before the House Select Committee on Aeronautics and Space Exploration, which began hearings on August 1, and explained the manned spaceflight

initiative. Concurrent with the approval of the National Aeronautics and Space Act of 1958, the House created a standing committee on science and astronautics on July 21, headed by Congressman Overton Brooks of Louisiana. Subcommittees included a committee on Scientific Training and Facilities headed by George P. Miller of California, a Subcommittee on Scientific Research and Development headed by Olin E. Teague of Texas, a Subcommittee on International Cooperation chaired by Victor L. Anfuso of New York, and a Subcommittee on Space Problems and Life Sciences under Congressman B.F. Sisk of California. President Dwight D. Eisenhower signed the National Aeronautics and Space Act on July 29. Although the act referred to "manned and unmanned" space vehicles, it by no means specified that the American or NASA "activities in space" necessarily involved placing men or women in space. Not all were convinced (nor would be as the years passed) that a space program and putting humans into space were necessarily synonymous. Nevertheless, in those first weeks following approval of the act, Silverstein and Gilruth urged Dryden to create a special task group to implement a *manned* spaceflight program.[4]

That the American response to Sputnik should literally be to put an "American in space" did not reflect prevailing public opinion or the conventional wisdom of the aeronautical, scientific or military communities. Even among NACA/NASA personnel, many, including senior people, believed that the projected manned spaceflight program was an overreaction at best, a stunt at worst, and necessarily temporary in either event. The "conventional wisdom" was more closely aligned to the idea that manned spaceflight was very premature and could develop only after the technology evolved from unmanned spacecraft. Moreover, many Americans still possessed some innate disaffection for things mechanical, or robotic, that had to do with the further intrusion of machines in the "garden" of American life or, more so, into the "heavens." Flight in any dimension was something some Americans had had difficulty with since the days of the Wright brothers. Despite their reservations and skepticism, Americans had an equally strong, but ambivalent fascination with the "machine." Space vehicles, if such were to be, clearly needed the benign control of the human hand. Although totally unrelated to the in-house NACA/NASA deliberations, a feature article by a prominent political leader in a prominent engineering journal reinforced the arguments in support of manned space vehicles.

Lyndon Johnson knew intuitively that space was not simply something "out there," but something intimately associated with the quality of life on Earth. He believed space was the first new physical frontier to be opened since the American West.

In Congress, Senator Lyndon Johnson had become an advocate of a "broader understanding" of the new Space Age. The August edition of the *American Engineer*

featured an article by Lyndon Johnson, who stressed that America was "badly underestimating the Space Age." Although security had been our first concern, and properly so, Johnson suggested that the overwhelming focus on satellites and missiles missed the point. "The ultimate [purpose] of space vehicles is the transport of man through outer space near or to the Moon, some of the planets, perhaps even to other galaxies. . . . Whatever the date, manned space vehicles will be—when they come—far less of a detail, far more a pinnacle of accomplishment than we now think." The Space Age, Johnson said, will have an impact of the greatest force on how we live and work. "We are underestimating the meaning of this whole new dimension of human experience." We have entered a new frontier, he said, the first new physical frontier to be opened since the American West.[5] Affairs now moved very quickly.

President Dwight D. Eisenhower appointed Dr. T. Keith Glennan as the first Administrator of NASA, and Dr. Hugh L. Dryden, who had headed NACA, to be Deputy Administrator. They assumed their posts on August 19. Glennan, born in Enderlin, North Dakota, in 1905, earned a degree in electrical engineering from Yale University in 1927. His first employment was in the new "sound" movie industry, before joining Electrical Products Research Company, a subsidiary of Western Electric. He became involved primarily in administration rather than research, at times heading divisions of Paramount Pictures, Metro-Goldwyn-Mayer, and Vega Airlines. During World War II, Glennan joined the Columbia University Division of War Research and soon became director of the Navy's Underwater Sound Laboratories at New London, Connecticut. He became president of Case Institute of Technology in 1947 and elevated it into the ranks of the top engineering schools in the Nation. He served as a member of the Atomic Energy Commission between 1950 and 1952. The Space Act declared that "NACA shall cease to exist . . . ," and Glennan announced its close on September 30 and the beginning of NASA on October 1. It is a time of "metamorphosis," he said, " . . . it is an indication of the changes that will occur as we develop our capacity to handle the bigger job that is ahead . . . We have one of the most challenging assignments that has ever been given to modern man."[6]

A few days after NASA became operational, Max Faget, Warren North, Dr. S.A. Batdorf, and Paul Purser went to Huntsville and spent an intensive 2 days discussing with Wernher von Braun and some 30 other engineers and military officers the participation of the Army Ballistic Missile Agency (ABMA) and Redstone in the launch of a manned capsule. On October 7, Glennan, Dryden, and Roy Johnson, Director of the Army's Advanced Research Projects Agency (ARPA), heard Gilruth's final proposal for manned spaceflight that had been approved by a joint NASA/ARPA committee, and which essentially reflected the summer work of Gilruth's task group. "Within two hours," Gilruth said, "we had approval of the plan and a 'go ahead.' " Glennan advised Gilruth to return to Langley and organize a group to manage the project—but to report directly back to Abe Silverstein in the Washington NASA office, rather than to the center director.[7] Not only had a manned spaceflight program been authorized, but the program was to be autonomous and independent of any other NASA center, thus effectually creating the organizational nucleus of what would become the Manned Spacecraft Center or (in 1973) Lyndon B. Johnson Space Center in Houston, Texas. For all practical purposes, the Manned Spacecraft Center existed and operated at the Langley Aeronautical Laboratory for almost 4 years prior to its relocation in Texas. In truth, it may have been that one of the motives for the organization of an autonomous entity to deal with

manned spaceflight was to preserve the integrity of the traditional research orientation of the NACA/NASA organization, and possibly even to isolate the project because it was premature or a stunt from the perspective of the mainstream (and presumably more serious) research and scientific efforts of NASA. It could also have been a simple matter of expediency. The establishment of the STG gave the program identity and some protection from agency politics and funding squabbles.

As Glennan explained to the House Committee on Science and Aeronautics in 1959, "To get going, we have had to organize with one hand, while, at the same time, . . . operate with the other." It is not an efficient way to do business, he said, but there was never time to proceed in an orderly fashion. Wesley Hjornevik, who joined the STG as its business and administrative manager, recalled that at what may have been the true moment of inception of the STG, in a meeting with Glennan following the presentation to President Dwight D. Eisenhower and his staff by Gilruth's group, the reality of the manned vehicle project struck. The meeting closed with Glennan's comment, "okay men, let's get on with it." Whereupon Gilruth's mouth "fell open;" he made inquiries about staff, money and facilities. "Glennan," Hjornevik said, "just got red in the face." He had no answers to those questions. He got mad, pounded on the table and repeated, "I said get on with it," and got up and walked out.[8] In a sense, both Hjornevik and Glennan had identified the most prominent and distinctive features of the early manned space effort—its relative spontaneity and organizationally amorphous qualities.

Although the STG was unofficially established on October 8, 1958, it was, as Paul Purser noted later, an ad hoc arrangement, for Gilruth had no written authorization to head the STG or to actively organize and recruit. Gilruth acknowledged that he had been given "a job of tremendous difficulty and responsibility," with no staff and only oral orders to "get on with the job." He credited Floyd Thompson, director of the Langley Center, with not only cooperation but also guidance in establishing the manned space program. And given the fact that Gilruth would be dismembering the Langley Center staff, that was no easy commitment by Thompson. Finally, Gilruth dissipated some of the cloud surrounding the establishment of the STG by announcing in a memorandum dated November 3, 1958, (as suggested by Thompson) that the STG did indeed exist, and that he had the authority to request the transfer of personnel to his group.[9]

That memorandum effectually marked the inception of the Manned Spacecraft Center. The document is significant both for the manner of its promulgation and the fact that it named those who became the "charter members" of the manned spacecraft program. "Recruiting" for the STG began with meetings between Purser, Charles Zimmerman and R.O. House, who agreed to recommend to Floyd Thompson that a proposal be forwarded to NASA Headquarters to create 230 positions on the "space payroll." Of these, 110 were to be directly related to the manned-satellite project, 60 to support groups, and 60 for other space-related projects. Thompson agreed to fund 119 of the positions through Langley, with 36 transfers to be effected immediately. Paul Purser roughed out a "Task Group" memo containing 34 names to which Gilruth added 2.[10]

The next day, November 4, Floyd Thompson scratched a brief approval on the memo saying "This request is okay with the exception of (William J.) Boyer" (whom he wished to retain on his staff).[11]

NASA - Langley
November 3, 1958

MEMORANDUM for Associate Director
Subject: Space Task Group

1. The Administrator of NASA has directed me to organize a space task group to implement a manned satellite project. This group will be located at the Langley Research Center, but in accordance with the instructions of the Administrator, will report directly to NASA Headquarters. In order that this project proceed with the utmost speed, it is proposed to form this Space Task Group around a nucleus of key Langley personnel, many of whom have already worked on this project.

2. It is requested, therefore, that initially the following 36 Langley personnel be transferred to the Space Task Group:

Anderson, Melvin S. (Structures)	Livesay, Norma L. (Files)
Bland, William M., Jr. (PARD)	Lowe, Nancy (Steno)
Bond, Aleck C. (PARD)	MacDougall, George F., Jr. (Stability)
Boyer, William J. (IRD)	Magin, Betsy F. (PARD)
Chilton, Robert G. (FRD)	Mathews, Charles W. (FRD)
Donlan, Charles J. (OAD)	Mayer, John P. (FRD)
Faget, Maxime A. (PARD)	Muhly, William C. (Planning)
Fields, Edison M. (PARD)	Purser, Paul E. (PARD)
Gilruth, Robert R. (OAD)	Patterson, Herbert G. (PARD)
Hammack, Jerome B. (FRD)	Ricker, Harry H., Jr. (IRD)
Hatley, Shirley (Steno)	Robert, Frank C. (PARD)
Heberlig, Jack C. (PARD)	Rollins, Joseph (Files)
Hicks, Claiborne R., Jr. (PARD)	Sartor, Ronelda F. (Fiscal)
Kehlet, Alan B. (PARD)	Stearn, Jacquelyn B. (Steno)
Kolenkiewicz, Ronald (PARD)	Taylor, Paul D. (FSRD)
Kraft, Christopher C., Jr. (FRD)	Watkins, Julia R. (PARD)
Lauten, William T., Jr. (DLD)	Watkins, Shirley (Files)
Lee, John B. (PARD)	Zimmerman, Charles M. (Stability)

(signature)
Robert R. Gilruth
Project Manager

While Gilruth organized his STG at Langley, Abe Silverstein established an office called Manned Space Flight at NASA Headquarters in Washington with George Low as its head. Silverstein, trained as a mechanical engineer, was a veteran flight researcher who joined NACA in 1929. In 1943 George Lewis, who headed the Aircraft Engine Research Laboratory in Cleveland (renamed the Lewis Flight Propulsion Laboratory in 1948), named him to a special committee to coordinate NACA's high-speed aircraft research. Low, who worked with Silverstein in Cleveland and assisted Gilruth's ad hoc committee in planning a spaceflight program, returned with Gilruth to Langley to serve as deputy assistant to Max Faget but was on the job for only a few weeks when Silverstein called him back to

Washington. Low, born in Vienna, Austria, in 1926, left Germany in 1938 and immigrated with his family to the United States. He received the bachelor of aeronautical engineering degree from Rensselaer Polytechnic Institute in 1948, briefly worked for General Dynamics, returned to Rensselaer for a master's degree, and joined NACA as a research scientist at the Lewis Flight Propulsion Laboratory in 1949. He had worked closely with Gilruth in putting together the final plans for Project Mercury in the summer of 1958, and now in Washington with Silverstein, Low considered himself "Bob Gilruth's representative in Washington." He worked very closely with the STG and later the Manned Spacecraft Center until he rejoined Gilruth in Houston in 1964.[12]

Silverstein and Low quickly discovered that while Gilruth's group "had good technical strength," it lacked the personnel and expertise to manage the budgeting, finance, and general administration for a manned satellite program. Low and Silverstein effectually became the personnel and fiscal administrators for the STG, while Gilruth focused on technical management. Low explained later that the STG:

> . . . was a highly technical organization which initially showed little interest in the business management aspects. Personnel management, financial management, etc., were handled on an ad hoc basis. The people were interested in the technical job and had little time for any more than that.[13]

This proved to be both a blessing and a curse. On the one hand, the "manned satellite program," as it was called for a time, was ill-prepared for the rapid physical growth it experienced; and on the other hand, the fluidity of the organization enabled it to do things, as Gilruth observed, that "could only occur in a young organization that had not yet solidified all of its functions and prerogatives."[14] Nevertheless, an administrative crisis would continue to plague the manned spacecraft program through most of its early years. Efforts to deal with the problem led first to an attempt to organize the manned spacecraft program within the administrative structure of Goddard Space Flight Center, being built near Beltsville, Maryland, and finally, to the creation of an autonomous NASA spacecraft center.

Gilruth and his associates plunged ahead with fresh intensity. Silverstein and Low met with Gilruth at Langley weekly; and Gilruth, Paul Purser, or another of the task group went to NASA Headquarters or to another center as often. Ten new members were transferred to the STG from the Lewis Center, including Low, Andre Meyer, Scott Simpkinson, Merritt Preston and Warren North, among others. During the first months of their existence, the group perfected the design and technical specifications for the manned satellite, arranged for launch support with the Air Force's Ballistic Missile Division at Cape Canaveral, worked out test procedures for the capsule and the Redstone rocket, gave intensive attention to the use of Thor versus Jupiter rockets for intermediate-range flights, and resolved many problems relating to trajectory, guidance, astronaut selection and training, recovery, and costs.[15]

The capsule or man-carrying satellite was to have a pressurized breathing atmosphere within a blunt face and conically shaped afterbody. Gilruth attributed the first working design for the capsule to Caldwell (pronounced Cadwell) C. Johnson of the Langley and Wallops Island design group, working closely with others in the STG. Max Faget and Andre Meyer, he said, conceived of the "escape tower" and Faget contributed the contour couch which would protect the occupant from the high g-forces of launch and reentry. The capsule would be

launched by an Air Force (Ballistic Missile Division) Atlas rocket, with the Army's Redstone rocket, under development by Von Braun's group in Huntsville, Alabama, used for early test flights. On reentry it would descend by parachute to a water impact. Because it would be America's first manned messenger "to the gods," Abe Silverstein thought the project should be called "Mercury." It was an excellent choice, Gilruth thought, and one that generated great pride. Director Glennan publicly announced the Mercury project on December 17, 1958.[16]

The STG's new project orientation improved both the technical focus of the engineers and the organizational lines of the group. Gilruth, as Director of the STG (and director of Project Mercury), placed Charles Donlan immediately under him as the Associate Director. Upon his graduation from Massachusetts Institute of Technology in 1938, Donlan joined the Langley Aeronautical Laboratory and began work on aircraft spin design criteria. During the war he worked on tests of the Air Force's XS-1 design and became the project engineer for the design and construction of Langley's high-speed (7- by 10-foot) wind tunnel, and subsequently headed the high-speed wind tunnel section. A flight systems division headed by Max Faget, an operations division under Charles Mathews, and a reliability and quality assurance group reported to Gilruth through Donlan. Paul Purser was Special Assistant to Gilruth.[17]

In practice, the association between division heads and the directors—and the staff, wherever they might be—was very informal and collegial. For the most part these were professional engineers who had worked together on various projects in the past and now were joined together to work on another far more exciting and demanding project. Each assumed the tasks they were best suited to perform and critiqued and assisted the others work. And work they did!

They worked holidays, evenings, and weekends. They worked New Year's Day. Gilruth recalled the days of the STG's first year as a time of "the most intensive and dedicated work of a group of people" that he had ever experienced. "None of us," he said, "will ever forget it."[18]

During their first weeks on the job, the STG completed the specifications for the Mercury capsule and placed it, through Langley's procurement officer Sherwood Butler, in the hands of potential contractors who were to return their proposal within approximately 90 days. NASA awarded McDonnell Aircraft Corporation the contract for the construction of the Mercury capsule on January 9, 1959.[19] Thus, the STG early established itself as the design and management team for manned spacecraft programs.

Originally, the manned spacecraft program anticipated considerable in-house design, production, and operations. Gilruth's group, for example, arranged for launch rockets and services through the Air Force and Army Ballistic Missile Agency, and also began work on its own Little Joe rocket to be used for escape system tests at Wallops Island. A group under Scott Simpkinson at the Lewis Laboratory in Cleveland, in cooperation with a small task group under Jack Kinzler at Langley, constructed full-scale Mercury capsule models (called "Big Joe") to be launched aboard Atlas boosters from Cape Canaveral for heat transfer and stability tests.[20] The STG achieved a successful launching of a Mercury prototype vehicle in September 1959, within less than a year of the creation of NASA and the STG.

Gilruth arranged to borrow physicians, flight surgeons, and psychologists from the Army and Navy to advise on the selection of spacecraft crew members. Dryden and Gilruth, in fact, discussed naming such crew members variously "astronauts" or "cosmonauts." Dryden

favored the term "cosmonaut," inasmuch as the flights would be made in the cosmos or near space, while the term "astro" or "astral" suggested star flights. "Astronaut," however, became accepted simply by virtue of common usage and preference by team members, and it stuck. The STG medical advisors and psychologists urged the selection of astronauts from the more dangerous professions, such as race car drivers, mountain climbers, scuba divers, or test pilots. Whether it was judiciously, fortuitously, or both, it was President Eisenhower who decided that astronauts should be selected from a pool of military test pilots. And they all breathed a sigh of relief, Gilruth recalled, because it "allowed the delegation of flight control and command functions to the pilot of the satellite."[21]

The new year, 1959, dawned with still only a small group assigned to manned spacecraft projects. The original 35 in the STG had been joined by 10 engineers from Lewis, and another 12 Langley personnel had been shifted to STG projects. Other individuals had been recruited from the Army and the Air Force, but staffing quickly became a serious problem. Floyd Thompson, who cooperated fully with Gilruth's constant requests for personnel from the ranks of Langley staff, finally slowed Gilruth's "raids," which left his own staff so terribly imbalanced, by telling him: "Bob, I don't mind letting you have as many good people from Langley as you need, but from now on I am going to insist that for each man you want to take, you must also take one that I want you to take."[22] The problem with staffing was compounded by the reality that the United States had only a limited supply of aerospace engineers, fewer still with the credentials that would be useful to the STG. Moreover, the postwar aerospace market was a terribly competitive one such that the government had the greatest difficulty competing in the marketplace. This market situation contributed in the long run to greater and greater dependency on contractors for goods and services, but NASA Administrator James Webb believed that greater reliance on private contractors would help build a stronger constituency for NASA programs. Moreover, President Eisenhower abhorred the creation of large federal establishments, particularly those that might compete with private enterprise. But an unusual and highly fortuitous circumstance enabled Gilruth to obtain a new cadre of aerospace engineers which greatly alleviated his recruiting problems and proved extremely important to the American space program over the next several decades.

On February 20, 1959, AVRO Aircraft, Ltd. of Canada, a subsidiary of Britain's A.V. Roe Corporation, closed its doors and terminated about 13,000 employees in response to a decision by the Government of Canada to scrap its plans to build an air defense force centered on the Arrow (CF105) fighter, then reputed to be one of the best designed high-performance aircraft on the drawing board. The AVRO CF100 was in production, and a jet liner, similar to a Learjet, was ready for production. Development of a "state-of-the-art" fighter, however, proved perhaps overly ambitious for Canada and terribly costly and the then highly touted American Bomarc defense system seemingly reduced the necessity for fighters. The result was simply a decision by Prime Minister John Deifenbaker's government to suspend the program. Company officials, hoping to demonstrate the economic impact of such a decision, elected to dramatize their plight by terminating all employees at once.[23] The government, however, was unmoved.

A huge pool of highly qualified aerospace engineers suddenly became available. Among these, for example, were Jim Chamberlin, R. Bryan Erb, Rodney Rose, and others. Erb, who was born in Calgary, was first led to his interests in space by an explorer who visited

his fifth grade elementary class, and predicted that one day man would fly to the Moon. That, Erb recalled, caught his attention. He later received a C.E. degree in fluid dynamics at the University of Alberta, and then a master's at the College of Aeronautics in Cranfield, England. At Cranfield, Erb's interest in space was reinvigorated by the visit of science fiction author Arthur C. Clarke, and by the intense interest of members of the British Interplanetary Society. He joined AVRO Aircraft Ltd. in Toronto, for work in thermodynamics in 1955, only to receive a notice one morning that as of the end of the day, on Friday, February 20, 1959, he was unemployed. Similarly, Rod Rose, who was born in Cambridge, England, obtained a fellowship at the Cranfield Institute of Technology after a "Gentleman Apprenticeship" with A.V. Roe in Manchester. He worked for Vickers Supermarine for a time on a Swift transonic airplane before emigrating to Canada in 1957 to work with AVRO Aircraft, Ltd. Rose attributes the demise of the Arrow project largely to politics.[24]

He recalls reporting to work as usual on Friday, February 20, and that about "elevenish" an announcement was made on the speaker system that a serious announcement would be made later in the day. Shortly after 3 p.m., he said, an announcement was made that as of the close of work, all employees were terminated, and would be able to return Monday morning to pick up their belongings. One of the people working with him, Rose recalled, had just arrived from England, was living in a hotel with his wife and child, had received no pay, and had no money. Some 20,000 people, he estimated, were directly affected by the lay-off, and another 100,000 who provided various services to the project were probably put out of work. The major problem, he believed, was that the Arrow project and AVRO were creatures of the Liberal government, and with the return of the Conservative Party to power came a purge of all things associated with the past Liberal Party regime. The purge was so complete, he added, that plans, models, specifications, and designs of the Arrow fighter, engine components, and tests were methodically and deliberately destroyed. It was, he believed, a tragic loss for Canada and the world aerospace industry, for the Arrow CF105 was far ahead of its time.[25]

The expertise developed in work on the Arrow (which had been designed with a Mach 2 performance ability), however, became an invaluable part of the NASA manned spacecraft effort. Rose believed that AVRO expertise including operations experience, real-time telemetry, and "fly-by-wire" [where controls operated through a computer system] know-how plus Arrow advances in thermodynamics, materials and structures, among other things, greatly facilitated the development of the American manned spacecraft effort.[26]

In this context, Jim Chamberlin, whom Rose described as a brilliant engineer and who would become a key person in the design of the Mercury project, contacted Gilruth, with whom he had close personal and professional associations, and asked if the STG might be interested in the AVRO people.[27] It was an undisguised opportunity, and Gilruth acted immediately.

He, Charles Donlan, Charles Mathews, Paul Purser, and Kimble Johnson promptly flew to Toronto, interviewed about 100 applicants for jobs with the STG, within 10 days extended offers to about 50 AVRO engineers, and received acceptances from 25. Among the 25 was Bryan Erb, whose American connections dated back seven generations to Captain Henry Erb (who threw his lot with the Loyalists in the American Revolution and left the United States for Canada in 1783). Erb, in a sense, had returned home. Another was Rod Rose, who confessed that he had required a bit of persuasion from Jim Chamberlin.[28]

By May most of the 25 AVRO engineers were intensely involved in Project Mercury, most of them in middle-management technical positions, and a few such as Chamberlin and Rod Rose soon in senior level positions. It was, Rose recalled, an instant meshing marred perhaps only by the fact that his immediate supervisor, Jerry Hammack, spoke "Georgia" and constantly chided Rose about his inability to speak "good English." By the end of 1960, six additional former AVRO employees joined the NASA contingent, a few of whom went directly to the Goddard Space Flight Center and to NASA Headquarters. About half of the 31 employees from Canada were born in Canada, half were from England, and one (Tec Roberts) came from Wales. The AVRO/NASA roster included:

Pete Armitage	Bryan Erb	Dave Ewart	Dennis Fielder
Morris Jenkins	Rod Rose	Dick Carley	Tom Chambers
Norm Farmer	John Meson	Bruce Aikenhead	Frank Chalmers
Jack Cohen	Stan Cohn	Gene Duret	Joe Farbridge
John Hodge	Fred Mathews	Owen Maynard	John Shoosmith
George Watts	Stan H. Galezowski	Tec Roberts	George Harris
Dave Brown	Les St. Leger	Burt Cour-Palais	Jim Chamberlin
Len Packham	Bob Vale	Bob Lindley	

The "AVRO connection," as Rod Rose called it, swelled the ranks of the manned spacecraft personnel force from about 135 persons to about 160 by April 1959 and, more importantly, provided engineering talents and expertise which simply were unavailable in the United States. At the time, even qualified aeronautical engineers were hesitant to apply for a position in the STG in the belief that it was temporary at best and "Mickey Mouse" at worst.[29]

Gilruth's needs for additional personnel reflected only one aspect of NASA growth pressures. The STG was a new and still relatively small part of the NASA complex of centers and programs. Abe Silverstein began arrangements for the transfer to NASA of approximately 250 members of the naval research staff who had worked under Dr. Homer Newell on upper atmospheric research and under Dr. John P. Hagan on the Naval Research Laboratory's Vanguard satellite program. Many of these people worked in and around the Washington area, and Silverstein wanted to provide them facilities in the area. When he asked Dryden about possibilities, Dryden commented that "just the day before at a meeting of the National Geographic Society he had been asked by a representative from the Agricultural Department if NASA needed any land in the Washington area for a lab site and that they would welcome NASA's use of land at the Beltsville site." Silverstein followed up and received approval for the transfer of 500 acres. It was, he said, the beginning of the Goddard Space Flight Center, which he named in honor of America's rocket pioneer, Robert H. Goddard. The center was officially created on May 1, 1959.[30]

Because the STG was a "highly technical organization" whose personnel had little time for administration, Silverstein decided to incorporate the STG under the mantle of the new Goddard Space Flight Center. Silverstein arranged the appointment of Harry Goett from the Ames Research Center to head the Goddard Center, with Gilruth to be Deputy Director. Gilruth and the STG, however, would physically remain at Langley until the completion of Project Mercury. In theory, Goett would provide administrative control and

Gilruth technical direction, while Silverstein could provide policy direction and control from Washington.

Several things went wrong with this plan. Once Goett became a director, his formerly warm relationship with Silverstein cooled and cooperation became difficult. And instead of improving the business management of the STG and Project Mercury, the 200 miles separating Gilruth's operations from the administrative center only aggravated management difficulties. Moreover, Gilruth, who once reported directly to Silverstein as an autonomous director, now reported to Silverstein through Goett. It began, as George Low concluded, "a serious rift between Silverstein and Gilruth." This "Goddard interlude" reinforced the perception which was growing that the manned spaceflight initiative needed to be a separate task group, center or entity of some kind.[31] Goddard was only one of the new centers being added to the NASA collection.

In October 1959, President Eisenhower announced the transfer of the Army Ballistic Missile Agency's Development Operation Division in Huntsville, Alabama, and the launch facilities at Cape Canaveral, Florida, to NASA. With congressional approval effective March 14, President Eisenhower, by Executive Order, renamed the Huntsville facility the George C. Marshall Space Flight Center on the following day. On July 1, 1960, Dr. Wernher von Braun became the director of the facility whose primary mission would be to develop "high thrust space vehicles," and more precisely for the moment, the Redstone, Centaur and Saturn rockets.[32]

Von Braun and every center director, including Thompson at Langley and Goett at Goddard, were competitors for the limited supply of men and money in the face of burgeoning programs and responsibilities. Moreover, Von Braun, who had previously been "completely responsive" to NASA (and STG) requirements, now was within the NASA organization an administrator of higher rank than Gilruth and enjoyed greater public recognition. Gilruth's lack of rank within the system was partly alleviated in January 1961 when the STG was broken out of the Goddard organization and restored to its original autonomy with a direct reporting line to Silverstein.

The real issue involved delineating responsibility for the manned space program as an effort distinct from other NASA programs and projects. Silverstein said that with the growth of new projects and the full realization of the scale of the manned effort within the NASA program, "it became clear to Drs. Glennan and Dryden and me that perhaps the concept of using Goddard as a place to house the manned program was wrong and that Goddard should direct the unmanned satellite program and a wholly new center be created for the manned spaceflight program."[33] The general public and Congress, to some extent, were generally oblivious to all of these problems. If it had not been true before, the elections of 1960, which brought John F. Kennedy to the White House, focused national attention on the "missile gap," the "space race," and the "red menace."

Americans were aware that the Soviets had launched Luna I, the first spacecraft into interplanetary space, in January 1959 followed shortly by Luna II, which impacted on the Moon in September, and Luna III, which flew behind the Moon in October. The latter coincided with Premier Nikita Kruschev's visit with President Eisenhower at Camp David. The elections in November were tightly contested by Eisenhower's Vice President, Richard M. Nixon, and the Democratic candidate, John F. Kennedy, who

stressed that the all-too-obvious "missile gap" was the product of a past Republican administration which had become too complacent about America's position of power and wealth in the world, and so uncaring that many Americans, particularly minorities, failed to share in the affluent society. The apparent missile gap, accentuated by the Soviet Moon rocket launches, provided a critical edge in the election. Kennedy very narrowly defeated Nixon.

The election returns, however, had not convinced President Eisenhower that a missile gap existed, nor that manned spaceflight could be justified beyond Project Mercury. When his Science Advisory Committee submitted a report, prepared by a panel headed by Dr. Donald Hornig of Brown University, of projected costs of prospective manned space programs, he was understandably concerned. Project Mercury could cost a projected $350 million, an Earth and lunar orbital mission an additional $8 million, and a lunar landing an estimated $26 to $38 million more. When he asked why a lunar landing should be undertaken, the mission was likened by one of the staff to Columbus' voyage to the New World. Eisenhower snorted in response: "I'm not about to hock my jewels." And in the 1962 budget sent to Congress in January 1961, the President questioned the validity of extending manned spaceflight beyond the Mercury project.[34]

Eisenhower was not alone in his perception of the viability of continuing manned space missions. NASA Director Keith Glennan confided to Oran Nicks, who directed NASA's Lunar and Planetary Programs between 1961 and 1968 before becoming an Associate Administrator at Headquarters and then Deputy Director at Langley (1970 to 1980), that his real interest throughout his administration of NASA was *other* than manned spaceflight. Congress, however, was much bolder. In February 1959, the House Select Committee on Astronautics and Space Exploration advised creating programs that would lead to the "manned exploration of the Moon and nearby planets with eventual establishment of scientific bases on these bodies." In July 1960, Congress urged as a high priority program "a manned expedition on the Moon in this decade."[35] During the early years of the manned space program, Congress rather than the executive branch tended to exercise leadership and take the initiative in space program planning. Congress also anticipated President John F. Kennedy's bold initiative for a lunar landing within the decade.

Although President-elect Kennedy had urged a stronger effort in space, he had been and remained ambivalent about "man-in-space." Shortly before Christmas, John Kennedy invited Lyndon Johnson to join him at Palm Beach, Florida, while he was vacationing and recuperating from the vigorous election campaign. Johnson prepared for the meeting by investigating, among other things, the status of the space program. He was informed by his staff that the Nation did not have a comprehensive or centrally coordinated space program, and that at NASA "there has been a continuing lack of leadership and competence, basically in administration but not excluding the scientific field." The Space Council created by the NASA enabling act was moribund, despite Johnson's earlier personal understanding with President Eisenhower to have the President serve as its lead. And he was advised that NASA needed a tough and competent new administrator. The Mercury program, he was informed, had suffered "slippage," and other programs including Saturn, communications and weather satellites, and scientific probes were showing "slippage and failure." Moreover, bitter controversy existed between the Army, Navy and Air Force over

roles and missions related to space. The Air Force wanted responsibility for the entire program and would relegate NASA to a strictly advisory role.[36]

At their meeting Kennedy asked Johnson to head the administration's initiatives in prohibiting discrimination against minorities doing business with the government. Johnson agreed, and then was asked by Kennedy what else he would like to do. Johnson replied that he would like to continue his contact with space activities. Kennedy agreed, and issued a press release indicating that he would rely on the Vice President for space leadership. As Johnson recalled, "Every president brings to the office his own special concerns, which are the result of his interests and experience. Space was not one of President Kennedy's primary concerns at that time."[37]

Edward C. Welsh, who became Executive Secretary of the National Aeronautics and Space Council, began drafting amendments to the NASA legislation making the Vice President, rather than the President, a member and the chairman of the Space Council, which was approved by Congress in April. When Kennedy suggested that General James M. Gavin head NASA, Johnson responded that "it would be a serious mistake to appoint any military man to head the organization." And Kennedy responded, "All right, find another administrator." Johnson did. He personally interviewed some 20 prospective candidates and selected James E. Webb, former Director of the Bureau of the Budget and Under Secretary of State during the Truman administration.[38]

NASA Administrator Keith Glennan resigned on January 20, 1961, the last day of President Eisenhower's administration, without having received any statement from the President-elect as to his intentions regarding NASA. Webb, who was formally sworn into office on February 14, asked that Hugh Dryden be retained as Deputy Administrator. Meanwhile, a "lunar flight feasibility committee" chaired by George Low, and including Oran Nicks, Max Faget, and others, prepared a paper for the Vice President which offered a brief technical justification for a lunar landing.[39]

At the end of March, President Kennedy met with Johnson, Budget Director David Bell, and science advisor Jerome B. Wiesner, and others to discuss space matters. One consensus of the meeting was that the United States needed to develop more powerful rocket engines. Johnson advised setting a goal, "a bold and understandable challenge," to move America forward. Johnson said that he continued to discuss "this concept with the President at some length over the next few weeks."[40] The President's and the Nation's problems were soon exacerbated by another spectacular Soviet space achievement and an American-backed military debacle in Cuba.

On April 12, 1961, Major Yuri Gagarin became the first human to "leave this planet, enter the void of space, and return." Public dismay at this new evidence of Soviet space prowess rivaled that of Sputnik 4 years earlier. President Kennedy and Johnson conferred at length on the 19th, and on the 20th Kennedy directed Johnson to head a Space Council inquiry to see "where we stand in space." He asked:

> 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 land on 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?[41]

Although the President's memorandum, Johnson recalled, came to him only 3 days after "the disastrous failure at the Bay of Pigs," Kennedy was not trying to use space to divert attention from the debacle in Cuba. Edwin C. Welsh, Executive Secretary to the Space Council, concurred that the collapse of the Cuban invasion did not encourage a space venture, but if anything was a deterrent in that the administration could not afford a failure. On the same day that President Kennedy addressed his memorandum to Johnson, Congress approved an amendment to the Space Act making the Vice President, instead of the President, chairman of the National Aeronautics and Space Council.[42]

Space Council meetings began on April 22. Consultation and advice came from James Webb, who of course was a member of the Council. Johnson invited Frank Stanton, president of Columbia Broadcasting System; George R. Brown, president of the Houston-based Brown & Root Construction firm; and Donald C. Cook, executive Vice President of American Electric Power Company, to meet with the council. Hugh Dryden, Wernher von Braun, Admiral John T. Hayward (Assistant Chief of Naval Operations for Research and Development), and General Bernard A. Schriever were among those consulted. The Space Council reported to the President on April 28 that at the moment neither the United States nor the Soviet Union were known to have the capability of circumnavigating the Moon or landing a man on it, but that "with a strong effort the United States could conceivably be first in those accomplishments by 1966 or 1967."[43]

The scientific community and medical community, and indeed NASA Administrator James Webb, counseled a more moderate approach to the "space problem." An ad hoc Committee on Space headed by Jerome Wiesner, who became Kennedy's Science Advisor, stressed the accumulation of scientific data from unmanned probes. Another special panel of the Science Advisory Committee chaired by Dr. Donald Hornig urged more experiments with animals before men were committed to spaceflight, and gave only "lukewarm" endorsement to Project Mercury. Although Webb sought an expanded space program, he sought a "balanced" program and was uncertain about the costs and propriety of a manned lunar expedition.[44]

Although the debate continues as to whether the manned lunar expedition was inherently a political decision or a scientific decision, the political climate at the time strongly influenced the administration's decision. Views within the technical/scientific community were not clear. Technical people, engineers, test pilots, and life scientists looked at the problem of manned spaceflight from different perspectives. The public both feared the Soviet Union and the risks of an arms/space race. No one understood the extent of real costs involved or could estimate benefits or economic returns. The decision to attempt a manned lunar landing would require a substantial commitment of personnel, talent, and money and would affect the whole society. Leadership in American space initiatives now shifted dramatically from Congress to the White House. On May 25, John Kennedy addressed Congress and the American people:

> With the advice of the Vice President, who is Chairman of the National Space Council, we have examined where we are strong and where we are not, where we may succeed and where we may not. Now it is time to take longer strides—time for a great new American enterprise—time for this nation to take a clearly leading role in space achievement, which in many ways may hold the key to our future on Earth.[45]

> I believe that this nation should commit itself to achieving the goal, before the decade is out, of landing a man on the Moon and returning him safely to Earth.[46]

Congress turned to the task of defining and funding the President's new space policy with enthusiasm. Hearings in the House and Senate closed with the approval of approximately $1.7 billion in funding for space, and the promise of an additional $40 to $70 billion expenditure in the decade of the 1960's. A special report released by the House Committee on Science and Astronautics in August explained the "Practical Values of Space Exploration" as the generation of "new knowledge," the enhancement of America's international prestige and stature, and interestingly, the suggestion that space exploration might be a substitute for war. The economic benefits of the space program "spread across the entire industrial spectrum—electronics, metals, fuels, ceramics, machinery, plastics, instruments, textiles, thermals, cryogenics, and a thousand other areas." Space research should generate new industries, new power sources, progress in "human engineering," advanced communication systems, weather prediction and control mechanisms, the development of high-speed lightweight computers, advances in solid state physics, new economic alliances and private enterprises and jobs related to space.[47]

In some respects this new project was thrust upon NASA and its components, including the STG. But in most respects it was a project invited, planned for, dreamed of and enthusiastically entered into by the NASA community. The inception and design of a lunar mission actually pre-dated President Kennedy's announcement by almost 2 years. As the initial flights of Mercury developed, meetings between Silverstein and Gilruth's staff and personnel generated a program that would go beyond Mercury's limited spaceflight and which in three stages (A, B, and C) projected an Earth orbit, a lunar orbit, and a lunar landing. Silverstein prophetically named the project Apollo, for the Greco-Roman god of the Sun and prophecy. In 1960, some STG personnel actually began work on Apollo-related projects. "Gemini," according to Abe Silverstein, "was created as a filler between the Mercury and Apollo programs since it was recognized that the flight operations in Mercury would be terminated long before Apollo hardware would be ready to fly." It was believed that too lengthy an interval without flight would destroy the capability of flight operations and the astronauts.[48]

The administration's endorsement of a program to put an American on the Moon shifted NASA's technological and fiscal focus more fully on its manned spaceflight program, and prominently upon Bob Gilruth and the STG. The lunar landing was to be a NASA objective, and all centers would contribute to its accomplishment. But the new lunar mission seemed to mandate that the manned spacecraft program be established as a separate center, rather than remain under the administrative auspices of Goddard Space Flight Center or the Langley Research Center.

The greatly expanded NASA mission also required an administrative reorganization to accomplish an engineering, scientific and production feat which far exceeded anything the United States previously had entered into and before which (in terms of technical complexity, costs, and, as it turned out, time) those great feats of transcontinental railroads and the Panama Canal paled.

Even as NASA Headquarters and other branches of government began to contemplate moving the space task program to its own site, Webb began to address the new

organizational problems relating to a far more massive operations and production effort by NASA. He created the Office of Manned Space Flight through which all programs relating to the lunar landing (and Mercury and Gemini) could be orchestrated. Program offices were also established for Space Science, Applications, and Advanced Research and Technology. All program offices reported through the Associate Administrator, Robert C. Seamans, Jr. (an MIT graduate and RCA engineer), and the Deputy Administrator, Hugh Dryden, to Webb. Homer Newell came from the Vanguard program to be Deputy Director for Space Science; Morton Stoller covered Applications, and Ira H. Abbott––Research and Technology. D. Brainerd Holmes was selected to head the Office of Manned Space Flight because of his experience with RCA in handling "large scale endeavors." As project manager of the Ballistic Missile Early Warning System, he was known as an organization man and credited with being a tough program manager. Holmes brought in Joe Shea from Bell Laboratories to head systems engineering. Bell Laboratories organized a management company called BellComm specifically to provide management assistance for NASA. Abe Silverstein left NASA Headquarters to become the Director of the Lewis Research Center, and Dryden remained the anchor man amidst all of the turnover.[49] New administrators, new organizations, and rapid expansion began to create personnel and management problems at a very critical moment in the life of the manned spacecraft program. These problems were generally sublimated to the great opportunities and excitement and the sheer hard labor involved in the existing programs and the new. To add to the confusion, by mid-1961 the decision was made to relocate the manned spacecraft program onto its own center.

The "slippage" in the space program reported to Lyndon Johnson seems to have faded by March, when the Kennedy administration assumed office. Real progress had in fact been made over the past several years and in 1961 much of the hard work began to bear fruit. The first team of astronauts was selected in 1959. In May of that year, Able, a rhesus monkey, and Baker, a squirrel monkey, were lofted to an altitude of 300 miles and 1500 miles downrange over the British West Indies. On December 4, 1959, and on January 21, 1960, Sam and Miss Sam made successful flights from Wallops Island; while on January 31, 1961, Ham, a chimpanzee, made a full dress suborbital flight in a Mercury capsule launched from Cape Canaveral, Florida, and ended up with "wet pants" when his capsule landed 150 miles beyond the recovery point with a collapsed heat shield which had punctured the capsule. Work on this problem, which was solved by placing impact absorbing metal honeycomb on the aft bulkhead and a cable and spring system between the heat shield and the capsule, enabled the launch of America's first manned flight to proceed. In the interim, Yuri A. Gagarin, a Soviet cosmonaut, made man's first journey into space in a 108-minute orbit of the Earth aboard the 5-ton Russian Vostok spacecraft.[50]

Although American consternation over this latest Soviet triumph led to the perception that Gagarin's flight hastened the launch of America's first astronaut, the fact was that an American launch had been imminent. Within the month, the STG successfully launched Alan Shepard aboard "Freedom 7" on May 5, 1961, for a 15-minute flight downrange. President Kennedy, who offered Shepard his personal congratulations by radio-telephone when he arrived aboard the pick-up carrier, hailed the flight as a "historic milestone," but urged America to "work with the utmost speed and vigor in the further development of our space program." Although unrelated to the Shepard flight, on May 16 a site selection team

visited Houston, Texas, one of the many locales being considered as a possible home for a new manned spacecraft center. And then, on May 25, President Kennedy announced the lunar landing initiative. May 1961, was, as Gilruth turned the phrase, "the end of the beginning" for America's manned space program.[51]

On September 19, 1961, NASA announced that its new "spaceflight laboratory" would be located in Houston, Texas, on 1000 acres of land made available to the government by Rice University.[52] By the end of the year and throughout 1962, first hundreds and then thousands of manned spacecraft personnel, contractors, support groups, and their families were making their way to the flat, seemingly hurricane-ridden coastal prairies south of Houston, until then the exclusive habitat of Texas cattle, oil derricks, rice fields, fish, ducks, some alligators, lots of mosquitoes, and a most enthusiastic and receptive local population.