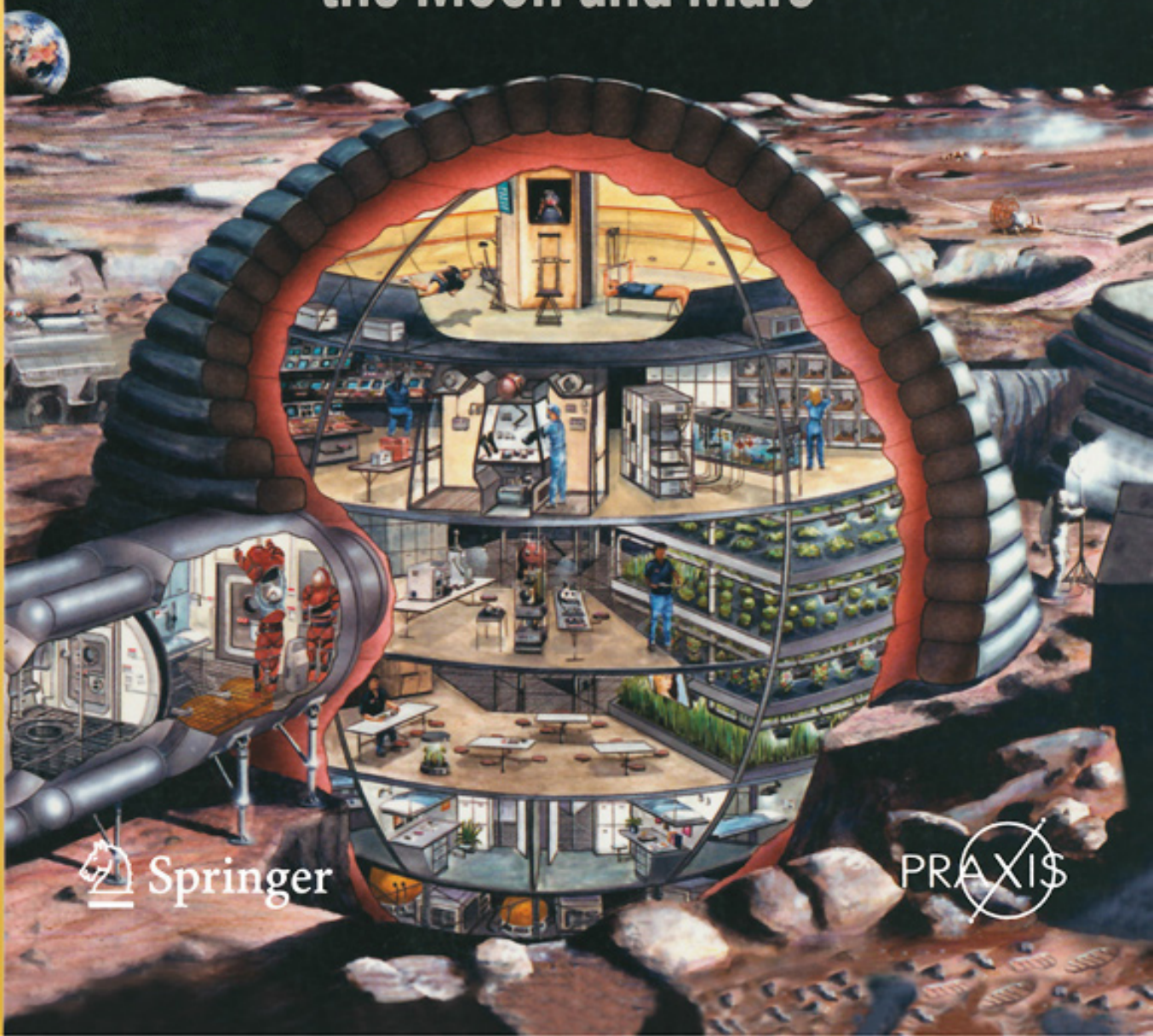
HAYM BENAROYA

TURNING DUST TO GOLD

Building a Future on the Moon and Mars



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Foreword

The goal of this book is to demonstrate that expanding our civilization to the Moon and beyond is not beyond our reach, intellectually or financially. Apollo was not our last foray into the Solar System. Science fiction, as good as some of it is, will have a difficult time staying ahead of science and engineering fact. However, this book is intended to be more than purely a technical manual. Space is not, nor should it be, only of interest to aerospace engineers and cosmologists. Space needs to be of interest and of concern to all of us. It is the world's West, as in Go West for new opportunities for freedom and limitless growth. What I hope to demonstrate to you is that not only *can* we go back to the Moon to stay, but that we *must* do so. And not only for esoteric reasons, but for many reasons, some mundane, but most related to our and our children's continued prosperity, and to our continued survival as a species.

Space, whether we or our children live in it or on the Moon or Mars, will be important to all of us because of the resources it will open for our industrial societies and for the markets it will create. It would be difficult to imagine the United States as a world power if its western border was the Mississippi River. Would a North American continent of several dozen independent states modeled after Western Europe have been able to resist the totalitarian attacks that occurred in the 20th century? Alone, neither Europe nor Asia was capable.

The expansion of the best Earth has to offer in science and culture to the Moon, then Mars, and eventually the Solar System, can only strengthen humanity's core positive achievements: democracy, individual rights, equal opportunities for an individual's achievements, and all that is inherent and is based on these being in place.

This book is written from the perspective of a future observer, more than 150 years into the future, and some of the narratives based on a fictitious group of documents discovered in an old repository that chronicled the settlement of the Moon during the last half of the 21st century and first half of the 22nd century. In order to make the documents more connected and interesting to the casual reader, they have been weaved into a chronological storyline meant to trace the early days of the human return to the Moon with the aim of permanent settlement.

The interviews in this book are real and original.

Preface

This book is an historical work based on a group of documents discovered in an old repository that chronicled the settlement of the Moon during the last half of the 21st century and into the 22nd century. There are gaps in the historical record for reasons that I won't get into here, so we have had to guess how we went from "point *a*" to "point *c*" without any detailed information about "point *b*." In order to make the documents more connected and interesting to the casual reader, I, Yerah Timoshenko, have tried as best as I can to weave the issues and concerns of an emerging spacefaring civilization into a coherent perspective. I have focused on the early days of the human return to the Moon with all its trials and tribulations. I am very pleased to have been able to include a good number of historical interviews with a cross-section of people who played a role in humanity's struggle into space. More about me and what I do later in the book.

The return to the Moon occurred at a time of great turmoil on Earth, especially the decades-long war on terrorism. Also, even though the economies of the larger countries were growing and successful, there were constant philosophical and real-world battles about the spending of scarce resources. Debt, both national and personal, was high and growing higher with no end in sight. As is common, most people were focused on the day-to-day activities and events that directly impacted their lives.

The early 21st century was heavily politicized, with all problems and all politics reduced to black and white. One was either on one side of the fence or the other. Those who recognized the gray aspects of reality usually ended up impaled on the fence that separated the camps. It was a time when democracy was spreading, but terrorism was also global. Mankind was making tremendous progress in the sciences and engineering, and the biological sciences were on the verge of breaking through to a deep understanding of the human body and the underlying causes of deadly diseases.

Many nations were once again interested in manned space travel. Rockets were the only way to bring large payloads and people into low Earth orbit and beyond. It was tremendously expensive but also the only option at the time. Space elevators, while studied and believed to be feasible, had not yet been prototyped and tested in the Earth–space environment. As we know now, the massive development of the space elevators led to a thousandfold increase in space activities by the early 22nd century.

Many of us are reminded of the California Gold Rush that began on 24 January 1848 when gold was discovered at Sutter's Mill in Coloma, California, now in the

Sacramento area. That news spread worldwide by the end of 1848, resulting in about 300,000 people coming to California over the next several years. The Rush converted San Francisco from a tent town to a small city, pushing the admission of California as a state in 1850. In the same way, once space elevator prototypes proved the technology viable, full-scale versions were built in orbit around Earth and here in orbit around the Moon.

After that, there was no stopping the flow of goods and people. The floodgates had been opened.

The California Clipper takes you to the California Gold Rush, February 1849.

Our transformation into a spacefaring species occurred in spurts. In the 1960s and 1970s we sent people to the Moon for short visits, and then we gave up on that. Then in the 1980s through the 2010s we sent people into low Earth orbit to build a space station. Somewhere around that time people in several of the more technologically advanced countries decided that it was time to rebuild the space effort with an eye to the permanent settlement of the Solar System, first the Moon, then Mars, and then – well then depended on how successful we were at the first two steps. But so far, in 2169, we have thousands of people on dozens of bodies in the Solar System.

We worked steadily at getting humans and machines into space and to the Moon. We always knew we could do it – what we did not know was whether the political support could be borne over such long time periods. So we started out as turtles with rockets, but ended up as hares with elevators. The rest is history.

This book is a commemorative as well as a selective accounting of some of the key events that punctuated our short history in space. It is published in 2169, two

hundred years after the first men landed on the Moon. There are discussions of some of the technical and other issues that were of great concern – some of which are still baffling our pioneers today.

So this story is a snapshot of how all that we see today, on the Moon, Mars, and beyond, evolved.

Acknowledgements

I gratefully acknowledge all the people who have deliberated about space and its challenges. I could not have written about such a broad subject without the insights of the community of scholars and practitioners. My interpretation of their work is subject to my perspectives and may have missed the mark – for which I take full responsibility.

I am thankful for the support and encouragement of Praxis Publishing, in particular, Clive Horwood, who accepted this project and graciously and patiently waited for me to complete the book over many missed deadlines. I am grateful to Dr John Mason who provided insightful suggestions for improving the style, content and organization of the manuscript, as I am to Rachael Wilkie who edited this work. And I appreciate the fine work with the LaTeX formatting of the manuscript by Frank Herweg, without whose efforts the book would not look as good as it does.

The book is more interesting due to the numerous images, many of which come from the NASA archives. I tip my hat to them for the development of such a collection, one that is indicative of all the great work of the NASA teams over the past six decades of trailblazing the space frontier. I sincerely thank all the creative people who generously granted permission to use their images. And I can never repay those who granted me interviews and trusted me to put their words in a book that they will hopefully find to be a good home.

I am grateful to and wish to highlight the two images created by my daughter Ana. And, last but not least, my sincere thanks go to my son, Adam, and my closest friend, Mark Nagurka of Marquette University, for their major editing of this book – resulting in a much improved style.

Dedication

I humbly dedicate this book
to all those who commit their lives
to enable the exploration of space
by humans and machines.
To those who make it possible by their engineering,
scientific and medical research,
by their creative achievements and imaginative practice.
To those who are now still in elementary school,
are able to look forward to the joy of discovery,
and will be the ones who return to the Moon,
take the first steps on Mars, the outer planets and their moons.
And last but certainly not least,
this book is dedicated to the men and women who spend their lives
– sometimes sacrificing their lives –
protecting the rest of us and our democracies
so that we can spend our lives
creating new worlds.

1 Go west ... settle space

"Beautiful, beautiful. Magnificent desolation."

Buzz Aldrin

In the year 2169, as we commemorate the 200th anniversary of humans landing on the Moon in 1969, we try to imagine how difficult it was during the early part of the last century as proponents of manned space travel and space settlement found themselves regularly discouraged by the progress they were witnessing. After all, only a few viewed space as a critical avenue for human creativity. It was viewed by many as a "special interest" for those who would find financial benefits as a result of manned space activity.[1] At that time, many problems existed on Earth (when was this not true!). Therefore, many preferred to minimize public expenditures for NASA and space in the U.S. Many teenagers had no interest in a return to the Moon, and roughly a quarter thought that the Apollo landings were faked!

Some of that thinking changed as a result of 43rd U.S. President George W. Bush's 14 January 2004 speech challenging and charging the U.S. to return to the Moon, to stay, as a first step in mankind's expansion to Mars and the remainder of the Solar System. His speech: *New Vision for Space Exploration Program*, given at NASA Headquarters, Washington, D.C. is presented below. This speech can be viewed as a turning point in the world's view on space exploration and settlement. Subsequently, the European Union, China, Japan and Russia, all committed their nations and organizations to a manned return to the Moon. Unfortunately, funding levels did not match the boldness of the vision.

1.0.1 Bush 2004 speech

President Bush: Thanks for the warm welcome. I'm honored to be with the men and women of NASA. I thank those of you who have come in person. I welcome those who are listening by video. This agency, and the dedicated professionals who serve it, have always reflected the finest values of our country – daring, discipline, ingenuity, and unity in the pursuit of great goals.

[1] No one who worked in space and aerospace was viewed as a neutral party in supporting a manned return to the Moon. They were viewed as a special interest rather than as an educated participant and supporter of one of the greatest adventures of humanity!

America is proud of our space program. The risk takers and visionaries of this agency have expanded human knowledge, have revolutionized our understanding of the universe, and produced technological advances that have benefited all of humanity.

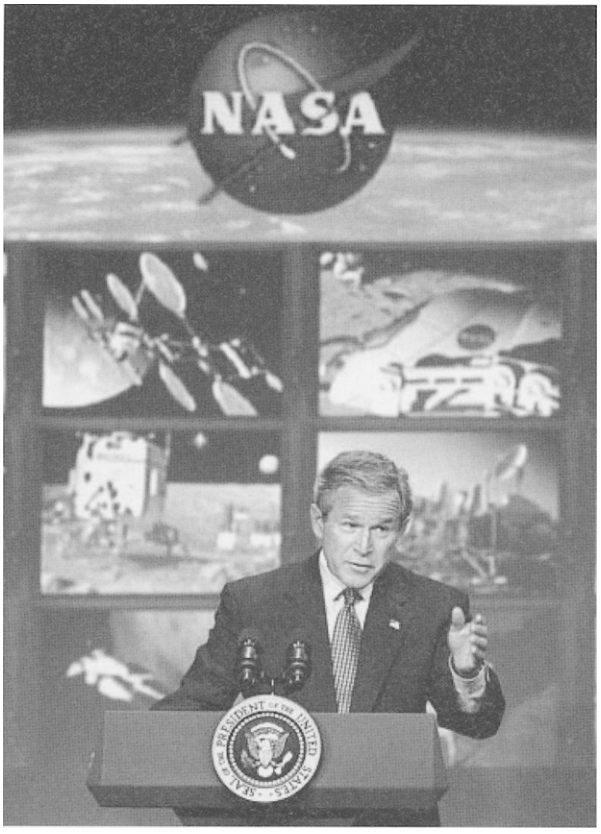

Fig. 1.1 President George Bush presenting his *New Vision for Space Exploration Program.* 14 January 2004. (Courtesy NASA)

Inspired by all that has come before, and guided by clear objectives, today we set a new course for America's space program. We will give NASA a new focus and vision for future exploration. We will build new ships to carry man forward into the universe, to gain a new foothold on the Moon, and to prepare for new journeys to worlds beyond our own.

I am comfortable in delegating these new goals to NASA, under the leadership of Sean O'Keefe. He's doing an excellent job. I appreciate Commander Mike Foale's introduction – I'm sorry I couldn't shake his hand. Perhaps, Commissioner, you'll bring him by – Administrator, you'll bring him by the Oval Office when he returns, so I can thank him in person.

I also know he is in space with his colleague, Alexander Kaleri, who happens to be a Russian cosmonaut. I appreciate the joint efforts of the Russians with our

country to explore. I want to thank the astronauts who are with us, the courageous spacial entrepreneurs who set such a wonderful example for the young of our country.

And we've got some veterans with us today. I appreciate the astronauts of yesterday who are with us, as well, who inspired the astronauts of today to serve our country. I appreciate so very much the members of Congress being here. Tom DeLay is here, leading a House delegation. Senator Nelson is here from the Senate. I am honored that you all have come. I appreciate you're interested in the subject – it is a subject that's important to this administration, it's a subject that's mighty important to the country and to the world.

Two centuries ago, Meriwether Lewis and William Clark left St. Louis to explore the new lands acquired in the Louisiana Purchase. They made that journey in the spirit of discovery, to learn the potential of vast new territory, and to chart a way for others to follow.

America has ventured forth into space for the same reasons. We have undertaken space travel because the desire to explore and understand is part of our character. And that quest has brought tangible benefits that improve our lives in countless ways. The exploration of space has led to advances in weather forecasting, in communications, in computing, search and rescue technology, robotics, and electronics. Our investment in space exploration helped to create our satellite telecommunications network and the Global Positioning System. Medical technologies that help prolong life – such as the imaging processing used in CAT scanners and MRI machines – trace their origins to technology engineered for the use in space.

Our current programs and vehicles for exploring space have brought us far and they have served us well. The Space Shuttle has flown more than a hundred missions. It has been used to conduct important research and to increase the sum of human knowledge. Shuttle crews, and the scientists and engineers who support them, have helped to build the International Space Station.

Telescopes – including those in space – have revealed more than 100 planets in the last decade alone. Probes have shown us stunning images of the rings of Saturn and the outer planets of our Solar System. Robotic explorers have found evidence of water – a key ingredient for life – on Mars and on the moons of Jupiter. At this very hour, the Mars Exploration Rover Spirit is searching for evidence of life beyond the Earth.

Yet for all these successes, much remains for us to explore and to learn. In the past 30 years, no human being has set foot on another world, or ventured farther upward into space than 386 miles – roughly the distance from Washington, D.C. to Boston, Massachusetts. America has not developed a new vehicle to advance human exploration in space in nearly a quarter century. It is time for America to take the next steps.

Today I announce a new plan to explore space and extend a human presence across our Solar System. We will begin the effort quickly, using existing programs and personnel. We'll make steady progress – one mission, one voyage, one landing at a time.

Our first goal is to complete the International Space Station by 2010. We will finish what we have started, we will meet our obligations to our 15 international partners on this project. We will focus our future research aboard the station on the long-term effects of space travel on human biology. The environment of space is hostile to human beings. Radiation and weightlessness pose dangers to human health, and we have much to learn about their long-term effects before human crews can venture through the vast voids of space for months at a time. Research on board the station and here on Earth will help us better understand and overcome the obstacles that limit exploration. Through these efforts we will develop the skills and techniques necessary to sustain further space exploration.

To meet this goal, we will return the Space Shuttle to flight as soon as possible, consistent with safety concerns and the recommendations of the Columbia Accident Investigation Board. The Shuttle's chief purpose over the next several years will be to help finish assembly of the International Space Station. In 2010, the Space Shuttle – after nearly 30 years of duty – will be retired from service.

Our second goal is to develop and test a new spacecraft, the Crew Exploration Vehicle, by 2008, and to conduct the first manned mission no later than 2014. The Crew Exploration Vehicle will be capable of ferrying astronauts and scientists to the Space Station after the shuttle is retired. But the main purpose of this spacecraft will be to carry astronauts beyond our orbit to other worlds. This will be the first spacecraft of its kind since the Apollo Command Module.

Our third goal is to return to the Moon by 2020, as the launching point for missions beyond. Beginning no later than 2008, we will send a series of robotic missions to the lunar surface to research and prepare for future human exploration. Using the Crew Exploration Vehicle, we will undertake extended human missions to the Moon as early as 2015, with the goal of living and working there for increasingly extended periods. Eugene Cernan, who is with us today – the last man to set foot on the lunar surface – said this as he left: "We leave as we came, and God willing as we shall return, with peace and hope for all mankind." America will make those words come true.

Returning to the Moon is an important step for our space program. Establishing an extended human presence on the Moon could vastly reduce the costs of further space exploration, making possible ever more ambitious missions. Lifting heavy spacecraft and fuel out of the Earth's gravity is expensive. Spacecraft assembled and provisioned on the Moon could escape its far lower gravity using far less energy, and thus, far less cost. Also, the Moon is home to abundant resources. Its soil contains raw materials that might be harvested and processed into rocket fuel or breathable air. We can use our time on the Moon to develop and test new approaches and technologies and systems that will allow us to function in other, more challenging environments. The Moon is a logical step toward further progress and achievement.

With the experience and knowledge gained on the Moon, we will then be ready to take the next steps of space exploration: human missions to Mars and to worlds beyond. Robotic missions will serve as trailblazers – the advanced guard to the unknown. Probes, landers and other vehicles of this kind continue to prove their worth, sending spectacular images and vast amounts of data back to Earth. Yet the human thirst for knowledge ultimately cannot be satisfied by even the most

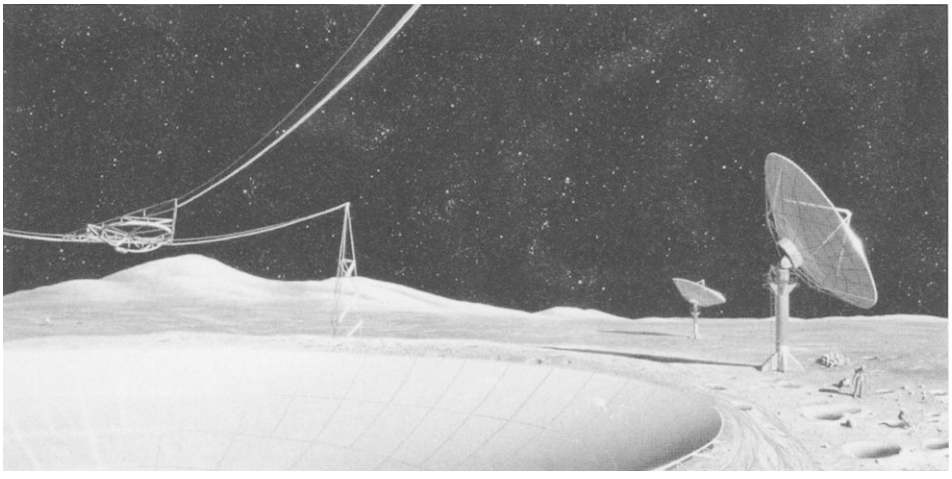

Fig. 1.2 This is an artist's concept depicting a possible scene of an observatory on the far side of the Moon. The artwork was part of NASA's new initiatives study which surveyed possible future manned planetary and lunar expeditionary activity. The objective of the lunar observatory case study is to understand the effort required to build and operate a long-duration human-tended astronomical observatory on the moon's far side. Some scientists feel that the lunar far side – quiet, seismically stable and shielded from Earth's electronic noise – may be the Solar System's best location for such an observatory. The facility would consist of optical telescope arrays, stellar monitoring telescopes and radio telescopes, allowing nearly complete coverage of the radio and optical spectra. The observatory would also serve as a base for geologic exploration and for a modest life sciences laboratory. In the left foreground, a large fixed radio telescope is mounted on a crater. The telescope focuses signals into a centrally located collector, which is shown suspended above the crater. The lander in which the crew would live can be seen in the distance on the left. Two steerable radio telescopes are placed on the right; the instrument in the foreground is being serviced by scientists. The other astronaut is about to replace a small optical telescope that has been damaged by a micrometeorite. A very large baseline optical interferometer system can be seen in the right far background. (The painting was done by Mark Dowman and Doug McLeod. S89-25054, January 1989. Courtesy NASA)

vivid pictures, or the most detailed measurements. We need to see and examine and touch for ourselves. And only human beings are capable of adapting to the inevitable uncertainties posed by space travel.

As our knowledge improves, we'll develop new power generation propulsion, life support, and other systems that can support more distant travels. We do not know where this journey will end, yet we know this: human beings are headed into the cosmos.

And along this journey we'll make many technological breakthroughs. We don't know yet what those breakthroughs will be, but we can be certain they'll come, and that our efforts will be repaid many times over. We may discover resources on the Moon or Mars that will boggle the imagination, that will test our limits to dream. And the fascination generated by further exploration will inspire our young

people to study math, and science, and engineering and create a new generation of innovators and pioneers.

This will be a great and unifying mission for NASA, and we know that you'll achieve it. I have directed Administrator O'Keefe to review all of NASA's current space flight and exploration activities and direct them toward the goals I have outlined. I will also form a commission of private and public sector experts to advise on implementing the vision that I've outlined today. This commission will report to me within four months of its first meeting. I'm today naming former Secretary of the Air Force, Pete Aldridge, to be the Chair of the Commission. Thank you for being here today, Pete. He has tremendous experience in the Department of Defense and the aerospace industry. He is going to begin this important work right away.

We'll invite other nations to share the challenges and opportunities of this new era of discovery. The vision I outline today is a journey, not a race, and I call on other nations to join us on this journey, in a spirit of cooperation and friendship.

Achieving these goals requires a long-term commitment. NASA's current five-year budget is $86 billion. Most of the funding we need for the new endeavors will come from reallocating $11 billion within that budget. We need some new resources, however. I will call upon Congress to increase NASA's budget by roughly a billion dollars, spread out over the next five years. This increase, along with refocusing of our space agency, is a solid beginning to meet the challenges and the goals we set today. It's only a beginning. Future funding decisions will be guided by the progress we make in achieving our goals.

We begin this venture knowing that space travel brings great risks. The loss of the Space Shuttle Columbia was less than one year ago. Since the beginning of our space program, America has lost 23 astronauts, and one astronaut from an allied nation – men and women who believed in their mission and accepted the dangers. As one family member said, "The legacy of Columbia must carry on – for the benefit of our children and yours." The Columbia's crew did not turn away from the challenge, and neither will we.

Mankind is drawn to the heavens for the same reason we were once drawn into unknown lands and across the open sea. We choose to explore space because doing so improves our lives, and lifts our national spirit. So let us continue the journey.

May God bless.

* * *

Even with this shot in the arm, many were skeptical of the desirability for such an "adventure." Few had the vision to think beyond the predictable and consider the possible and the desirable. Such linear thinking almost always leads to lower expectations and less action. We generally think linearly, meaning that we extrapolate the present into the future without accounting for the unexpected. Of course, the unexpected is, well, not expected! For example, in the year 1807, very few people would have extrapolated to the Wright Brothers' human flight one hundred years later. In 1869, only science fiction writers envisioned landing people on the Moon in 1969. Similarly, other great inventions in mechanics and electronics

were not envisioned and therefore the technologies to which those inventions gave birth could not have been foreseen except by a tiny group of visionaries.

Therefore, in 2004, when President Bush gave his speech, those who supported his vision understood the potential benefits of charting a course back to the Moon. They supported this action not because of what could be predicted as the possible benefits, but for all the unpredictable outcomes and synergies. This kind of non-linear thinking is useful because it opens up our minds to the impossible as well as the possible. "The possible requires a lot of hard work; the impossible takes a little longer."

Fig. 1.3 Yuri Alekseyevich Gagarin. (Official Soviet photograph)

The first person in space and the first to orbit the Earth on 12 April 1961 was the Soviet cosmonaut Yuri Alekseyevich Gagarin (9 March 1934 – 27 March 1968). On 5 May 1961, Mercury Astronaut Alan B. Shepard, Jr. blasted off in his Freedom 7 capsule atop a Mercury-Redstone rocket. His 15-minute suborbital flight made him the first American in space.

The race to the Moon began at this time.[2] It was an outgrowth of the political and military rivalry between the United States and the Soviet Union. We know that the Americans landed with men on the Moon first, but once this was achieved, interest quickly waned and resources were pulled from NASA. The initiation of the American response to Gagarin's flight was with President Kennedy's speech before Congress.

[2] *The Decision to Go to the Moon – Project Apollo and the National Interest*, J.M. Logsdon, MIT Press, 1970.

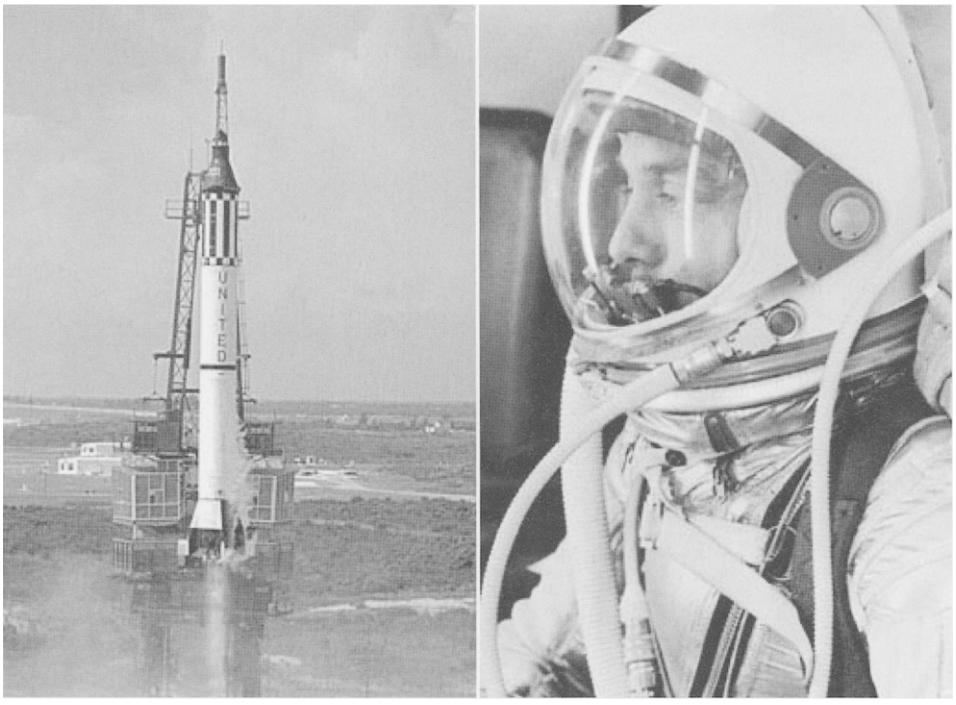

Fig. 1.4 Mercury astronaut Alan B. Shepard, Jr. and his Freedom 7 capsule atop a Mercury-Redstone rocket, 5 May 1961. (Courtesy NASA)

1.0.2 Kennedy 1961 speech

The following is the speech delivered by the 35th U.S. President John F. Kennedy before a joint session of Congress on 25 May 1961 titled "Special Message to the Congress on Urgent National Needs." This is the famous "Moon" speech where he committed the nation to send men to the Moon before the end of the decade. As we see, the space component of the speech is a small part of the overall speech, supporting the historical claim that the Apollo program was in reality a part of the Cold War and political program. The complete speech is reproduced here to provide the reader with the larger context of the "Space Race."

One cannot underestimate the importance of context in trying to understand how space plays out politically. Space enthusiasts from the dawn of Apollo have tried to justify spacefaring in isolation, trying to claim that the return to the Moon and then to Mars would justify the expense and benefit all of humanity. While true — and from this vantage point in the future, obviously true — it was always necessary to put space in the larger context. Once that was done, resistance died away quickly and spacefaring was "obvious."

President Kennedy: Mr. Speaker, Mr. Vice President, my copartners in Government, gentlemen and ladies:

The Constitution imposes upon me the obligation to "from time to time give to the Congress information of the State of the Union." While this has traditionally

Fig. 1.5 Special Message to the Congress on Urgent National Needs, delivered by President John F. Kennedy, delivered to a joint session of Congress, 25 May 1961.

been interpreted as an annual affair, this tradition has been broken in extraordinary times.

These are extraordinary times. And we face an extraordinary challenge. Our strength as well as our convictions have imposed upon this nation the role of leader in freedom's cause.

No role in history could be more difficult or more important. We stand for freedom.

That is our conviction for ourselves – that is our only commitment to others. No friend, no neutral and no adversary should think otherwise. We are not against any man – or any nation – or any system – except as it is hostile to freedom. Nor am I here to present a new military doctrine, bearing any one name or aimed at any one area. I am here to promote the freedom doctrine.

I.

The great battleground for the defense and expansion of freedom today is the whole southern half of the globe – Asia, Latin America, Africa and the Middle East – the lands of the rising peoples. Their revolution is the greatest in human history. They seek an end to injustice, tyranny, and exploitation. More than an end, they seek a beginning.

And theirs is a revolution which we would support regardless of the Cold War, and regardless of which political or economic route they should choose to freedom.

For the adversaries of freedom did not create the revolution; nor did they create the conditions which compel it. But they are seeking to ride the crest of its wave – to capture it for themselves.

Yet their aggression is more often concealed than open. They have fired no missiles; and their troops are seldom seen. They send arms, agitators, aid, technicians and propaganda to every troubled area. But where fighting is required, it is usually done by others – by guerrillas striking at night, by assassins striking alone – assassins who have taken the lives of four thousand civil officers in the last twelve months in Vietnam alone – by subversives and saboteurs and insurrectionists, who in some cases control whole areas inside of independent nations.

[At this point the following paragraph, which appears in the text as signed and transmitted to the Senate and House of Representatives, was omitted in the reading of the message:

They possess a powerful intercontinental striking force, large forces for conventional war, a well-trained underground in nearly every country, the power to conscript talent and manpower for any purpose, the capacity for quick decisions, a closed society without dissent or free information, and long experience in the techniques of violence and subversion. They make the most of their scientific successes, their economic progress and their pose as a foe of colonialism and friend of popular revolution. They prey on unstable or unpopular governments, unsealed, or unknown boundaries, unfilled hopes, convulsive change, massive poverty, illiteracy, unrest and frustration.]

With these formidable weapons, the adversaries of freedom plan to consolidate their territory – to exploit, to control, and finally to destroy the hopes of the world's newest nations; and they have ambition to do it before the end of this decade. It is a contest of will and purpose as well as force and violence – a battle for minds and souls as well as lives and territory. And in that contest, we cannot stand aside.

We stand, as we have always stood from our earliest beginnings, for the independence and equality of all nations. This nation was born of revolution and raised in freedom. And we do not intend to leave an open road for despotism.

There is no single simple policy which meets this challenge. Experience has taught us that no one nation has the power or the wisdom to solve all the problems of the world or manage its revolutionary tides – that extending our commitments does not always increase our security – that any initiative carries with it the risk of a temporary defeat – that nuclear weapons cannot prevent subversion – that no free people can be kept free without will and energy of their own – and that no two nations or situations are exactly alike.

Yet there is much we can do – and must do. The proposals I bring before you are numerous and varied. They arise from the host of special opportunities and dangers which have become increasingly clear in recent months. Taken together, I believe that they can mark another step forward in our effort as a people. I am here to ask the help of this Congress and the nation in approving these necessary measures.

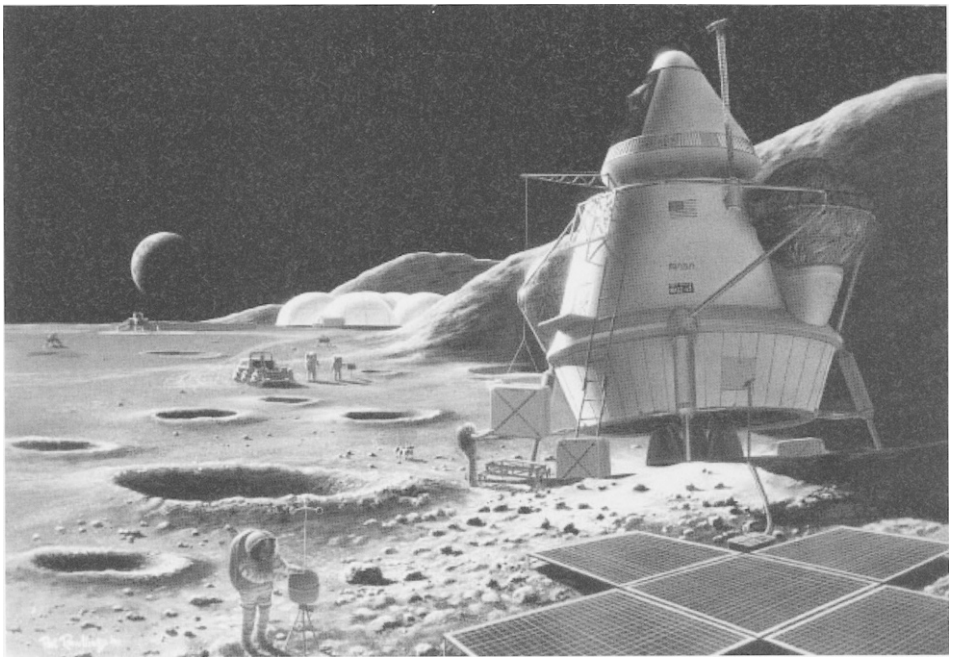

Fig. 1.6 Earth's Moon, just 3 days away, is a good place to test hardware and operations for a human mission to Mars. A simulated mission, including the landing of an adapted Mars excursion vehicle, could test many relevant Mars systems and technologies. (Artwork done for NASA by Pat Rawlings, of SAIC. S95-01563, February 1995. Courtesy NASA) See Plate 1 in color section.

II. ECONOMIC AND SOCIAL PROGRESS AT HOME

The first and basic task confronting this nation this year was to turn recession into recovery. An affirmative anti-recession program, initiated with your cooperation, supported the natural forces in the private sector; and our economy is now enjoying renewed confidence and energy. The recession has been halted. Recovery is under way.

But the task of abating unemployment and achieving a full use of our resources does remain a serious challenge for us all. Large-scale unemployment during a recession is bad enough, but large-scale unemployment during a period of prosperity would be intolerable.

I am therefore transmitting to the Congress a new Manpower Development and Training program, to train or retrain several hundred thousand workers, particularly in those areas where we have seen chronic unemployment as a result of technological factors in new occupational skills over a four-year period, in order to replace those skills made obsolete by automation and industrial change with the new skills which the new processes demand.

It should be a satisfaction to us all that we have made great strides in restoring world confidence in the dollar, halting the outflow of gold and improving our balance

of payments. During the last two months, our gold stocks actually increased by seventeen million dollars, compared to a loss of 635 million dollars during the last two months of 1960. We must maintain this progress – and this will require the cooperation and restraint of everyone. As recovery progresses, there will be temptations to seek unjustified price and wage increases. These we cannot afford. They will only handicap our efforts to compete abroad and to achieve full recovery here at home. Labor and management must – and I am confident that they will – pursue responsible wage and price policies in these critical times. I look to the President's Advisory Committee on Labor Management Policy to give a strong lead in this direction.

Moreover, if the budget deficit now increased by the needs of our security is to be held within manageable proportions, it will be necessary to hold tightly to prudent fiscal standards; and I request the cooperation of the Congress in this regard – to refrain from adding funds or programs, desirable as they may be, to the Budget – to end the postal deficit, as my predecessor also recommended, through increased rates – a deficit incidentally, this year, which exceeds the fiscal 1962 cost of all the space and defense measures that I am submitting today – to provide full pay-as-you-go highway financing – and to close those tax loopholes earlier specified. Our security and progress cannot be cheaply purchased; and their price must be found in what we all forego as well as what we all must pay.

III. ECONOMIC AND SOCIAL PROGRESS ABROAD

I stress the strength of our economy because it is essential to the strength of our nation. And what is true in our case is true in the case of other countries. Their strength in the struggle for freedom depends on the strength of their economic and their social progress.

We would be badly mistaken to consider their problems in military terms alone. For no amount of arms and armies can help stabilize those governments which are unable or unwilling to achieve social and economic reform and development. Military pacts cannot help nations whose social injustice and economic chaos invite insurgency and penetration and subversion. The most skillful counter-guerrilla efforts cannot succeed where the local population is too caught up in its own misery to be concerned about the advance of communism.

But for those who share this view, we stand ready now, as we have in the past, to provide generously of our skills, and our capital, and our food to assist the peoples of the less-developed nations to reach their goals in freedom – to help them before they are engulfed in crisis.

This is also our great opportunity in 1961. If we grasp it, then subversion to prevent its success is exposed as an unjustifiable attempt to keep these nations from either being free or equal. But if we do not pursue it, and if they do not pursue it, the bankruptcy of unstable governments, one by one, and of unfilled hopes will surely lead to a series of totalitarian receiverships.

Earlier in the year, I outlined to the Congress a new program for aiding emerging nations; and it is my intention to transmit shortly draft legislation to implement this program, to establish a new Act for International Development, and to add