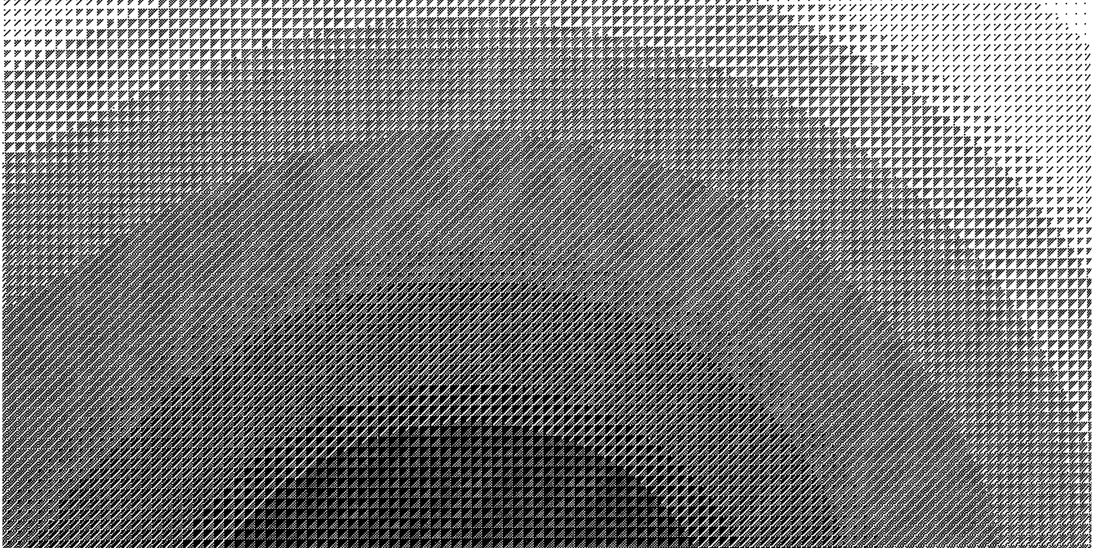
RETURN TO THE MOON



RETURN TO THE MOON

EXPLORATION, ENTERPRISE, AND ENERGY IN THE HUMAN SETTLEMENT OF SPACE

HARRISON H. SCHMITT

FOREWORD BY NEIL ARMSTRONG

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FOREWORD

By Neil A. Armstrong

I have in my library a book, published in 1896, entitled *The Sun*, by C. A. Young, PhD, LLD, Professor of Astronomy at Princeton. The learned professor easily discounts earlier theories that assumed that the Sun's energy resulted from the combustion of its gases. He wrote: "Even if the Sun were made of solid coal, burning in pure oxygen, it could last only about 6000 years. It would have been nearly one-third consumed since the beginning of the Christian era." That would result in a reduction in the size and energy output of the Sun, and a steady decrease in temperature of the Earth over the intervening centuries. The simple evidence of constancy in the growth of olive trees over two thousand years prohibited the possibility.

He examined two other hypotheses popular at the time: the chief proposed source of solar heat was (a) the impact of meteoritic material on the Sun's surface, or (b) the slow contraction of the Sun due to its own immense gravity. Without going into the detail of his elegant calculations, he ruled out the meteoritic theory and showed that the gravitational theory would yield a Sun that could only produce heat for about five million years. Something did not fit. Geologists had ample evidence that the Earth was far more than five million years old, and it seemed unlikely that the Earth would be older than the Sun.

Professor Young was short changed by time. In 1896, the same year in which Professor Young's book was published, Henri Becquerel, in France, discovered radioactivity. As we now know, radioactivity is a process wherein the atomic structure of certain elements naturally changes, giving off energy in the form of alpha, beta, or gamma rays.

In 1938, Otto Hahn and Fritz Strassmann transformed uranium into barium by neutron bombardment. The next year, Lise Meitner and Otto Frisch properly concluded that Hahn and Strassmann had split the uranium nucleus into a barium and a krypton nuclei giving off energy. Two foundations of science, the law of conservation of energy and the law of conservation of mass, were neither immutable nor mutually exclusive. Mass could be converted into energy! The implications were obvious to physicists around the world.

Hans Bethe received the 1967 Nobel Prize in Physics for his work on the nuclear reactions that are responsible for the energy-creating processes in stars. He proposed that hydrogen molecules, at extreme temperatures and pressures are "fused" into helium molecules. Some secrets of our Sun were beginning to be understood.

The Earth absorbs much of the solar energy bathing its surface then promptly radiates much of it away to the great empty space that surrounds us. The energy that remains is responsible for the Earth's temperature, the weather, and the existence of all plant and animal life. It is the engine that powers the Earth's water cycle from oceans to clouds to rainfall to creeks to rivers to oceans and lakes where evaporation reinitiates the entire process.

Few have ever believed that coal, oil and gas were unlimited resources. But known coal reserves are vast. 3-D seismography, deep-well drilling technology, and the ability to put wells in very deep water have managed to postpone the expected end of the oil era. Beginning in 1980, however, oil consumption outstripped new oil discovery and that deficit has been steadily increasing. Consequently, the number of years of known reserves is steadily decreasing. It is generally believed, therefore, that oil and gas will become increasingly expensive and the need for developing alternative sources of energy will be ever more obvious.

Such alternatives, fortunately, are numerous. Each has its advantages and disadvantages. Wind farms are growing more numerous in windy areas and are useful, but they are unlikely to become major contributors to the world's power needs.

Solar energy conversion is a possibility. Power from solar cells is available but is relatively highly priced. Panels in space could theoretically collect solar energy and beam it down to Earth but the practicality of the concept is unconfirmed. The use of solar power to produce hydrogen (and oxygen) from water is the subject of ongoing research.

The past quarter century has engendered interest in methane hydrates, a widely available fuel whose reserves are substantially larger than any of the fossil fuels, but have not, as yet, been commercially developed. Methane, however, like coal, contains a substantial amount of carbon and its combustion products are criticized for their greenhouse gas constituents.

Annual worldwide energy consumption is something more than 400 quadrillion BTUs and its production, conversion, and distribution is an enormous enterprise. No matter which of the many possible alternative concepts is selected for commercial implementation, it will undoubtedly require gargantuan investments

In *Return to the Moon*, Jack Schmitt presents another option for examination. This concept is dependent on three substantial and important developments: a commercial fusion reactor; an efficient mining operation on the Moon, and a reliable EarthMoon cargo transportation system. Each of these components is challenging and will require both substantial financial resources and the very best of intellectual talent. Each endeavor would be on the scale of a Manhattan Project or an Apollo Program.

Dr. Schmitt builds his persuasive case with a plethora of detail. He analyses the technical risks, the financial considerations, and the managerial and legal aspects. Readers familiar with this subject will find a goldmine of information to review and analyze. Those to whom the concept is revolutionary will find *Return to the Moon* thought provoking and exciting.

If you believe that Earth's increasing appetite for energy and the suspected future decrease in available energy will create an ever more severe problem for our Earth's population, you will find this proposal worthy of careful examination.

Neil Armstrong

ACKNOWLEDGMENTS

My wife, Teresa Fitzgibbon, provided the encouragement, editorial assistance, and many ideas without which the activities leading to this book would not have occurred. In addition to being the love of my life, Teresa makes that life happen.

From a technical and inspirational point of view, the nearly 20 year association with colleagues at the Fusion Technology Institute and various departments of the University of Wisconsin-Madison has been critical to the development of many of the concepts in *Return to the Moon*. Of particular note are interactions with Dean Gerald L. Kulcinski, Professor John F. Santarius, Dr Igor N. Sviatoslavsky, Professor Phillip E. Brown, Professor John (Jay) S. Gallagher, Professor Howard Thompson, Professor Richard B. Bilder, and the late Professor Eugene N. Cameron. Dennis Bruggink provided important graphical and computer assistance on many occasions. I also am particularly indebted to the hundreds of students who, since 1996, made teaching the course "Resources from Space" at Wisconsin such a stimulating and exciting experience.

I deeply appreciate Neil A. Armstrong's Foreword to *Return to the Moon*. Neil has made many unique contributions to the foundations of our knowledge about the Moon and its resources, including the gathering of critical samples of the lunar regolith discussed in Chapter 6. To have his insightful words accompanying a strategy to return there is both appropriate and gratifying.

An author needs all the factual and editorial help he can get. Such assistance, as well as encouragement, was thankfully received from Dean Gerald L. Kulcinski, Professor John F. Santarius, Dr Michael D. Griffin, Dr W. David Carrier, Professor Lawrence A. Taylor, Dr Gordon, and Jody Swann. Ted Lynn and Randall J. McDonald provided much needed early advice on publication matters. The patience, advice, and assistance of Clive Horwood, Dr John Mason, and Alex Whyte of Praxis–Springer, Tina Foulser of Bookens, and Paul Farrell of Copernicus, are much appreciated. Any errors or omissions, however, remain my sole responsibility.

Finally, I gratefully acknowledge the contributions and sacrifices of all the engineers, scientists, managers, technicians, support staff, contractors, astronauts, cosmonauts and their families who have participated in past space activities and fusion research. It will be on the foundations they have built, and for which the taxpayers largely have paid, that we will Return to the Moon and go beyond.

Harrison H. Schmitt
March 9, 2005

1

INTRODUCTION

ONE possible view of the future of humankind consists of a positive, expansive continuum – the "Star Trek" vision. That view assumes a continuation of hundreds of thousands of years of human migration into new habitats and the perpetuation of our search for new opportunities, personal fulfillment, and freedom. In modern times, this search has been particularly characteristic of "The English Speaking Peoples"[1] but not confined to this ethnic heritage, as witnessed by the achievements of migrants to the United States, Canada, and Australia from all over the world. These migrants came through a very special filter to survive and settle in new lands. For the most part, they came because of an intense desire to be free and to seek to better their social and economic conditions. The pull to these nations continues today. Mentally and physically, migrants could overcome the difficulties of leaving, of transit, and of the conditions of the wilderness. In special instances, they overcame slavery, servitude, and imprisonment. The future settlers of space will face no less a spectrum of challenges.

Return to the Moon encompasses a positive perspective for our future (Figure 1.1). It comes from nearly 40 years of my direct involvement with the space activities of the United States of America, including three days of lunar exploration as part of the 13-day Apollo 17 mission in December

FIGURE 1.1 Apollo 17 view of portions of the near and far sides of the Moon after leaving lunar orbit to return to Earth, December 16, 1972. (NASA Photograph AS17 152 23312)

1972. Additional insights come from 30 years of participation in and observation of national and international politics, including serving six years in the United States Senate. Finally, with my colleagues at the University of Wisconsin, there has been nearly 20 years of specific consideration of the role that lunar resources can play in the movement of human beings into space and in the betterment of the human condition on Earth.

In January 2004, President George W. Bush challenged NASA to once again "explore space and extend a human presence across our solar system." Those who believe in the future and in freedom embrace this vision of permanence in space for humankind. This new initiative places the President squarely in support of the movement of civilization into the solar system and "into the cosmos." If sustained by Congress and future Presidents, American leadership of this expansion of the ecological reach of our species will be accompanied by the transfer of human freedom, first to the Moon, then to Mars, and, ultimately, beyond.

President Bush's policy-driven initiative requires a sustained commitment of funding as well as tough, competent and disciplined management comparable to the Apollo Program of the 1960s and early 1970s. If the government of the United States wishes to lead the return of humans to deep space, its space agency of today is probably not yet the agency to undertake this new program. The National Aeronautics and Space Administration (NASA) lacks the critical mass of youthful energy and imagination required for work in deep space. NASA also has become too bureaucratic and too risk-adverse to efficiently address the President's challenge. To be assured of success, NASA would need to be totally restructured. Although some steps in this direction are occurring, the task faced by NASA remains formidable.

In restructuring NASA, it would be critical to use the lessons of what has worked and has not worked during 45 years of human activity in space. Of particular importance would be (1) that most of NASA be made up of engineers and technicians in their twenties and managers in their thirties, (2) the re-institution of internal design engineering activities in parallel with those of contractors, (3) the streamlining and delegation of management responsibility, and (4) the placement of senior managerial and technical leadership in the hands of experienced and competent men and women comparable to those who led Apollo. The existing NASA also would need to undergo a major rebuilding of its program management, risk management, and financial management structures. Restructuring is required to re-create the competence and discipline necessary to operate successfully in the much higher risk and more complex *deep* space environment relative to near-Earth orbit.

The United States has two basic options for both assuring results from, and the continuation of, a "sustained commitment" to deep space exploration and settlement. On the one hand, it could find a means to restructure and revitalize NASA and to provide it with a guarantee of continued funding sufficient to do the job – a tough order in the current national political environment, but one the President has directed NASA to undertake. Alternatively, the country's entrepreneurial sector could persuade national and international investors to make sustaining commitments based on the economic potential of lunar resources – which is not easy, but is at least predictable in terms of the conditions that investors require to be met relative to other uses of their capital. The option of rebuilding NASA is highly *un*predictable and its sustainability may depend on the appearance of a set of world circumstances comparable to those that faced the Congress and Presidents Eisenhower, Kennedy, and Johnson in the late 1950s and throughout the 1960s. Some, including the writer, would argue that those circumstances exist today, but no clear bipartisan consensus prevails on this point as it did in

1961. The American political environment is much more polarized than that during the Cold War. Now, opposition for opposition's sake is usually the rule.

Left unstated in the President's 2004 directions to NASA and requests to the Congress is an implicit challenge to the private sector of the United States to join in a reinvigorated migration into deep space. That sector of American life, particularly the entrepreneurial and investment risk-takers among us, should move forward in parallel with NASA's new efforts, protecting this unique economic foundation of American freedom. If private enterprise is to participate as more than useful and necessary contractors to NASA, then systematic business initiatives must be launched that will equal or exceed the technological and financial pace of publicly funded space efforts.

Although it fundamentally has an investor-driven economy, America has a tradition of parallel commercial and public technological endeavors, ranging from transportation to agriculture to communication to medicine. Such activities have often involved international partnerships and investors, and not all joint private and government efforts have been successful; however, enough have changed the course of history to warrant their consideration for space development. The creation of private trading routes, turnpikes, canals, and railroads helped to open the American frontier by building on the results of Lewis and Clark's Corps of Discovery, on Army expeditions that included the Corps of Topographical Engineers, and on waterway development by the Army Corps of Engineers. Since the 1880s, scientific research and technological innovations arising from the Land Grant College and University system have supported American farmers and associated agricultural businesses.

During the twentieth century, commercial aircraft and ground transportation industries grew in concert, respectively, with the research activities of the National Advisory Committee for Aeronautics and the construction of the Interstate Highway system. Satellite communications, the first venture into space-related business by private investors, was catalyzed by NASA's pioneering experiments and demonstrations in this field in the late 1950s and throughout the 1960s. The explosion in the quality of health care and in longevity since the 1930s has come in association with research breakthroughs by both the private sector and the National Institutes of Health. Many other beneficial and synergistic examples of parallelism can be cited, not the least of which was the introduction of commercial nuclear power.

Private and public endeavors operating together clearly have been far more productive than either would have been acting alone. In this vein, private space-related initiatives can benefit from the research and technology development funded by NASA and vice versa. The twentieth century, particularly since World War II and American stimulation of European and Asian post-war economic development, has seen research and technology development in other nations become positioned to participate in a privately led Return to the Moon initiative. That initiative also can supplement, support, and, if necessary, pick up the baton of space settlement if it is not carried forward by government.

The financial, environmental, and national security carrot for a Return to the Moon consists of access to low-cost lunar helium-3 fusion power. Helium-3 fusion represents an environmentally benign means of helping to meet an anticipated eight-fold or higher increase in energy demand by 2050. Not available in other than research quantities on Earth, this light isotope of ordinary helium reaches the Moon as a component of the solar wind, along with hydrogen, helium-4, carbon, and nitrogen. Embedded continuously in the lunar dust over almost 4 billion years, concentrations have reached levels that can legitimately be considered of economic interest. Two square kilometers of large portions of the lunar surface, to a depth of 3 meters, contains 100 kg (220 lb) of helium-3, i.e., more than enough to power a 1000-megawatt (one-gigawatt) fusion power plant for a year. In 2003, helium-3's energy equivalent value relative to $1.25 per million BTU steam coal equaled about $700 million a metric tonne and appears to be increasing to over twice that value by 2010. One metric tonne (2200 lb) of helium-3 fused with deuterium, a heavy isotope of hydrogen, has enough energy to supply a city of 10 million, or one-sixth of the population of the United Kingdom, with a year's worth of electricity, or over 10 gigawatts of power for that year.

By-products of lunar helium-3 production will add significantly to future economic returns as customers for these products develop in space. No such by-products are known that would warrant their return to Earth; however, locations in Earth orbit, on Mars, and elsewhere in deep space constitute potential markets. The earliest available by-products include hydrogen, water, and compounds of nitrogen and carbon. Oxygen can be produced from lunar water. Finally, metallic elements, such as iron, titanium, aluminum, and silicon, can be extracted from mineral and glass components in the lunar regolith (soil).

Over the last decade, historic progress has been made in the use of helium-3 fuels to produce controlled fusion reactions. This has occurred through the development of inertial electrostatic confinement (IEC) fusion technology at the University of Wisconsin-Madison. Progress there includes the generation of approximately one milliwatt of steady-state power in the form of protons and helium-4 nuclei produced by the fusion of helium-3 and deuterium (heavy hydrogen). Steady progress in IEC research, as well as basic physics, suggests that the helium-3 approach to fusion power has commercial viability (Chapter 5). Helium-3-based fusion, relative to other electrical plant options for the twenty-first century and beyond, can have inherently lower capital costs, higher energy conversion efficiency, a range of power from a hundred megawatts upward, and potentially no associated radioactivity or radioactive waste. Research and development costs to build the first helium-3 demonstration power plant are estimated to be about $5 billion.

As we reach toward the Moon and its resources, the development of fusion technologies will open new business opportunities in medical diagnostics and treatment, weapons detection, destruction of nuclear waste, and clean electrical power generation. Longer term, ancillary businesses will be possible because of low-cost access to space required to meet the demands of lunar resource acquisition. These additional business opportunities include providing services to the government for lunar and planetary exploration and science, national defense, and long-term on-call protection from asteroids and comets. Space and lunar tourism will also be enabled by the existence of such capabilities in the private sector.

A private, lunar resource-oriented enterprise will take a different technical path back to the Moon than the one designed by NASA (Chapters 4 and 7), and this dichotomy will be best for all concerned. More conceptional options will be explored, more engineering design approaches examined, and more opportunities for beneficial outcomes created. Indeed, successful commercial applications of fusion and space technologies to human needs and desires will underpin the private enterprise approach in contrast to the policy-driven foundation of the President's plan for NASA.

To provide competitive returns on investment in its lunar endeavors, the private sector will want heavier payload capability and lower cost in Earth–Moon launch systems than NASA appears to be planning. Private spacecraft will be specialized for the tasks of landing reliably and precisely at known resource-rich locations on the Moon rather than serving two or more masters such as the International Space Station *and* a Lunar Base. The private initiative will concentrate on lunar surface vehicles and facilities that provide reliable, low-cost resource recovery in addition to habitats for living. It also will require highly mobile and low-maintenance space suits that are less than half the weight and more than four times the mobility of Apollo suits, and have the glove dexterity of the human hand. All vehicles, facilities, and space suits will be designed for indefinite operational life, including embedded diagnostics, anticipatory component replacement, and ease of maintenance and refurbishment. Any required automated precursor missions to gather additional resource development information will use low-cost, data-specific approaches rather than attempt to meet broad, higher-cost scientific objectives. Research and development costs for launch and lunar operations equipment are estimated to be between $7 billion and $10 billion.

Management structures for a private initiative will follow proven corporate approaches and best business practices of comparable, high-technology enterprises (Chapter 11). These structures would be modified, as appropriate, by the lessons learned from Apollo (Chapter 9) for work in the complex and unforgiving environment of deep space. The Board of Directors and senior management will deal with programmatic issues involving planning, investors, conceptual approach, financial control, marketing and sales, governmental interfaces, public affairs, and the spin-off of ancillary businesses. Under this protective umbrella, responsibility to meet technical objectives will be delegated to several centers of excellence. Senior management will be drawn from any of the many private, federal, and defense sources where the most experienced and successful men and women can be found. A system of independent technical oversight will exist to assess these centers' readiness to proceed past programmatic milestones.

To minimize the amount of required inter-center coordination (and competition), centers will specialize, respectively, in Earth launch systems, spacecraft and flight operations, lunar resource extraction and processing, lunar surface support facilities, and fusion power systems. Centers of excellence will have internal design teams working in parallel with the implementing contractors, providing managers with two sources of information and opinion related to design and configuration control issues. Quality control and assurance will be managed as an internal responsibility of all employees and not just a centralized function of corporate headquarters. Critically, personnel management for the corporation will be charged with the need to maintain center organizations that are staffed mainly by workers in their twenties and managers in their thirties.

From early in its history, operational control of lunar activities will be placed on the lunar surface. Resource marketing and sales will be managed at corporate headquarters on Earth until those functions can reasonably be transferred to the its lunar surface operations. A private initiative will hire and support employees who wish to be settlers. From almost the first landing, the initiative's employees will be on the Moon to stay. All support functions, including medical treatment and rest and recuperation, will be provided on the Moon, not by a trip back to Earth. It will be a clear constraint on the design and operation of launch vehicles and spacecraft that there will be no significant stand-downs in the case of accidents. Rather, confidence in all hardware must be such that the next planned launch can proceed essentially on schedule.

International law relative to outer space (Chapter 12), specifically the Outer Space Treaty of 1967, permits properly licensed and regulated commercial endeavors. Under the Treaty, lunar resources can be extracted and owned, but national sovereignty cannot be asserted over the resource area. History clearly shows that a system of internationally sanctioned private property, consistent with the Treaty, would encourage lunar settlement and development far more than the establishment of a lunar "commons," as envisioned by the largely unratified 1979 Moon Agreement. Systems encompassing the recognition of private property have provided far more benefit to the world than those that attempt to manage common ownership.

The initial financial threshold for a private sector initiative is low: about $15 million. This investment would initiate the first fusion-based bridging business, that is, production of medical isotopes for point-of-use support of diagnostic procedures using positron emission tomography (PET). In contrast, the funding threshold for the United States government would be significantly higher: $800 million proposed for 2005 and building to an average annual addition of close to $1 billion. This latter estimate assumes both a repetitively willing Congress and a space agency capable of efficiently using this money as well as reprogrammed funds. The government, of course, would not benefit directly from the retained earnings of the fusion-based bridging businesses that are a natural consequence of the private sector approach.

The entrepreneurial private sector has an obligation to support a Return to the Moon to stay, as articulated by President Bush. We also have an obligation to follow our own path to get there in order to be additive to the overall goals of settling the Solar System and improving lives for those who remain on Earth.

Whenever and however a Return to the Moon occurs, one thing is certain: that return will be historically comparable to the movement of our species out of Africa about 150,000 years ago. Further, if led by an entity representing the democracies of the Earth, a Return to the Moon to stay will be politically comparable to the first permanent settlement of North America by European immigrants.

Reference

1. Churchill, W. S., 1956–1958, *The History of the English Speaking Peoples*, Dodd, Mead & Co., 4 volumes.

2

APOLLO: THE LEGACY

2.1 INTRODUCTION

You are hereby directed . . . to accelerate the super booster program for which your agency recently was given technical and management responsibility.

President Dwight D. Eisenhower
Letter to T. Kieth Glennan,
NASA Administrator
January 14, 1960

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

President John F. Kennedy
Address to Congress
May 25, 1961

> We choose to go to the moon. We choose to go to the moon in this decade and do the other things, not because they are easy, but because they are hard, because that goal will serve to organize and measure the best of our energies and skills, because that challenge is one we are willing to accept, one we are unwilling to postpone, and one which we intend to win . . .
>
> President John F. Kennedy
> Address at Rice University, Houston
> September 12, 1962

IN considering a Return to the Moon, it would be illogical as well as foolish not to examine the origins and legacy of the first human exploration of that small planet – Project Apollo (Figure 2.1). Much can be learned about the benefits to expect and the lessons that should be remembered. The lessons from Apollo will figure prominently in later chapters; here, it may be helpful to conduct a brief review of the Cold War origins of Apollo and its broad, beneficial legacies in the national, cultural and scientific histories of the United States and the world.

2.2 ORIGINS OF APOLLO

The initial catalyst for Americans venturing into deep space was the Soviet Union's October 1957 launch of Sputnik I, the first artificial satellite of the

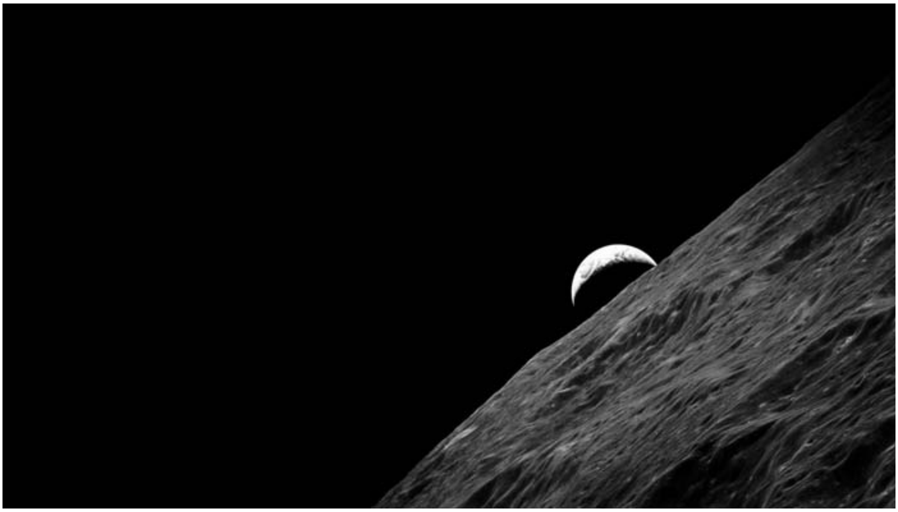

FIGURE 2.1 Earthrise from behind the Moon, one of the lasting symbols of Apollo. (NASA Photo AS17 152 23274)

Earth. It burst upon the American consciousness as one of the defining moments in the history of the United States. Although a temporary propaganda coup for the Soviets, the law of unintended consequences took over as a technological giant became focused on the obvious long-term importance of space. Thousands of young Americans began to think of space in the context of their personal futures and the future of the world and began to plan their education accordingly. The Eisenhower Administration and the Congress poured money into the public school system and into mathematics and science in particular. Other young aeronautical engineers in the National Advisory Committee for Aeronautics (NACA) began to study human space flight in general and flight to the Moon.

President Dwight D. Eisenhower's special message and legislation recommending the formation of the National Aeronautics and Space Administration (NASA) was sent to Capital Hill on April 2, 1958. Shepherded through Congress by Senator Majority Leader, Lyndon Baines Johnson, the resulting "Space Act" built NASA initially from the personnel, three field laboratories, and Washington Headquarters of the NACA. Eisenhower appointed electrical engineer T. Keith Glennan,[1] President of the Case Institute of Technology in Cleveland, to head the new agency. Hugh L. Dryden, last Director of the NACA, became Deputy Administrator. The President told the new Administrator, in Glennan's words, "he wanted a [space] program that would be sensibly paced and vigorously prosecuted."[2]

By the time NASA began operations on October 1, 1958, the nation had a strong foundation in aerospace technologies pertinent to the tasks ahead. For example, the NACA, from which NASA arose, had been established in 1915 "to supervise and direct the scientific study of the problems of [atmospheric] flight, with a view toward their practical solutions."[3] Gradually, the NACA moved from advisory coordination of the aeronautical research of various governmental agencies to a research agency status. It received funding in its own right with the Langley, Ames, and Lewis Research Centers conducting research in cooperation with industrial and federal engineers and scientists. In February 1958, General James H. Doolittle, hero of the early World War II bombing of Tokyo and chair of the main NACA advisory committee, had requested the first internal study on long-term research goals. Within its first year, NASA moved forward with these internal studies and one major set of contractor studies to define how human flights to the Moon and a landing on its surface might be accomplished.

On Glennan's initiative, the Army's Jet Propulsion Laboratory, managed by the California Institute of Technology in Pasadena, California was added to NASA near its beginnings as an agency.[4] Glennan, strongly supported by Eisenhower, also wanted Wernher von Braun's rocket development group in Huntsville, Alabama; however, the Army resisted this transfer for over a year. Finally, Eisenhower put his foot down and the new agency's initial field center configuration was completed in January 1960 with the final decision to transfer the Army Ballistic Missile Agency to NASA.[5] The Army rocket team, led by von Braun, became the nucleus of the new Marshall Space Flight Center to which also was transferred the Army's Missile Firing Laboratory at Cape Canaveral, Florida, later to become the Kennedy Space Center. The transfer of the Army Ballistic Missile Agency on January 1960 came with Eisenhower's personal directions "to accelerate the super booster [Saturn/Nova] program."[6]

Once the von Braun team had been established as a NASA unit, momentum increased steadily in the development of what became known as the Saturn family of heavy lift rockets and rocket engines, particularly the F-1 and J-2 engines.[7] The Army had started the development that led to these huge engines in December 1958 on the basis of a post-Sputnik recommendation by von Braun.[8] On several occasions, Eisenhower's personal intervention was significant in the continued development of huge launch systems.[9] The flight of Sputnik I, and growing belligerence on the part of the Soviet Union in relation to space and missiles, clearly left their mark on Eisenhower – as they had on many of my generation as well. In Washington, Eisenhower enlarged President Truman's President's Science Advisory Committee (PSAC).[10] To be its chair, he selected Dr James R. Killian, President of the Massachusetts Institute of Technology and thus the first presidential science adviser. Killian apparently was very influential in space-related matters during late 1957 through 1959.[11] Eisenhower's commitment to Saturn development, however, appears to be a prime manifestation of his personal concerns about space and the Soviet Union. On the other hand, to his subordinates, he occasionally professed a lack of enthusiasm for manned space flight in general[12] and flights to the Moon in particular.[13] Eisenhower's apparent antipathy toward man-in-space, particularly military man-in-space, only increased when the Soviets shot down Gary Powers' U-2 reconnaissance plane in 1960.[14]

In spite of such contradictory indications, it is difficult to believe, in view of his push for Saturn development, that Eisenhower had anything in the back of his mind other than human flights to the Moon.[15] As Glennan himself admitted in October 1960,[16] to what other reasonable use, in that day and age, could a 7.5-million-pound thrust rocket stage be put? The military had no defined requirements for thrust anywhere close to this level and no conceivable commercial satellites needed this capability. Only in 1960 – his last year as President, and in the preparation of the Fiscal Year 1962 budget he would hand to his successor – did Eisenhower attempt to hold federal spending for space and everything else into exact balance with projected revenues. This effort appears to have been based on principle and on regret that he had not done better in keeping his election promise to submit balanced budgets during previous budget cycles.[17] He undoubtedly realized that his successor and Congress would add significantly to his last budgetary requests for many parts of the government, including NASA. Indeed, this is exactly what happened.[18]

In retrospect, Eisenhower seemed split between his concern about the role of the United States as the protector of freedom in the world during the Cold War and his commitment to control the federal budget and the "acquisition of unwarranted influence ... by the military–industrial complex.".[19] Still, on Eisenhower's watch, NASA came into existence, public education in math and science was enhanced, studies of manned flights to the Moon progressed, and a manned lunar booster project was aggressively pursued.

The most important managerial and political step taken early in the Kennedy Administration, unrecognized at the time, was the selection of the right person as NASA Administrator. This took place a little less than three months before White House consideration of a Moon landing initiative began. The leadership of NASA – one of the last positions to be filled by the newly elected President – had been the focus of a tug-of-war between Kennedy's science adviser, Jerome Wiesner, and Vice-President Lyndon Johnson.[20] In late January 1961, Senator Robert S. Kerr of Oklahoma suggested that James E. Webb, President Truman's Director of the Bureau of the Budget (now Office of Management and Budget) be considered. Weisner and Johnson both knew Webb well and were comfortable with the suggestion. Webb had many reservations about becoming Administrator, but with the assurance from Kennedy that Hugh Dryden would continue as Deputy Administrator, he took the job. Innovative management, and not reacting to Soviet actions, would be Webb's stated focus while Administrator.[21] The President even made a flat statement to Webb that he had no space policy and Webb would be responsible for creating one. Kennedy, however, may have influenced Webb by reportedly saying, "There are great issues of national and international policy involved in this space program. I want you because you have been involved in policy at the White House level [and] State Department level."[22] This could have sounded to Webb like an invitation to be bold.

In addition to Dryden (63), Webb (54) also retained Robert C. Seamans Jr (43), as the third member of the top management team.[23] In Dryden, Webb had a respected and experienced scientist and science administrator, and in Seamans he had inherited a top-notch engineer and engineering manager with strong contacts throughout the aerospace community and at MIT, where Seamans had taught. Webb, himself, had the Washington political and managerial insights necessary to operate in that competitive, cut-throat, political environment. He soon found that his primary adversary in the Washington environment, on the issue of space science versus manned space flight, would be one of his sponsors, Jerome Wiesner.[24] Weisner's efforts to control NASA would be backed by many of the scientists on the President's Science Advisory Committee that he led.

For a few months, Wiesner and the Bureau of the Budget, led by David Bell, were able to show progress in developing manned space flight capabilities. Events, however, began to take a life of their own. Kennedy personally approved going forward with "long duration Mercury flights" after budgetary discussions with Seamans and Bell on March 22, 1961, as they revised and augmented the FY1962 budget.[25] The "Mercury Mark II" project quickly evolved into the two-man, Gemini spacecraft. At that same March meeting, Kennedy also agreed to the restoration and enhancement of funds for Eisenhower's "super booster" as well as funds to "expedite supporting technology required for attainment of lunar goal." These actions signaled Kennedy's strong interest in manned lunar flights three weeks before Yuri Gagarin's flight into space and two months before committing NASA and the country to a lunar landing.

On April 12, 1961, the Soviet Union placed Gagarin in orbit around the Earth and returned him safely. Faced with the fact of the Gagarin flight and its obvious impact on Americans and the world, Kennedy held a Cabinet meeting two days later at which he asked what options the United States had in overcoming the Soviet lead in space. After the debacle in Cuba at the Bay of Pigs, an abortive rebel invasion that began on April 15, Kennedy's interest in a space initiative seemed to increase. Kennedy again brought up the possibility of a manned Moon landing in a memorandum to Johnson.[26] Kennedy 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?" At an April 21 press conference, Kennedy followed this with, "If we can get to the Moon before the Russians, then we should."