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"With A View To Their Practical Solution"

SIXTY YEARS WITH THE NACA AND NASA

1915-1975
By
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One value of the Bicentennial Year is already being served, and rather painlessly as seems evident by the amazing size of this audience. This is very pleasing. History is not a vogue subject of study in American schools at almost any level. Busy Americans tend not to be history minded, which includes scientists and engineers. A few intuitive scientists, engineers and managers become interested in the history of their own field of specialization and beyond their own career horizons. By definition, someone genuinely history-minded is mainly interested in re-creating knowledge of the past and not shaping the future. When someone says history proves something, you had better listen very carefully.

American historians, for their part, have not been too helpful either. They have not been greatly interested in the history of science and technology until very recently. And, they tend not to be interested in recent events. So here in the twentieth century, when science and technology have increasingly been a great influence on social change, in war and in peace, we have this dichotomy between the busy makers of history in the fields of

science and technology, and the historians relatively uninterested in science and technology. The history of the NACA and NASA fell between these two stools, at least until the spectacular Apollo achievements on live TV.

The Bicentennial now provides us with the rare opportunity to examine the 43-year history of the National Advisory Committee for Aeronautics and the 17-years of the National Aeronautics and Space Administration for its own sake. It is a legitimate subject for discussion. I hope that what I might say about this continuum of experience will be helpful to some of you. Some parts of the history of the NACA and NASA obviously some people in the audience know more about than I may ever know. History is only as good as its sources. When you hear a historian say something, find out the sources for his generalizations. What are his hypotheses, what are his inferences or his facts upon which he bases his thoughts?

It is not a historical accident that at the oldest laboratory of NASA we have a spot here in the Bicentennial Series to look at history.

I will not bore you with the obvious on how important the technology of flight has been in recent American history — whether it was World War II or preserving global peace, or the changed view of man upon the world itself because of "spaceship earth," as viewed for the first time from above the moon by the Apollo 8 astronauts. The price of a ticket will carry you by air to the

far corners of the earth. We now also know we live in a dynamic universe. We are catching the sun's rays to try to heat our houses. This is not new to knowledge but the horizons and the problems have changed. The whole history of flight from man starting to fly like a bird safely, which the Wright brothers contributed in controlled flight, has led us to the moon. With the Space Shuttle we are now entering the phase where practical space transportation hopefully will become economic, and not just heroic and novel.

It has only been 360 years since Galileo first pointed a telescope at the moon, about the time this part of the world was first getting settled as a matter of fact. Galileo's sketches of the large craters on the Moon was the discovery of a "New World," and was a seminal event in the rise of modern science. It was just 66 years after the Wright brothers demonstrated controlled flight in 1903, man first set foot upon the surface of the Moon. This was just six and one-half years ago.

One historian of technology, who has been most helpful to us in NASA, is Melvin Kranzberg, editor of Technology and Culture, quarterly of the Society for the History of Technology. Kranzberg has suggested that the school children of the twenty-fifth century (the 25th century is Buck Roger's century for those unfamiliar with the older comics), that the school children will chant the doggerel in their classrooms: "In nineteen-hundred-and-sixty-nine, Neil Armstrong leaped for all mankind."[1] The point here is that the

first date of history memorized by most of us, was anchored by "the ocean blue" and "fourteen-hundred-and-ninety-two."

The recency of the history we are looking at today is reinforced by the fact that the first employee of the NACA, Dr. John F. Victory, just departed this world a little over a year ago. People here today have shaken hands with Orville Wright and Neil Armstrong. The entire experience of practical flight has been confined within the memory of people still living, although increasingly a precious few. It has been a working assumption of the NASA historical program, besides getting all the documents, that history passed on to posterity should have the benefits of the inputs of as many of the key participants as possible. But I suspect that there are probably some academic historians attempting to write NASA's history just like everyone involved is now dead. One man's memory is not history, it is a memory. But these memories can be most helpful to the historian.

Hugh L. Dryden once conveyed a thought which coupled the thrust of a research engineer with the historian's method, when he said in his Wilbur Wright Lecture in 1949: "The most important tool in aeronautical research, even more than the large wind tunnel, is the human mind." History too is an intellectual process.

You will have the opportunity after the 4th of July to visit the new National Air and Space Museum across the street from NASA Headquarters. It will be simply a stunning exhibition of the prime artifacts in the history of flight technology. Behind each one of

them is a human story, one involving the details, conception, design, construction, test, modification, and application in each airplane and spacecraft. About the same time this great historical display will be open, the Viking lander hopefully will be setting down upon the surface of the planet Mars. It may answer some questions but it will likely raise many more questions.

To get your mental time machine turned back, I could ask who was the first American to fly? The bicentennial of the first American to become airborne on a man-made device will not occur until 1984. (1984 was the 30-year projected date for George Orwell's forecast of things to come). Who was the first American to fly? His name was Edward Warren. He was a 13-year old boy persuaded to ride a tethered 30-foot hot-air balloon. His brief up and down voyage on the balloon of Peter Carnes of Bladensburg, Maryland, is mentioned only in the Baltimore newspapers of the day, and only several out-of-print histories. This flight happened, perhaps significantly, within a year of the first Montgolfier balloon flights in France in 1783. The flight of Edward Warren preceded the so-called premier balloon flight in America, that of Blanchard from behind Independence Hall in Philadelphia in 1794. It was witnessed by George Washington and his entire cabinet, so it is in all the history books. To get your time machine turned back, be it noted that to Frenchmen in 1783, the first balloon flights were regarded as man's historic fulfillment of his dream of flight since the beginning of recorded history. Yet we have to

keep in perspective that the Wright brothers developed the first practical flying machine, and the German V-2 of World War II was the first large practical liquid fuel rocket. One of our Presidents referred to Apollo 11 in July 1969, as the greatest event in human history since "The Creation." Who knows what man in the twenty-fifth century will say about 1969?

THE NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

We will have to waltz through the history of the NACA and NASA, touching only upon a few highlights. Fundamental questions of who, what, where, when, and why on all major aspects of this sixty year history simply cannot be fleshed out in such a short time, even if I knew everything which I don't.[2]

Why was the National Advisory Committee for Aeronautics created? To make a complex story short, the NACA was created after the beginning of World War I in Europe and because there was an "aeronautics gap." The land of the Wright Brothers had fallen behind aeronautical progress in all of the major nations of the world. It was realized in 1913, after a visit to the laboratories of Europe by Jerome C. Hunsaker and Frank Zahm, that all the leading nations, before the guns of August began firing, had created national aeronautical laboratories. Hunsaker had been detailed by the U.S. Navy to teach the first courses in aeronautics at MIT and Zahm had been placed in charge of Dr. Langley's laboratory back of the Smithsonian. Despite the best efforts Smithsonian

Secretary Walcott and Alexander Graham Bell, both members of the National Academy of Sciences, they were unable to get approval in Washington for the creation of a Federally-funded aeronautical laboratory. With the outbreak of World War I, and the endorsement of Acting Secretary of the Navy, Franklin D. Roosevelt, the legislation creating the National Advisory Committee for Aeronautics was added as a rider to the Naval Appropriations Act of March 1915.

I have not documented very well the plight of American aviation before World War I. Two illustrations will suffice here. First, the entire operational air force of the Army Signal Corps, the 1st Aero Squadron, was assigned to support the primitive actions against Pancho-Villa in Mexico in 1916. It was not shot down by Pancho-Villa's forces, it just wore itself out and was destroyed by its own operations. Secondly, no aircraft of American design and manufacture flew in combat in World War I. American airmen flew French and British aircraft, Spads and Sopwith Camels. If the war had lasted a couple of years longer, why of course American aircraft with the "Liberty" engine would have had quite an effect. The political goal to "blacken the skies over Berlin" with aircraft produced by American industry never came about. There were many investigations after the war why this had happened, which is another story. The National Advisory Committee for Aeronautics made some notable policy decisions during the war, and the Aircraft Proving Ground was opened here at Langley Field for Army, Navy, and NACA units. But the first NACA wind tunnel did not begin operations, and the Langley Memorial Aeronautical Laboratory was not dedicated

until 1920. By that time the Army Air Service had moved their flight test operations to Dayton, Ohio, and the Navy had moved their flying boats to Norfolk.

The charter of the National Advisory Committee for Aeronautics was a classic document. Its few phrases served well, and may be familiar to you because part of it was always found on the desk of a Director of the Langley Laboratory. I'd guess that during the past 17 years I have been asked at least 50 times for the precise wording or location of the text of the charter of the NACA.[3]

The authority established the Advisory Committee for Aeronautics, not to exceed 12 members: two each from the aeronautics branch of both the Army and the Navy, one each for the Weather Bureau, the Bureau of Standards, and the Smithsonian; with five knowledgeable persons (meaning from industry or academe). At its first meeting, it added the word "National." It was later expanded to 17 members. Members were "to serve without compensation." (That's one way to get legislation passed!) And:

> "That it shall be the duty of the Advisory Committee for Aeronautics to supervise and direct the scientific study of the problems of flight, with a view to their practical solution, and to determine the problems which should be experimentally attacked, and to discuss their solution and their application."

The legislation also specified that the Committee may direct and conduct research and experiment in aeronautics in "a laboratory or laboratories." "The sum of $5,000 a year, or so much thereof

as may be necessary, for five years is hereby appropriated..." It provided that an annual report be submitted to the Congress through the President. The Annual Report came to be prepared with meticulous care as if the life of the NACA depended upon it. Secretary of Commerce Herbert Hoover tried to get NACA transferred to the Bureau of Standards, a threat which was revived regularly. Some members of the U. S. Army Air Service had eyes on NACA too. But by the time of Lindbergh's trans-Atlantic flight in 1927, the Langley Laboratory had made contributions to both the Army and Navy. 1927 was the year the first Langley Inspection was held, a most effective means of acquainting the aviation community with the work of the NACA. Moreover, NACA's technical reports had gained reputation internationally. It had a Paris Office under John Ide, and NACA's Office of Technical Intelligence kept up with worldwide developments in the technology of flight, the military air services, and the aircraft industry during the rapid developments of the 1930's. This was the "golden period" of NACA contributions with a view to their practical solution of the problems of flight,

NACA was really an independent agency. Members of the Main Committee were appointed by the President. But the Committee elected its own Chairman (he was not approved by the Congress). The Committee hired the Director of Aeronautical Research, who managed the internal organization of the NACA. The laboratories of the NACA responded to the quidance with resolutions of the Main

Committee. Of course, the Committee really gave national focus upon the problems of aeronautical science. It represented the needs of the Army and Navy Air Services, the Weather Bureau, —— this national focus to aeronautics was rather rare on a particular field of endeavor in the Federal establishment, almost until the creation of the Atomic Energy Commission after World War II. A high compliment was paid the NACA when it retained sovereignty over aeronautics when the OSRD was created in 1940, to mobilize scientists out of uniform for World War II.

The work of the laboratories, as I will not have time to elaborate, and which Langley under Dr. Henry Reid was the only one for twenty-six years, responded to the guidance of the Main Committee through the Director of Aeronautical Research.[3] But the reputation of the NACA to solve the practical problems of flight meant that many problems were brought directly to Langley by people from industry and the military services. The Laboratories did the work of the NACA, and there are several books you can examine for part of this story.[4] Langley became the "mother laboratory" of the NACA with the creation of the Ames and Lewis Laboratories during World War II, and later the units at Wallops, Virginia, and Edwards, California, not to forget Project Mercury much later that eventually became the Johnson Space Center.[5]

The charter of the NACA became somewhat restrictive as you have this great convergence of new technologies of flight — that which stemmed from Robert H. Goddard and the first practical liquid

fuel rocket in the German V-2, and jet propulsion for aircraft. Everyone learned that Nazi Germany set out to build a better NACA and did during World War II —— a dictatorship can be as efficient in basic research as a democracy. By the time all these new technologies begin to converge in the 1950's, "aeronautics" meant much more than the focus on aerodynamics, airfoils, and instrumentation. The work of the PARD (Pilotless Aircraft Research Division) of Langley under Robert Gilruth started its notable research using rocketry to get at the problems of high speed flight. And, the notable rocket research airplane program, starting with the supersonic X-1, led NACA to the threshold of space. NACA Director Dryden was a little concerned when William O'Sullivan got involved with the air density satellite experiment of the International Geophysical Year, but decided that a program approved by the President would suffice. At the same time, the industry and the military services started bringing their problems related to high-speed military jet aircraft and later guided missiles to the NACA. The "view to their practical solution" continued to prevail during the late 1940's and early 1950's.

The classic example of NACA's restrictive charter was illustrated on the day of Sputnik in October 1957 at Lewis Laboratory. Executive Secretary John F. Victory heard the dry runs for the Triennial Inspection, which each year he carefully made it his job to be sure that every station on on the tour, and every man at each station, had his presentation down letter perfect to impress the

VIP's, including the Congressmen. He categorically demanded that all references to space —— particularly one paper on ion propulsion in space, which was pretty far out as regards early application in space —— be deleted. "NACA will be finished if the Congress ever finds out we are working on the Buck Roger's stuff," he said. That Friday evening, October 4, 1957, news that the Russians had launched the world's first earth satellite became known. When the Lewis Inspection began the next week, all references to space were restored. Abe Silverstein even made the New York Times on the advanced propulsion studies underway at NACA Lewis. Here at Langley, Max Faget had been unable to get approval for a NACA satellite using solid propellant stages in a booster rocket.

It is difficult to illustrate in few words how the NACA operated. It had a great reputation. The Committee was not the NACA organization in the laboratories. The Technical Committees, in key disciplines, also had nationwide membership and served as a clearing house for information on problems and progress on the frontiers of flight. You name a prominent person in the technology of flight, and you will likely find at one time or another he was on a technical committee of the NACA. This would include Robert Seamans, and even our current Administrator, James C. Fletcher. These technical committees functioned effectively. General "Hap" Arnold could leave a meeting of the Main Committee, put on his Army Air Force hat and direct Wright Field to do something that the NACA was not doing, or vice versa. One must be careful to distinguish

the work of these various components of the NACA, which, in effect, were to lead to the placement of the civilian space mission atop the NACA with the creation of NASA. One big change, of course, was that the NASA had a Headquarters instead of just the "Washington Office" of the NACA, and it no longer had a Main Advisory Committee but reported directly to the White House.

It should be noted that the Chairmen of the NACA were always very strong persons over the years.

° Dr. Joseph Ames (1927-1939) of John Hopkins, served as Chairman of the Executive Committee from 1919 until becoming Chairman of the NACA in 1927. It was Dr. Ames, Dr. Thompson reminded me, who said: "The business of the NACA is research, and we stand to our business." The NACA did not get into the practical design and systems development of aircraft until the research airplanes.

° Dr. Vannevar Bush of MIT (1939-1941) used the Technical Committee systems of the NACA in setting up OSRD. This mobilized scientists for World War II, except for NACA in aeronautics and the MAnhattan Project for the atomic bomb. He wrote in his memoirs that when one moves to Washington, you must find a man like John F. Victory if you expect to get anything done.[6]

° Dr. Jerome C. Hunsaker (1941-1956) of MIT was also a very strong figure, one of the designers of the Navy NC-4 which flew the Atlantic right after World War I. The NACA grew from 523 persons in 1939, to 6,800 in 1945. Once the fix-up of military aircraft

during World War II was completed, the NACA got back to its basic work of fundamental research.

° Dr. Jimmy Doolittle, the last Chairman (1955-1958), who also was a key figure in getting NASA created atop of the NACA in 1958. He was also Chairman of the Scientific Advisory Board of the Air Force.

Each Chairman of the NACA testified before the Appropriations Committees of the Congress with the Director of the NACA.

Examining briefly some of the leading people of the NACA may permit me to bring the NACA story to life a little within a few minutes.

The first employee in 1915, was John F. Victory. He was a court reporter hired to record the deliberations of the NACA. He shared an office with Colonel "Billy" Mitchell before the U. S. entered World War I. John Victory developed a religious passion about the NACA, its mission and its people. He fought the Civil Service Commission. He fought the Selective Service during World War II to prevent NACA people from being drafted — the "one day soldiers" resulted as NACA people were placed in the Army Air Force Reserve (Naval Reserve at Ames) for the duration. John F. Victory most effectively functioned with the Congress. He would visit every new-elected Senator or Congressman, introduce himself, and explain what the NACA was, and offered the help of NACA on any aviation problem that might arise. When the famous NACA cowling increased the air speed of air-cooled-engined aircraft, he worked up dollar figures that showed that this saving in time and gasoline

for commercial operations would be a greater amount than the entire funding provided the NACA from the beginning. NACA had only two Directors, Dr. George Lewis (1924-1945) and Dr. Hugh L. Dryden (1947-1958), and they ruled over the NACA research program. But it was John Victory who oversaw the housekeeping details of dollars, personnel, and lots of little important things.

There is no biography of Dr. George Lewis, Director of the NACA for twenty-one years (1924-1945). He was a mechanical engineer who became a strong research manager, smoked cigars and wore pince-nez glasses. He was constantly concerned that the work going on at Langley was practical, and he maintained cordial relations with the entire aviation community, particularly in Washington. He came to the Langley Laboratory almost every week. He could get on the Washington-Norfolk ferry boat at 6 PM in the evening, and be at Point Comfort at 6 AM the next day. He'd spend the day at Langley, then return to Washington that evening. He always occupied State-room 13, and had a special shutter device to pull moving air through his stateroom during hot weather. When he flew the Hindenburg to Europe to examine Germany's new laboratories in 1937, he reported to the staff of General Hap Arnold what he had found. He corresponded with Robert Goddard in the 1920's and Charles Lindbergh in Europe in the 1930's. Lindbergh was very instrumental in pushing the the state of the art to the 550 mph airplane for the possible coming war, and was instrumental in the creation of the Ames and Lewis laboratories. In 1941, returning from Langley, Lewis told his NACA driver awaiting him (Mike Cushman): "It was a sad day at Langley

yesterday. Langley just went over 1,000 people. When you get that many people you begin to get inefficient." Dr. Lewis also reported once that he had discovered that Abe Silverstein had another wind tunnel, using a boiler off the Laboratory some place. Everyone seems to agree that Dr. Lewis killed himself by hard work during World War II.

Dr. Hugh L. Dryden, the second NACA Director (1947-1958), was a scientist, who got his Ph.D. at the age of 20 while working at the Bureau of Standards, a student of Joseph Ames. It is indeed fitting that the Dryden Flight Research Center will be dedicated next month. Dryden and Lyman J. Briggs began propeller-tip aerodynamic studies in 1924 —— compressibility was reached at 450 mph, and the flow of air separated from the air foil. He became a lay Methodist preacher, spoke every Sunday somewhere, did not smoke anything, and drank ginger ale. Briggs and Dryden attained international stature for their NACA reports in 1926 on research on a 3-stage, turbine-driven, compressor at GE, Lynn, Mass. Later they ran tests at Mach .5 to Mach 1.08 and observed a shock wave one-half-inch in front of an air foil. Dryden headed an interagency committee on low-cost housing technology in the 1930's, and did the famous study proving that a baseball did indeed curve when properly pitched.

Dryden had a photographic eye and instant recall. During World War II, he worked on guided-missiles for the OSRD, particularly on the "Bat," a guided bomb. He was the Scientific

Director of the Army Air Force Scientific Advisory Group under Theodore von Karman in 1944-1945. The von Karman group found mach 4.4 wind tunnels in Germany, and made recommendations on R&D which served the country importantly. One of his major post-war jobs was working out the Unitary Wind Tunnel Plan. While the NACA lost its relative monopoly of wind tunnel technology, the Unitary Wind Tunnel Plan insured that every Federally-funded wind tunnel in NACA or the USAF was not duplicative. Dryden also refused to be Chairman but generally prepared the agendas for the North Atlantic Treaty Advisory Group for Aeronautical Research and Development (AGARD). As the Director of the NACA, of course, the working out of the research airplane program, with the Air Force and the Navy, became an important means of extending the research profiles of high-speed. Importantly, Dryden was close to the decision-making process in the White House, when NASA was created. And, most importantly, it was Deputy Administrator Dryden who retained the role of the Research Center in the NASA. It was testimony enough that both of NASA's first two Administrators, Dr. T. Keith Glennan and James E. Webb accepted their posts provided that Hugh L. Dryden would remain as Deputy Administrator of NASA. When he died in 1965, he was never really replaced. Congressional Committees sometimes did not agree with him, some people in the NACA even regarded him as conservative; they came to know that what Hugh Dryden, the NACA or the NASA promised to do, indeed was accomplished. He was, in his quiet way, the most brillant intellect I have ever met. He never said "no." But he would suggest a better alternative to a proposal which had the same effect.[7]

I am sorry I do not have time to review the role of the NACA laboratory directors — Henry Reid, Smith DeFrance, and Ray Sharp.

THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

The basic historical question is why was the National Aeronautics and Space Administration created?—is a complex story but can be easily answered. It was a result of an evolving national decision process to create a civilian space agency atop the NACA after the Russians launched the first satellite of the earth on October 4, 1957. Sputnik was a shocking technological surprise to the American people. It was no surprise to the people in NACA or the rest of the aerospace community. The space first was certainly novel, but it took a while before space exploration took a trajectory of its own. The idea that the Russians had a superior rocket which could carry a thermonuclear warhead at intercontinental ranges, could not be explained away. So Sputnik was a symbol of a "technological Pearl Harbor" in the military sense, and priority efforts were devoted by the White House and the Congress to get on with ballistic missile development and possible space projects to help insure peace. In his first major speech after Sputnik, President Eisenhower said: "What the world needs today is not a giant leap into space, but a giant step toward peace." He tried to explain why he had decided in 1955 that the U.S. satellite to be launched for the IGY would not be lofted by a military missile for the sake of international science.

It took a year until NASA officially began, and the process of the national decision to create a civilian space agency led to the passage of the National Aeronautics and Space Act of 1958. This is a remarkable legislative charter, which I may assume most of you may have read. You should. It preserved the aeronautical research mission of the NACA, and expanded the scope of the requirements of space flight technology to be served "with a view to their practical solution." Space operations imposed even greater requirements for reliable performance than airplanes, and particularly when men flew in spacecraft.

Why NASA was created evolved after the impact of the Russian sputniks percolates over several months. Even before Sputnik, President Eisenhower had opted strongly for keeping space peaceful, and concerning which he pounded the table when I interviewed him in 1966, saying: "What was more important than keeping space peaceful?" The ICBM program began before the IGY satellite program, but Eisenhower sought unsuccessfully to establish an "open skies" accord with the Soviet Union. With Sputnik, the Russian satellite did open up the skies for nonmilitary over-flights, and in the name of international science. Eisenhower appointed a Science Advisor in the White House after Sputnik II carried a little Russian dog into orbit early in November 1957. He named James R. Killian to this post. While military concerns prevailed, the thought that the NACA might be the best way to get started on nonmilitary space efforts early appeared. It was mentioned at a Saturday luncheon in the White House mess at a meeting in late November 1957, by four "Jims":

James R. Killian, James Fisk of Bell Telephone Laboratories and a member of the President's Science Advisory Committee, James McCormack of the Air Force, Atomic Energy Commission, and later MIT, and James Doolittle, Chairman of NACA and of the Scientific Advisory Board of the Air Force. The point was discussed that if the Air Force got the ballistic missile job, could the Army do the space job, or vice versa? It was McCormack and Fisk who agreed that NACA, with its experience in aerospace technology and effective relations with the military services, industry, and the technical community might be a good way to get started with minimum disruption. The IGY space effort could be continued, the nonmilitary satellites and projects of the military services could be assured of gaining scientific results, and the military rocketry could be used for these nonmilitary purposes. At the same time, military aspects of space could remain in the Department of Defense. Nothing happened while the NACA prepared to play a research engineering role in space technology that it had already started to do, additional to aeronautical research. Even after the Vanguard blew up on the pad in December 1957, nothing tangible happened until the Army launched Explorer I on January 31, 1958, and Eisenhower directed Killian to come up with a recommended space organization. In the meantime, the DOD had created the Advanced Research Projects Agency (ARPA) to get atop the "missile mess" in the Pentagon and serve as an interim focal point for getting missile and space projects underway. Additionally, the American Rocket Society and the Rocket and Satellite Research Panel had recommended strongly

that full space accomplishments would best be served by a non-military space agency. And, in the meantime, Lyndon B. Johnson, Majority Leader of the Senate, had become a champion of a vigorous nonmilitary space program for its own sake. I have been spending the past several years documenting in full detail this full story on how NASA was created, and how it got underway during its formative early years before receiving approval for the Apollo program as a national priority.[8]

In short, NASA was created out of NACA because of President Eisenhower, James R. Killian aided by James Doolittle and Dryden and the PSAC members, and Lyndon B. Johnson. Of course, others helped shape the legislation declaring that U.S. "activities in outer space shall be devoted to peaceful purposes for the benefit of all mankind." The so-called "reconstituted NACA" called "NASA" was to pull together probably the greatest single group of competent engineers in peacetime. The NACA people were not the least important in the NASA story to date. But they were joined by many dedicated engineers from other governmental agencies and industry.[9]

It was the great good fortune of NASA that it always had an Administrator who seemed right for the historical environment of his time. T. Keith Glennan, James E. Webb, Thomas Paine and James Fletcher —— each of them are deserving of fuller appreciations.

To get further along in the NASA story, the second phase of NASA, was dominated by the Apollo goal. About the recommended decision by President John F. Kennedy to land an American on the moon in the 1960's, it can be said that it was never considered

other than a NASA job at the highest level. It was a decision made before the first Mercury astronaut flew in space. It was a decision pressed by President Kennedy after another Russian space challenge when an obscure Red Air Force Major named Yari Gargarin made the first space flight around the world on April 12, 1961.

President Kennedy had not been a space enthusiast, and had turned the job of selecting a new NASA Administrator over to Vice President Lyndon B. Johnson. Johnson had been turned down by 19 to 23 (LBJ used both figures) men unwilling to take the NASA job. There were some people in high places who felt the Air Force should take over Project Mercury and most of the U.S. space program. How fortunate NASA was to get James E. Webb as its second Administrator. But the role of NASA people in the Apollo lunar-landing decision is not yet fully known, which I am also working on. The goal was very simple — an American on the moon in this decade.[10]

It was no accident that NACA people early got the top jobs in NASA because NACA and ARPA sorted out national space tasks during the summer of 1958, and before Glennan came aboard. Robert Gilruth and Abe Silverstein had been detailed by Director Dryden earlier to shape the NACA budget and program for the additional space projects to be transferred. Gilruth preferred taking on the manned satellite program, later called Mercury, while Silverstein became first Director of Space Flight Program in NASA Headquarters. While T. Keith Glennan thus inherited a space-going NACA, and all of the projects and programs transferred immediately into NASA, he started recruiting the

the best people possible from outside of NACA.

I shall not have time but for a word on the research engineering aspects directly transferred from the NACA traditions. With regard to the reliability of launch vehicles and of spacecraft, a major effort had to be made to get inherited things working. The Air Force, Army, and Vanguard boosters did not work very well, which is true of all first generation new systems. In the space science and application areas, NASA learned that if a project director was a scientist, his deputy had better be an engineer; or vice versa. With regard to manned space flight, the Space Task Group here at Langley was always mindful of a man in the loop from NACA experience. Rocket people were experienced in automated systems. Every consideration had to be made for safe, reliable, and well-defined operational fail-safe technology in Project Mercury. The Headquarters manned space flight office consisted of George Low and Warren North, in the beginning. It was the point of contact for STG as well as planning future programs.

Early in 1959, Harry Goett of Ames was made Chairman of the "Research Goals" Committee in NASA Headquarters to shape the guidance to focus the work of all NASA centers. Out of the visits of this Committee to the former NACA laboratories emerged definition of those critical areas of space flight engineering requiring definition and additional research and analysis before NASA could come up with a sound space program for the next decade. In short, it was a process of getting at the most practical solution of the most critical problems. Out of the Goett Committee process, additional to studies

of space flight technology emerged the thrust: the manned lunar mission appeared the best goal to collate known and unknown knowledge so that intermediate technology in rockets and spacecraft would be building blocks ultimately a part of a feasible operational system. Besides stirring the laboratory research and giving meaning to the important Long Range Plan for space which Congress and the White House wanted for NASA, was the suggestion for the goal of a manned lunar landing. Early in January 1960, Glennan gave planning approval for a circumlunar manned mission, and to use the ABMA/Marshall Saturn C-2 to fly men around the moon, perhaps after 1970. This would be the manned program to follow Mercury. When Silverstein, Gilruth, Low, and others considered how to get more help in planning how this should be done, Gilruth listed all of the key problems that remained to be defined — solar radiation, re-entry physics from lunar trajectory, and so forth. The conclusion was immediately reached in February 1960 that the NASA laboratories had to be brought into this problem-definition exercise before guidance for any industry studies could be contracted which would be meaningful. As is known, a circumlunar Project Apollo was announced in July 1960, as the post-Mercury manned space flight program.

"With a view to their practical solution" came to the fore again once the lunar-landing Apollo program got a national priority and got underway in mid-1961. A whole series of joint technical panels with the best informed technical participants from all the NASA centers including Marshall, Goddard, and JPL, played, I would

submit, an indispensible role in the ultimate Apollo achievement.[11]

IN RETROSPECT

To the historian, the continuum of the historical experience of the NACA and NASA for sixty-years seems indisputable.[12] The tradition of the practical excellence of aeronautical flight research was made an expanded imperative in space operations of making more complex machines work more reliably in the most hostile environment of space. Meshing of many disciplines of the sciences and engineering beyond aeronautics presented a steep learning curve since 1957. Additionally, knowledge of the space medium itself has been a constant dynamic process of generating practical solutions for newly appreciated problems.

Is the Space Act charter of NASA still valid? To the historian those who say it is not, seem unfamiliar with the history of how we got where we are. In many new ways the challenge of space, like aeronautics yet too, appears just as challenging if not more so today than it ever was. There are many others interested in ecological and other space-related concerns on Earth, and colonization or manufacturing in space beyond the sheer attraction of curious scientists and the exploration of the unknown accessible but not yet reached. We shall see.

I have talked more about the NACA than NASA, but fifty minutes to cover sixty-years is still fifty minutes. I did not have time to change "NA¢A" to "NA$A," once doodled by a Director of the Bureau of the Budget, and a NACA/NASA engineer, and all the other dimensions

of size and change in our history. But I have focused upon the factor of time, and trying to give you perspectives on the past for today.

Perhaps you will now be more mindful that many millions of people will not forget man's first view of the earth as provided by the Apollo 8 astronauts, or Neil Armstrong's leap for all mankind. Eisenhower's thrust to keep space peaceful has so far been a reality. Apollo was a promise of President Kennedy that came to pass, which is not a commentary on the batting average of politicans. The Apollo-Soyuz program was more than an experiment in proving Americans and Russians could get along when they are lofted into space. These historical milestones of NASA's technical and even political experiences in the recent past, shall continue to help shape future events for they belong to everyone.

There is an illustration of how my NACA-NASA theme of "with a view to their practical solution" can be related to our Bicentennial perspectives.

I had the rare privilege of once hearing the great historian from Richmond, Douglas Southall Freeman, lecture at the Air University in 1954. He wrote the great biographies of George Washington and Robert E. Lee. Dr. Freeman was talking about leadership. During the question period, he was asked did Washington and Lee had anything in common as military leaders? Dr. Freeman replied that he did not think that George Washington and Robert E. Lee had anything similar in their makeup, although they both came

from Virginia. He thought for a moment, and then said that there was something that both George Washington and Robert E. Lee had in common: "They both did little things well."

I would submit that research engineers and scientists, and managers thereof, would likely agree that the history of flight from the Wright brothers to the Viking landing on the planet Mars, documents that little things must be done well and "with a view to their practical solution." Hopefully, future historians will do a better job in explaining why and how this was done.

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11. This statement does not detract from the historic contribution of the Congress or the White House in sustaining the Apollo Program, the role of NASA management, or the contributions of other government agencies, as well as contractors of the Apollo teams in industry and academe.

12. Two recent works span the History of the NACA and NASA, Arthur L. Levine, The Future of the Space Program, New York: Praeger, 1975; and Frank W. Anderson, Orders of Magnitude: A History of the NACA and NASA, NASA SP-4403, 1976 (Forthcoming).