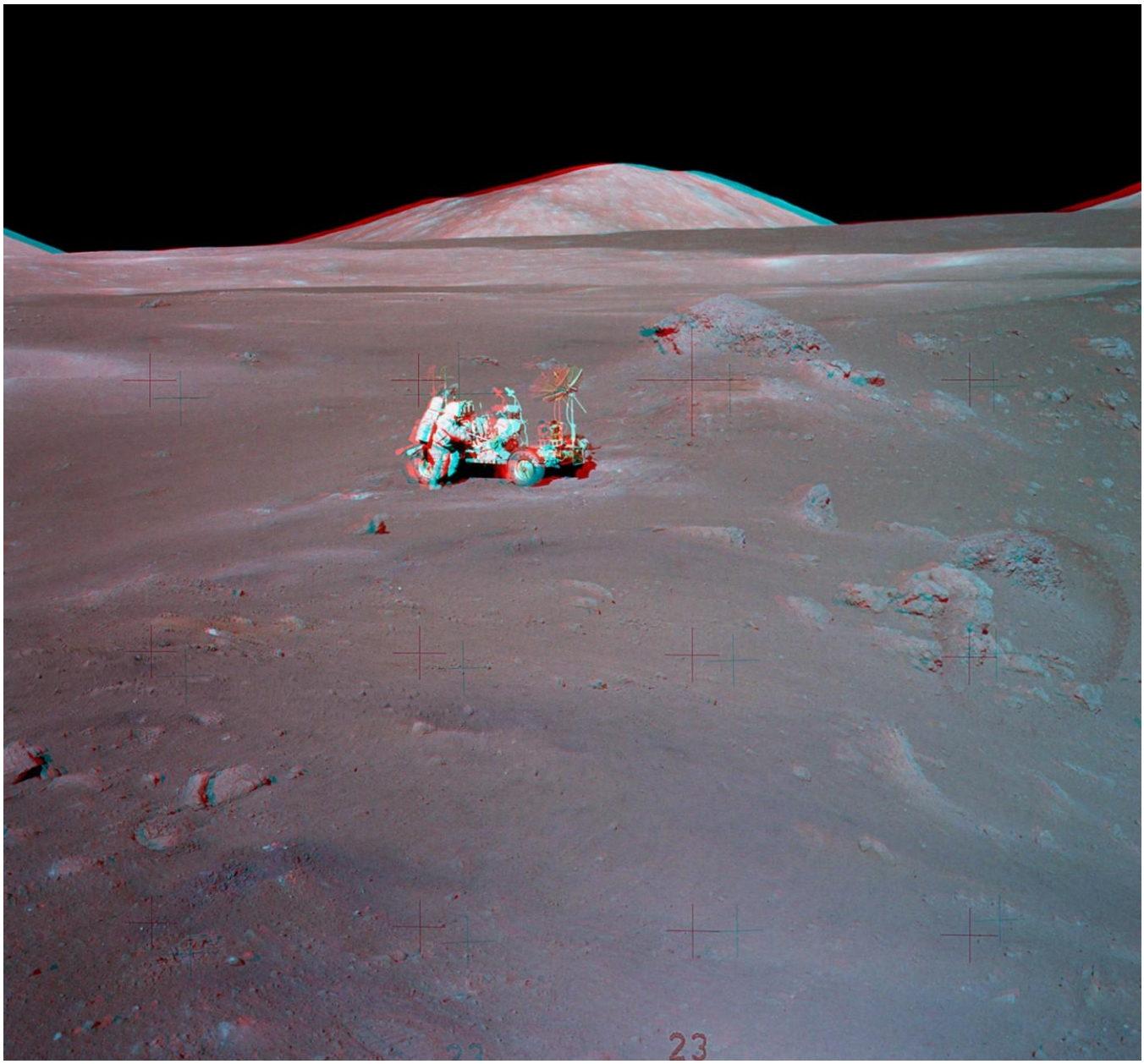
Space Policy and the Constitution

Dr. Harrison H. Schmitt

Foreword by
Michael D. Griffin



Frontispiece
Anaglyph (red-cyan glasses required) of Apollo 17 Astronaut Harrison H. Schmitt on EVA 2 at Shorty Crater (off photo to the right) in the lunar Valley of Taurus-Littrow on December 12, 1972. He is holding a double-core sample tube of the orange soil that he discovered moments earlier. The site of the orange soil is the bright patch between the left front fender of the rover and the rocky mound on the rim of Shorty a few yards above and to the right. A photo of this orange soil forms the **endpiece** at the back of this book. (NASA photos AS17-137-21011-10 composited by the editor).

Cover Photo:
Apollo 17 Astronaut Harrison H. Schmitt working at the lunar rover at the Station 7 stop located on a slope of the North Massif near the Wessex Cleft. A rock sample bag is on his right shoulder. The peak of the East Massif across the valley is about 20 km away. A continuation of the view to the right is on the **back cover**. (NASA photo AS-17-146-22345)

Space Policy and the Constitution

SPACE POLICY
AND THE
CONSTITUTION

Dr. Harrison H. Schmitt

Returning to the Moon and to deep space constitutes the right and continuing space policy choice for the Congress of the United States. It compares in significance to Jefferson's dispatch of Lewis and Clark to explore the Louisiana Purchase. The lasting significance of Jefferson's decision to American growth and survival cannot be questioned. Human exploration of space embodies the same basic instincts— the exercise of freedom, betterment of one's conditions, and curiosity about nature. Such instincts lie at the very core of America's unique and special society of immigrants.

—Harrison H. Schmitt, Feb. 1, 2010.

NOTE

The original essays comprising these chapters were issued as Press Releases seriatim on the dates indicated at the end of each chapter. They have since been revised for this special booklet. The eight essays here were extracted from ***America's Uncommon Sense: The Founders' View Today***, an ongoing collection of the author's reflections on current political events and the U.S. Constitution. The numbers 7, 18, 20, 49, 35, 25 at the end of each chapter refer to the original essay numbers. The themes of 35 and 25 determined their order here. The Prologue is essay 46, and the Epilogue, essay 47. The booklet as well as the full compendium in whole or in parts can be downloaded in PDF and Kindle formats (Downloads page). The essays of the latter can also be read individually online at:

http://americasuncommonsense.com/blog/downloads

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Illustrations and Credits

Covers: ***front***, ***rear***: View of the author at Station 7, Taurus-Littrow Valley (*front*), and an adjacent view to the right (*rear*). See captions. (NASA photos enhanced and/or modified by the editor.)

Frontispiece: The author at Station 4, Shorty Crater, after discovering the orange soil. See caption for more details. (3D anaglyph composite from NASA photos AS17-137-21011, -21010 specially reconstructed by the editor.)

Foreword: Provided by Dr. Michael Griffin.

Prologue: Provided by the author.

Space Exploration Divider: The author skipping in lunar gravity back to the Lunar Rover at Station 5, Camelot Crater. (3D anaglyph composite from NASA photos AS17-145-22165,-22164 specially reconstructed by the editor.)

Chapter 1: ***Heading Photo***: Space Shuttle *Atlantis* captured in silhouette against the sun on 05/12/2009 during the STS-125 mission (NASA/Thierry Legault photo). ***Fig. 1.1***: Artist's concept of the *Constellation Program*'s *Ares V* at lift-off. (NASA photo). ***Fig. 1.2***: The *Shenzou 5* roll-out from the VAB to launch pad SLS-1 at the southern Launch Complex 4 at Jiuquan Satellite Launch Center in preparation for the first Chinese manned orbital spaceflight. (Public domain photo by AAxanderr). ***Fig. 1.3***: The International Space Station (ISS) as photographed from the *Atlantis* space shuttle on its final mission. Note the Moon in the distance. (NASA photo S135-E-011814). ***Fig. 1.4***: Artist's concept of working at a lunar outpost (NASA photo). ***Fig. 1.5***: Artist's concept of a projected mission to an asteroid using two *Orion* spacecraft (Lockheed Martin photo)

Chapter 2: ***Heading Photo***: The International Space Station as seen from *Atlantis* on STS-115 in September 2006. (NASA photo). ***Fig.2.1***: A Russian *Soyuz* spacecraft at the PIRS docking port. (NASA photo iss005e19567). ***Fig. 2.2***: Artist's concept of a *Shenzhou* spacecraft (left) docking with the *Tiangong-1* space module (right). A successful automated, unmanned rendezvous and docking of the *Shenzhou-8* spacecraft with the module was completed on Nov. 2, 2011 and again 12 days later before returning to the Earth. (China Manned Space Engineering Office photo). ***Fig. 2.3***: Artist rendering of Orbital Science Corporation's (OSC) *Cygnus* cargo ship approaching the ISS (OSC photo). ***Fig. 2.4***: Artist rendering of a launch of Orbital Science Corporation's (OSC) *Antares* medium-lift launch vehicle from Wallops Island, VA. Its maiden flight is scheduled for mid-2012. (OSC photo).

Chapter 3: ***Heading Photo***: The asteroid Ida and its moonlet Dactyl photographed by the *Galileo* spacecraft on its way to Jupiter on August 28, 1993. For scale, Dactyl is ca. 1 mile (1.67 km) across. (NASA photo). ***Fig. 3.1***: Artist's concept of the *Orion* spacecraft approaching the ISS. (NASA photo). ***Fig. 3.2***: Artist's concept of the *Altair* lunar lander. (NASA photo JSC2007-E-113280). ***Fig. 3.3***: A prototype of the re-designed *Orion* multi-purpose crew vehicle (MPCV) being trucked to Florida to the Kennedy Space Center Visitor's museum. (NASA photo). ***Fig. 3.4***: A comparison of the sizes of 3 generations of JPL rovers from the *Pathfinder*, *Mars Excursion Rover*, and *Mars Science Lab* Programs. (NASA/JPL photo). ***Fig. 3.5***: The author's book, *Return to the Moon*, published in 2006, discusses at length the costs and economic and

defense benefits of mining He-3 as a fuel for power and shipping it from permanent lunar mining settlements back to the Earth. ***Fig. 3.6***: Construction work on the flight test model of the *Orion* MPCV began at the Michoud Assembly Facility on Sept. 9, 2011. (NASA photo JSC2011-E-120357). ***Fig. 3.7***: A Mathew Brady photo of Abraham Lincoln with his troops after the Antietam Creek battle on Sept. 17, 1862, a major turning point in the war—the largest number of combined casualties of any single battle of the war; Gen. George B. McClellan (6th from left) was relieved of duty for lack of performance; Gen. Robert E. Lee withdrew the Army of Northern Virginia back across the Potomac; and Lincoln issued the Emancipation Proclamation. Capt. George Armstrong Custer is standing at the tent at the far right with his hand on his sword. (Library of Congress, LC-DIG-cwpb-04352, public domain photo).

Chapter 4: ***Heading Photo***: A composite of the Earth, the Moon, and Mars (NASA photo). ***Fig. 4.1***: The asteroid Gaspra at top and at bottom the Martian Moons Deimos (left) and Phobos (right). The objects are scaled to their relative sizes, Gaspra ~18 km, Deimos ~15 km, and Phobos ~20 km. (NASA composite photo). ***Fig. 4.2***: The *Phoenix Polar Lander* photographed by the *Mars Reconnaissance Orbiter* (MRO) on May 28, 2008 in the process of landing on Mars. The 10 km diameter Heimdall Crater in the background is actually 20 km beyond *Phoenix* outlined by the black square. The inset at bottom left is an enlargement of that square. This photo demonstrates 3 unparalleled engineering successes: (1) the design and operation of a special parachute for the ultra thin Martian polar air, (2) the highest latitude landing by a spacecraft on Mars at 68° N, and (3) the first time a spacecraft landing on another planet has been photographed by another spacecraft orbiting that planet (NASA/Jet Propulsion Lab-Caltech/University of Arizona photo at http://photojournal.jpl.nasa.gov/catalog/PIA10705). ***Fig. 4.3***: The asteroid Vesta photographed by the *Dawn* spacecraft (NASA photo PIA14313). ***Fig. 4.4***: An early artist's concept of a radio telescope and supporting solar power station on the Moon's far-side. The radio antenna design is fixed, similar to that at Arecibo in Puerto Rico. (NASA photo). ***Fig. 4.5***: A dust devil on Mars photographed in Gusev Crater by the *Spirit* rover. One of many dust devils photographed in motion by the rovers similar to those seen spinning in the American Southwest deserts (NASA/JPL photo). ***Fig. 4.6***: A possible means of effectively launching He-3 and other volatiles mined on the Moon into lunar orbit for pickup and delivery to Earth. This artist's concept shows a "mass driver", i.e., an electromagnetic device designed to accelerate canisters up to orbital velocity. (NASA photo S78-23252). ***Fig. 4.7***: A simulation of the *NEAR-Shoemaker* spacecraft landing on the asteroid Eros. Not designed to land, the Johns Hopkins engineers gently put it on the surface as its last mission achievement. The spacecraft has just made a small bounce covering the solar panel tips with dust and leaving two small craters in the animation. (Frame grab by the Editor from a NASA/JHU-APL photo). ***Fig. 4.8***: One of the best 3D anaglyph pans by the *Spirit* rover in Gusev Crater on Mars. The rover is located at its winter parking site called 'Winter Haven'. The hill to the left of center in the distance is 'McCool Hill', named in honor of the Columbia shuttle astronaut, William C. McCool. On its right flank is a feature called 'Oberth' after the German rocket visionary, Hermann Oberth. This feature is likely a hydrothermal fumerole, and is shown in more detail in ***Figs. 4.9*** and ***4.10***. (NASA/JPL photos PIA01905 (*top*) and PIA01907 (*bottom*), at http://photojournal.jpl.nasa.gov/catalog/PIA01905; etc. for PIA1907.). ***Fig. 4.9***: McCool Hill and Oberth Fumerole in greater detail. '**F**' marks the position of the probable fumerole and the '**v**'s denote sinuous trails issuing from collapsed vents near the fumerole (*left*). The lower trail can be clearly seen in the 3D anaglyph at right as having been sculpted by water that flowed from the vent. The upper trail to the left of the left **v** is delineated by the lighter-colored sinuous layer, but the trough is not so apparent. This whole area has been characterized by Steve Squyres and associates as having been formed by hydrothermal activity. (From NASA/JPL photos PIA1907 and PIA1905, respectively). ***Fig. 4.10***: 3D anaglyph showing an enlarged view of the fumerole, and especially the carving of the lower sinuous trench by the action of flowing water (cf. ***Fig. 4.9***).

Science and Education Divider: The author investigating the split boulder at Station 6 on the slope of the North Massif. The author was instrumental in conducting an *in situ* geological analysis to determine the boulder's origins and which samples to take. (3D anaglyph composited from NASA photos AS17-140-21497, -21496 by the editor).

Chapter 5: ***Heading Photo***: Monticello where Thomas Jefferson successfully pursued science and the useful arts (the term used for engineering in his day). (Photo by Matt Kozlowski under the GNU Free Documentation License). ***Fig. 5.1***: The Avro Canada *CF-105 Arrow* in flight. (Photo from the Canadian Department of National Defence). ***Fig. 5.2***: An *Aegis BMD* missile test launch (U.S. Dept. of Defense photo). ***Fig. 5.3***: A PAC-3 missile intercepting an incoming test ballistic missile. (U.S. Dept. of Defense photo). ***Fig. 5.4***: The *Patriot Advanced Capability-3* (PAC-3) missile test launch (U.S. Dept. of Defense photo). ***Fig. 5.5***: The successful launch of the *Ares I-X* rocket on October 28, 2009. This rocket was the first step in the development of the *Ares I* and *Ares V* launch vehicles. The *Constellation Program*, of which it was part, was cancelled by President Obama 3 months later in 2010. (Frame grab by the editor from the NASA live Internet feed). ***Fig. 5.6***: A comparison of the *Ares V* heavy lift (left) and *Ares I* (right) launch vehicles of the now-cancelled *Constellation Program* (NASA Photo). ***Fig. 5.7***: Part of the Superconducting Super Collider complex built near Waxahatchie, TX as it appeared deserted in 2008. It would have been the largest and most energetic particle accelerator in the world with a ring circumference of 87 km and an operating energy of 20 TeV per proton. The project was canceled in October, 1993 amidst controversial budget problems. (Public domain photo by Magnus Manske). ***Fig. 5.8***: A duplicate of the Golden Spike that joined the Union Pacific and Central Pacific Railroads on May 10, 1869 forming the first transcontinental railroad. (Public domain photo by Neil916). ***Fig. 5.9***: The 4th flight of the Wright brothers at Kitty Hawk, NC on Dec. 17, 1903 ended in a crash! The forward-mounted elevators are broken. The first flight set the record. (Library of Congress LC-DIG-ppprs-00614 photo).

Chapter 6: ***Heading Photo***: Division of Public Inquiries, Office of War Information Industrial Employment poster OWI Poster No. 55 by magazine illustrator George Rapp published in 1943 by the U.S. Government Printing Office (No. 520464). (Public domain photo). ***Fig. 6.1***: Entrance to Virginia Polytechnic Institute on Alumni Mall. The bridge connects Torgersen Hall (*left*), the Advanced Communications and Information Technology Center, with Newman Library (*right*). The bridge is also the library reading room and study hall for students. The State University has long maintained co-op working programs with industries throughout the South in which students alternate work semesters with study semesters, especially valuable in engineering fields. (Photo by EpicV27 under the GNU Free Documentation License). ***Fig. 6.2***: U. S. Dept. of Education, Washington, DC (Photo by Coolcaesar under the GNU Free Documentation License) ***Fig. 6.3***: Replica of *Sputnik I* in the U.S. National Air & Space Museum. (NASM photo). ***Fig. 6.4***: Lockheed Martin/Boeing F-22 Raptors, rated the most advanced and superior stealth fighters ever produced. The program was terminated in 2010 after 195 were built. (U.S. Air Force photo).

Epilogue: ***Photo 1***: Artist's concept of the as yet unnamed Chinese Space Station, comprising three *Shenzhou* spacecraft docked with various habitat/work modules and several docking nodes. (China Manned Space Engineering Office photo). ***Photo 2***: The landing of STS-135, the final mission of space shuttle *Atlantis* (NASA Photo). ***Photo 3*** STS-135 *Atlantis* docking at the ISS on its final mission. (NASA photo). ***Photo 4***: A possible logo for the proposed new NSEA agency. ***Photo 5***: Apollo 17 Astronaut Harrison H. (Jack) Schmitt, a lunar explorer a very long way from home. The pose, although deliberate, was a lucky accident. Gene Cernan, seen mirrored in Jack's gold visor, held the Hasselblad camera down and at arm's length

hoping that the flagpole horizontal hanging bar would point the American flag homeward bound towards the Earth. A portion of the Moon can be seen behind Jack and in his visor. This mission concluded America's first great human exploration of our nearest neighbor in space nearly 40 years ago (NASA Photo AS17-134-20384).

TABLE OF CONTENTS

FOREWORD

Harrison Schmitt — known as "Jack" since childhood — is many things: geologist, pilot, astronaut, Senator, professor, author, and accomplished public speaker. He is intellectually gifted, impressively educated, uncompromisingly honest, relentlessly determined, and remorselessly logical. In addition to all of these things (Jack might well say "as a consequence of them"), he is also a principled conservative; i.e., the political orientation once known simply as "conservative", before it began to be equated with the holding of particular social and religious views. Jack therefore values individual liberty and responsibility over collective control, excellence over mediocrity, and, most assuredly, the Constitution that was "ordained and established" by our nation's Founders in their belief that "We the People" might best preserve and protect such values through a limited government of strictly enumerated powers. Jack believes that the Constitution means what it plainly says, that (not having been written primarily by lawyers) lawyers are not required to explain that meaning, and that this everlasting agreement among ourselves as to how we shall govern our society deserves to be strictly enforced by the people upon their governors.

But Jack is hardly anti-government; he does not advocate the simple-minded abdication of the clear government responsibility, again enshrined in our Constitution, to "promote the general welfare". He fully understands that according to the supreme law of the land there are things the President and Congress must do, as well as things that they may not do.

Nowhere in this work does he state these beliefs; indeed, it is rare for Jack to refer to himself at all, even during a personal conversation. But in his respectful, careful parsing of the language of our Constitution, in the reverence he shows for the values of personal liberty and American exceptionalism, and through his exactingly logical elucidation of the incompatibility between many current government policies and the mandates of our nation's Constitution, his values are placed clearly in evidence. However, by confining himself to issues and ideas, actions and consequences, Jack maintains a level of civil discourse that is regrettably rare in American politics today.

While he writes on many topics, former Senator Schmitt is also former Astronaut Schmitt, a man who clearly still loves space, spaceflight, and space exploration. Jack's interest in these subjects is not merely the affection of a long-retired astronaut for the cherished experiences of his youth. He has larger concerns. He understands the value to a society of defining, exploring, occupying, exploiting, and extending the frontier of its time. He understands the contributions to technology and science, to the arts and the culture at large, and, further, to the stature of a society in the larger world when that society is preeminent on the frontier. Jack Schmitt cares about space because space is the

frontier of our time, and he knows what will happen to societies that understand this and what will happen to those that do not.

Accordingly, then, this is a work that calls the reader's attention not to the scientific and technical merits of spaceflight and space exploration; but rather to the cultural, societal, and strategic imperatives for American leadership in space that make informed attention to a robust national space program a Constitutional responsibility of those who, by our consent, govern our nation's affairs. He argues clearly and cogently that those responsibilities are going unmet today, and he proposes what must be done to meet them. Jack makes the case for space as no one else can, and he shows how and why we are on the wrong path— leaving the rest of us with the question: what can we do to obtain the leadership we need instead of the leadership we have?

Michael D. Griffin,
King-McDonald Eminent Scholar
Professor, Mechanical & Aerospace Engineering
University of Alabama, Huntsville,
May 25, 2011

PROLOGUE

On May 25, 1961, President John F. Kennedy announced to a special joint session of Congress the dramatic and ambitious goal of sending an American to the Moon and returning him safely to Earth by the end of that decade. President Kennedy's confidence that this Cold War goal could be accomplished rested on the post-Sputnik decision by President Dwight D. Eisenhower to form the National Aeronautics and Space Administration and, in January 1960, to direct NASA to begin the development of what became the Saturn V rocket. This collection of essays on ***Space Policy and the Constitution*** commemorates President Kennedy's decisive challenge 50 years ago to a generation of young Americans and the remarkable success of those young Americans in meeting that challenge.

How notions of leadership have changed since Eisenhower and Kennedy! Immense difficulties now have been imposed on the Nation and NASA by the budgetary actions and inactions of the Bush and Obama Administrations between 2004 and 2012. Space policy gains relevance today comparable to 50 years ago as the dangers created by the absence of a coherent national space policy have been exacerbated by subsequent adverse events. Foremost among these events have been the Obama Administration's and the Congress's spending and debt spree, the continued aggressive rise of China, and, with the exception of operations of the Space Shuttle and International Space Station, the loss of focus and leadership within NASA headquarters.

The bi-partisan, patriotic foundations of NASA underpinned the remarkable Cold War and scientific success of the Apollo Program in meeting the goal of "landing a man on the Moon and returning him safely to the Earth". Those foundations gradually disappeared during the 1970s as geopolitical perspectives withered and NASA aged. For Presidents and the media, NASA's activities became an occasional tragedy or budgetary distraction rather than the window to the future envisioned by Eisenhower, Kennedy and the Apollo generation. For Congress, rather than being viewed as a national necessity, NASA became a source of politically acceptable "pork barrel spending" in states and districts with NASA Centers, large contractors, or concentrations of sub-contractors. Neither taxpayers nor the Nation benefit significantly from this current, self-centered rationale for a space program.

Is there a path forward for United States' space policy? When a new President takes office in 2013, he or she should propose to Congress that we start space policy and its administration from scratch. A new agency, the National Space Exploration Administration (NSEA), should be charged with specifically enabling America's and its partners' exploration of deep space, inherently stimulating education, technology, and national focus. The existing component parts of NASA should be spread among other

agencies with the only exception being activities related to U.S. obligations to its partners in the International Space Station (ISS).

Changes in the Space Act of 1958, as amended, to accommodate this major reinvigoration of the implementation of space and aeronautical policy should be straightforward. Spin-off and reformulation of technically oriented agencies have precedents in both the original creation of NASA in 1958 by combining the National Advisory Committee on Aeronautics (NACA) and the Army Ballistic Missile Agency and the creation of the United States Air Force in 1947 from the Army Air Forces.

The easiest change to make would be to move NASA Space Science activities into the National Science Foundation (NSF), exclusive of lunar and planetary exploration science but including space-based astronomical observatories. At the NSF, those activities can compete for support and funding with other science programs that are in the national interest to pursue. Spacecraft launch services can be procured from commercial, other government agencies, or international sources through case-by-case arrangements. With this transfer, the NSF would assume responsibility for the space science activities of the Goddard Space Flight Center and for the contract with Caltech to run the Jet Propulsion Laboratory.

Also, in a similarly logical and straightforward way, NASA's climate and other earth science research could become part of the National Oceanic and Atmospheric Administration (NOAA). NOAA could make cooperative arrangements with the NSF for use of the facilities and capabilities of the Goddard Space Flight Center related to development and operation of weather and other remote sensing satellites.

Next, NASA aeronautical research and technology activities should be placed in a re-creation of NASA's highly successful precursor, the NACA. Within this new-old agency, the Langley Research Center, Glenn Research Center, and Dryden Flight Research Center could be reconstituted as pure aeronautical research and technology laboratories as they were originally. The sadly, now largely redundant Ames Research Center should be auctioned to the highest domestic bidder as its land and facilities have significant value to nearby commercial enterprises. These actions would force, once again, consideration of aeronautical research and technology development as a critical but independent national objective of great economic and strategic importance.

NASA itself would be downsized to accommodate these changes. It should sunset as an agency once the useful life of the International Space Station (ISS) has been reached. De-orbiting of the ISS will be necessary within the next 10 to 15 years due to escalating maintenance overhead, diminished research value, sustaining cost escalation, and potential Russian blackmail through escalating costs for U.S. access to space after retirement of the Space Shuttles. NASA itself should sunset two years after de-orbiting, leaving time to properly transfer responsibility for its archival scientific databases to the NSF, its engineering archives to the new exploration agency, and its remaining space artifacts to the Smithsonian National Air and Space Museum.

Finally, with the recognition that a second Cold War exists, this time with China and its surrogates, the President and Congress elected in 2012 should create a new National Space Exploration Administration (NSEA). NSEA would be charged solely with the human exploration of deep space and the re-establishment and maintenance of American dominance as a space-faring nation. The new Agency's responsibilities should include robotic exploration necessary to support its primary mission. As did the Apollo Program, NSEA should include lunar and planetary science and resource identification as a major component of its human space exploration and development initiatives.

To organize and manage the start-up of NSEA, experienced, successful, and enthusiastic engineering program and project managers should be recruited from industry, academia, and military and civilian government agencies. NSEA must be given full authority to retire or rehire former NASA employees as it sees fit and to access relevant exploration databases and archives. An almost totally new workforce must be hired and NSEA must have the authority to maintain an average employee age of less than 30. (NASA's current workforce has an average age over 47.) Only with the imagination, motivation, stamina, and courage of young engineers, scientists, and managers can NSEA be successful in meeting its Cold War II national security goals. Within this workforce, NSEA should maintain a strong, internal engineering design capability independent of that capability in its stable of contractors.

NSEA would assume responsibility for facilities and infrastructure at the Johnson Space Center (spacecraft, training, communications, and flight operations), Marshall Space Flight Center (launch vehicles), Stennis Space Center (rocket engine test), and Kennedy Space Center (launch operations). Through those Centers, NSEA would continue to support NASA's operational obligations related to the International Space Station. NSEA should have the authority, however, to reduce as well as enhance the capital assets of those Centers as necessary to meet its overall mission.

Enabling legislation for NSEA should include a provision that no new space exploration project can be re-authorized unless its annual appropriations have included a minimum 30% funding reserve for the years up to the project's critical design review and through the time necessary to complete engineering and operational responses to that review. Nothing causes delays or raises costs of space projects more than having reserves that are inadequate to meet the demands of the inevitable unknown unknowns inherent in complex technical endeavors.

The simple charter of the National Space Exploration Administration should be as follows:

> *Provide the People of the United States of America, as national security and economic interests demand, with the necessary infrastructure, entrepreneurial partnerships, and human and robotic operational capability to settle the Moon, utilize lunar resources, scientifically explore and settle Mars and other deep space destinations, and, if necessary, divert significant Earth-impacting objects.*

Is this drastic new course for national space policy and its implementation the best course to repair what is so clearly broken? Do we have a choice with Cold War II upon us, with American STEM education a shambles, with domestic engineering development and manufacturing disappearing, and with an ever-growing demand for American controlled, economically viable, clean energy?

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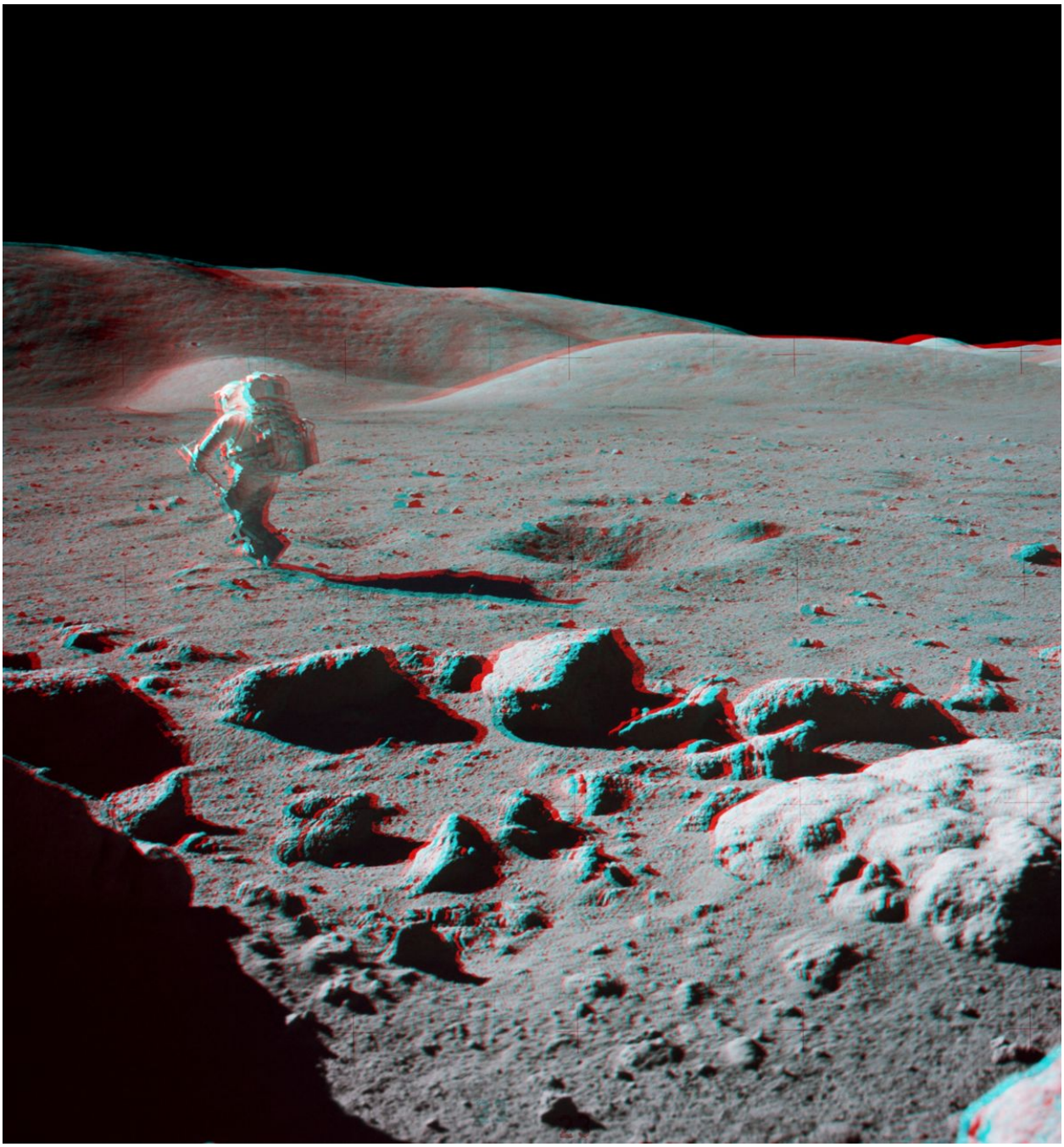
Originally published on May 25, 2011, at http:/americasuncommonsense.com/blog/downloads/ as Release #46, *Space Policy and the Constitution #4 – Former Senator Schmitt Proposes Dismantling of NASA and Creation of a New, National Space Exploration Administration (NSEA),* and revised for publication here.

Harrison H. Schmitt
Albuquerque, New Mexico
May 25, 2011

Harrison H. Schmitt is a former United States Senator from New Mexico as well as a Geologist and Apollo 17 Astronaut— the last American to set foot on the Moon on December 11, 1972. He is author of ***Return to the Moon*** (Springer-Praxis, New York, 2006), and currently is an aerospace and private enterprise consultant and a member of the new Committee of Correspondence.



The author skipping in lunar gravity on his way to the Rover at Station 5, Camelot Crater

SPACE EXPLORATION

Chapter 1

The space shuttle *Atlantis* silhouetted against the solar limb in this dramatic telescopic view

THE ESSENTIAL ROLE OF SPACE

New Space Policy Cedes the Moon to China, the Space Station to Russia, and Liberty to the Ages

The Administration announced a new Space Policy in 2010, after a year of morale bending clouds of uncertainty. The lengthy delay, the abandonment of human exploration, and the wimpy overall thrust of the policy indicates that the Administration does not understand, or want to acknowledge, the essential role space plays in the future of the United States and of liberty. Antagonism against America's demonstration of predominance in space continues.

Expenditures of taxpayer provided funds on space related activities find constitutional justification in Article I's power and obligation to "provide for the Common Defence." This power relates directly to the geopolitical importance of space exploration at this frontier of human endeavor. A vibrant space program sets the modern geopolitical tone for the United States to engage friends and adversaries in the world as well as building wealth, economic vitality, and educational momentum through technology and discovery. For example, in the 1980s, the leadership of the former Soviet Union believed America would be successful in creating a missile defense system

Fig. 1.1. Artist's concept of *Ares V*, the heavy-lift launch vehicle of the *Constellation Program* that would have returned Americans to the Moon by 2020. The Program was canceled by President Obama in Feb. 2010. (NASA photo)

because we succeeded in landing on the Moon and they had not. Dominance in space clearly constituted a major factor leading to the end of the Cold War.

With a new Cold War looming before us, involving the global ambitions and geopolitical challenge of the national socialist regime in China, President George W. Bush attempted to put America back on a course to maintain space dominance. What became the *Constellation Program* comprised his 2002 vision of returning Americans and their partners to deep space by putting astronauts back on the Moon, going on to Mars, and ultimately venturing beyond. Unfortunately, like all Presidents since Eisenhower and Kennedy, the Bush Administration lost perspective about space. Inadequate budgeting and lack of Congressional leadership and funding during *Constellation's* most important formative years undercut Administrator Michael Griffin's effort to fully implement the Program beginning in 2004. Delays due to this period of under-funding have rippled through national space capability until we must retire the Space Shuttle in 2011 without a replacement to access space. Now, we must pay at least $63 million per seat for the Russians to ferry Americans and others to the International Space Station. How the mighty have fallen!

Not only did *Constellation* never receive the Administration's promised funding, but the Bush Administration and Congress required NASA (1) to continue the construction of the International Space Station (badly under-budgeted by NASA Administrator O'Keefe, the OMB, and ultimately by the Congress), (2) to accommodate numerous major over-runs in the science programs (largely protected from major revision or cancellation by narrow Congressional interests), (3) to manage without hire and fire authority (particularly devastating to the essential hiring of young engineers), and (4) to assimilate, through added delays, the redirection and inflation-related costs of several Continuing Resolutions. Instead

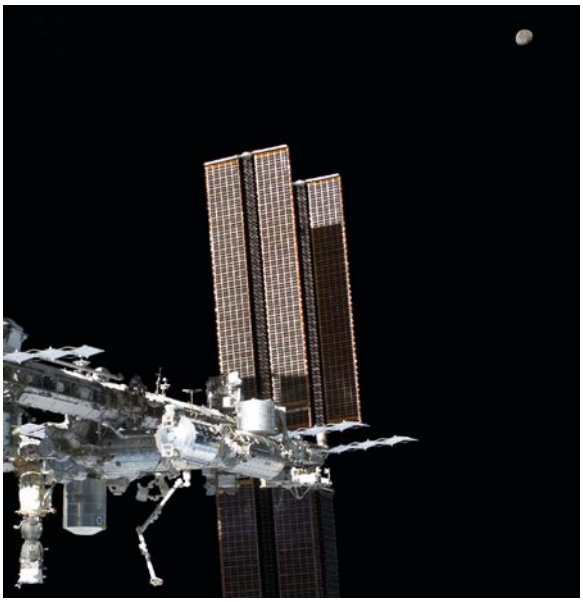


Fig. 1.2. Photo of the ISS from *Atlantis*, preparing for departure on its final mission. Note the Moon in the upper right corner. (From NASA S135-E-011814)

Fig. 1.3. *Shenzhou 5*, China's first manned orbital spacecraft, atop a CZ-2F rocket on its way to the launch pad. (PD photo)

of fixing this situation, the current Administration did not retain Administrator Griffin, the best engineering Administrator in NASA's history, and now has cancelled *Constellation*. As a consequence, long-term access of American astronauts to space rests on the improbable success of an untested plan for the "commercial" space launch sector to meet the increasingly risk adverse demands of space flight.

Histories of nations tell us that an aggressive program to return Americans permanently to deep space must form an essential component of national policy. Americans would find it unacceptable, as well as devastating to human liberty, if we abandon leadership in deep space to China, Europe, or any other nation or group of nations. Potentially equally devastating to billions of people would be loss of free nations' access to the energy resources of the Moon as fossil fuels diminish on Earth.

In that harsh light of history, it is frightening to contemplate the long-term, totally adverse consequences to the standing of the United States in modern civilization if the current Administration's decision to abandon deep space holds for any length of time. Even its commitment to maintain the International Space Station using commercial launch assets constitutes a dead-end for Americans in space. At some point, now set at the end of this decade, the Station would be abandoned to the Russians or just destroyed.

What, then, should be the focus of national space policy in order to maintain leadership in deep space? Some propose that we concentrate only on Mars. Without the experience of returning to the Moon, however, we will not have the engineering, operational, or physiological insight for many decades to either fly to Mars or land there. The President suggests going to an asteroid. As important as asteroid diversion from collision with the Earth someday may be, just going there hardly stimulates scientific discovery anything like a permanent American settlement on the Moon! Other means exist, robots and meteorites, for example, to obtain most

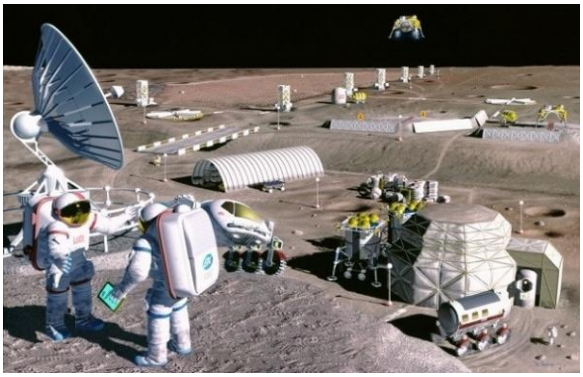


Fig. 1.4. Artist's concept of working at a lunar outpost (NASA photo).

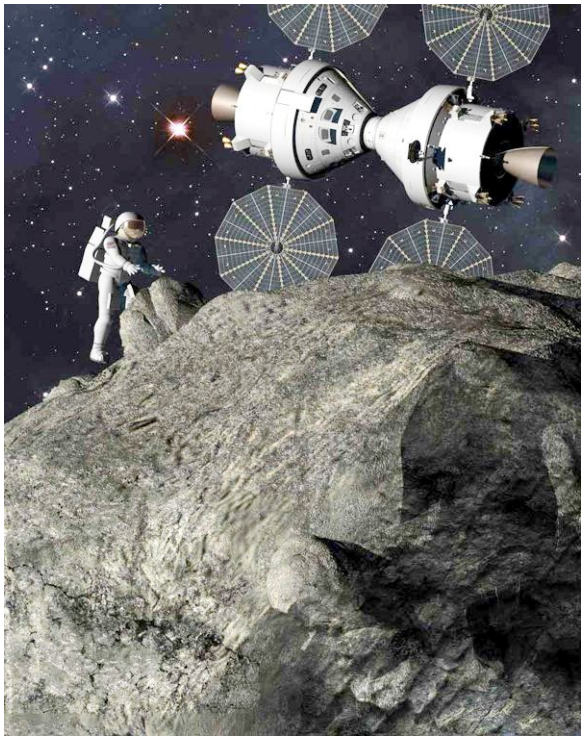


Fig. 1.5. Artist's concept of a projected mission to an asteroid using two *Orion* spacecraft (Lockheed Martin photo)

or all of the scientific value from a human mission to an asteroid. In any event, returning to the Moon inherently creates capabilities for reaching asteroids to study or divert them, as the case may be.

Returning to the Moon and to deep space constitutes the right and continuing space policy choice for the Congress of the United States. It compares in significance to Jefferson's dispatch of Lewis and Clark to explore the Louisiana Purchase. The lasting significance of Jefferson's decision to American growth and survival cannot be questioned. Human exploration of space embodies the same basic instincts— the exercise of freedom, betterment of one's conditions, and curiosity about nature. Such instincts lie at the very core of America's unique and special society of immigrants.

Over the last 150,000 years or more, human exploration of Earth has yielded new homes, livelihoods, know how, and resources as well as improved standards of living and increased family security. Government has directly and indirectly played a role in encouraging exploration efforts. Private groups and individuals take additional initiatives to explore newly discovered or newly accessible lands and seas. Based on their specific historical experience, Americans can expect that benefits comparable to those sought and won in the past also will flow from their return to the Moon, future exploration of Mars, and the long reach beyond. To realize such benefits, however, Americans must continue as the leader of human activities in space. No one else will hand them to us without requiring a huge economic or political price.

With a permanent resumption of the exploration of deep space, one thing is certain: our efforts will be as significant as those of our ancestors as they migrated out of Africa and into a global habitat. Further, a permanent human presence away from Earth provides another opportunity for the expansion of free institutions, with all their attendant rewards, as humans face new situations and new individual and societal challenges.

Returning to the Moon first and as soon as possible meets the requirements for an American space policy that maintains deep space leadership, as well as providing major new scientific returns. Properly conceived and implemented, returning to the Moon prepares the way to go to and land on Mars. This also can provide an infrastructure for

space exploration in which freedom-loving peoples throughout the world can participate as active partners.

Again, if we abandon leadership in deep space to the any other nation or group of nations, particularly a non-democratic regime, the ability for the United States and its allies to protect themselves and liberty for the world will be at great risk and potentially impossible. To others would accrue the benefits—psychological, political, economic, and scientific—that the United States harvested as a consequence of Apollo's success 40 years ago. This lesson has not been lost on our ideological and economic competitors.

American leadership absent from space? Is this the future we wish for our progeny? I think not. Again, future elections offer the way to get back on the right track.

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Chapter 2

The International Space Station as seen from *Atlantis* on STS-115 in September 2006

DEEP SPACE EXPLORATION

The President's Irrational Views on Space Policy

The President has repeated his advocacy for the abandonment of a program of deep space exploration by Americans in return for vague promises about future actions. His irrational and technically ridiculous proposals on national space policy, now largely adopted by the Congress, would put the nation into a steady decline in its human space flight endeavors toward the total absence of NASA Astronauts from space within a decade. With the demise of the International Space Station in about 2020, if not sooner, America's nationally sanctioned human spaceflight activities would end.

American leadership absent from space– is this the future we will leave to our children and the cause of liberty? I hope not. Once again, the President and his supporters in this fool's errand expose their basic belief that America is not exceptional, that Americans should apologize for protecting liberty for 250 years, and that the human condition would be no worse off without our past expenditure of lives, time, and treasure in freedom's behalf.

Fig. 2.1. A Russian *Soyuz* spacecraft at the PIRS docking port. *Soyuz* is the only means at present for American astronauts to gain access to the ISS.

Since 1957, national space policy, like naval policy in the centuries before, has set the geopolitical tone for the interactions between the United States and its international allies and adversaries. The President's FY2011 budget submission to Congress shifts that tone away from leadership by America by abandoning human exploration and settlement of the Moon and Mars to China and, effectively, leaving the Space Station under the dominance of Russia for its remaining approximately 10-year life.

With the Station's continued existence inherently limited by aging, these proposals sign the death warrant for NASA-sponsored human space flight. Until the Space Station's inevitable shutdown, the President also proposes Americans ride into space at the forbearance of the Russians, so far, at a cost of more than $60 million a seat. Do we really want to continue to go, hat in hand, to the Russians to access a Space Station American taxpayers have spent **$150 billion** to build? What happens as the geopolitical and ideological interests of the United States and an increasingly authoritarian Russia continue to diverge?

In spite of funding neglect by the previous Administration and Congresses, a human space flight program comparable to *Constellation* remains the best way to develop the organizational framework, hardware, and generational skills necessary for Americans to continue to be leaders in the exploration and eventual settlement of deep space. Protecting liberty and ourselves will be at great risk and probably impossible in the long term if we now abandon deep space to any other nation or group of nations, particularly a non-democratic, authoritarian regime like China (**Fig. 2.2**). To others would accrue the benefits, psychological, political, economic, technical, and scientific, that accrued to the United States from Apollo's success 40 years ago. This lesson from John Kennedy and Dwight Eisenhower has not been lost on our ideological and economic competitors.

An American space policy that maintains deep space leadership, as well as providing major new scientific discoveries, requires returning to the Moon as soon as possible. Returning to the Moon prepares the way to go to and land on Mars, something we are a long way from knowing how to do. Returning to the Moon, importantly, trains new young Americans in how to work in and with the challenges of exploring and living in deep space. This also continues a policy in which freedom-loving peoples throughout the world can participate as active partners. Even more pragmatically, settlements on the Moon can send badly needed clean energy resources back to Earth for everyone's use and that are not under the control of some authoritarian regime.

In contrast to space activities that relate to national security, including the geopolitical standing of the Unites States among competing states and ideologies, there

Fig. 2.2 Illustration of the unmanned, automated rendezvous and docking of the Chinese *Shenzhou-8* spacecraft (*left*) with the *Tiangong-1* module (*right*) which occurred on November 2, 2011. (China Manned Space Engineering Office photo).

exists great potential for investor-driven commercial enterprises related to space. Commercial communications satellites remain the best example of the realization of this potential. Lunar helium-3 fusion power may someday reach and surpass this level of true commercialization. The key to such enterprises is that they are "investor-driven" even though their technology base may include earlier development activities by the United States government.

In contrast to this normal definition of space commercialization, the President and NASA want to create a totally taxpayer subsidized rocket and spacecraft capability and call it "commercial", hoping that it would include acceptable and affordable means of taking astronauts to the Space Station. Do we really want to put all our national space access eggs in the one basket of unproven, fully subsidized launch capabilities with limited independent oversight? What happens if a risk adverse NASA and Congress eventually make those potential capabilities unaffordable and unattractive to non-NASA customers? The Board of any reputable investor-owned company must

Fig. 2.3. Artist rendering of Orbital Science Corporation's (OSC) *Cygnus* cargo ship approaching the ISS (OSC photo).

Fig. 2.4. Artist rendering of a launch of Orbital Science Corporation's (OSC) *Antares* medium-lift launch vehicle from Wallops Island, VA. Its maiden flight is scheduled for April 2013. (OSC photo).

ask exactly this last question.

The Founders did ***not*** expect the Federal Government to fund activities beyond those applicable to specified powers of Congress and the President, such as those powers required for direct and indirect applications to our "common defence." This constitutional line between true commercialization and national defense is a very useful line to draw. Indeed, earlier federal aeronautical and satellite communications technology development drew this line carefully by funding technology development and not actual commercial products based on such technology. These technologies often have been critical to national security, but their application in commercial activities has been left largely to investor-driven decisions.

Advocacy of extra-constitutional "investments" (read "subsidies") by government in ventures aimed at commercial applications, even to meet a non-defense federal requirement, reflects a desire for more federal control of private enterprise rather than belief in the realities of the market place. Few, if any, past successes for this approach can be identified. Even those past federal "commercial" investments with constitutional justification, such as the Transcontinental Railroad, ended up being very messy and corrupt.

NASA's chartered function, unfortunately not recognized by the current Administration, remains that of maintaining America as the international leader in all major aspects of space exploration and promoting space technology development, some of which may have commercial as well as defense applications. The private sector's function remains twofold: that of being dedicated contractors fulfilling NASA constitutional requirements and that of commercializing space technologies. NASA's function is ***not*** that of being a total substitute for investors whether or not it may be a future customer for those investors.

The right and continuing space policy choice for the Congress of the United States remains as previously approved by Democrats and Republicans alike. Returning to the Moon compares in significance to President Jefferson's dispatch of Lewis and Clark into wilderness of the Louisiana Purchase. Jefferson's decision had unquestioned and critical significance to American growth and survival. As with the American West, human exploration of space embodies basic human instincts— freedom, curiosity, and betterment of one's conditions. America's unique and special society of immigrants still has such instincts at its core.

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Chapter 3

Asteroid Ida and its moonlet Dactyl photographed by the *Galileo* spacecraft

A BOLD APPROACH FOR SPACE EXPLORATION?

Concerns about the Administration's Proposed Space Policies

The President announced a "bold approach for space exploration and discovery," to quote the 2010 White House statement. In considering his FY2012 budget proposals for NASA, Congress rightly should ask just how "bold" is this approach versus what America requires in the intense geopolitical environment of space. In addition, Congress should ask for specifics as to why this approach would be better than the *Constellation Program* previously approved by a Congress controlled by the President's own Party, and whether it truly "advances America's commitment to human spaceflight and exploration of the solar system" to again quote the White House. Congress also should question if the proposals support the primary constitutional rationale for funding NASA, that is, as a contribution to "the common Defence."

Fig. 3.1. Artist's concept of the *Orion* spacecraft, bearing a marked resemblance to the Apollo Command and Service Module, only larger, approaching the ISS. The original *Orion* crew excursion vehicle was part of the *Constellation Program* cancelled by President Obama in 2010, and would have taken crews to the ISS, the Moon, Mars, and other points in the solar system. (NASA photo)

The previous United States space policy, twice approved by the Congress in response to President George W. Bush's FY2005 and subsequent budget requests, called for focused technology development and mission formulations that would (1) enable a return to the Moon not later than 2020; (2) be consistent with future Mars exploration; (3) complete the construction of the International Space Station; and (4) replace the Space Shuttle with a new crewed vehicle not later than 2014. The *Constellation Program's* design could have achieved these goals subject to the projected run-out funding for NASA in that original FY2005 budget.

Unfortunately, the Bush White House submitted annual budgets for FY2006-10 that funded *Constellation* $11 billion less than originally deemed necessary to maintain the proposed schedule. This includes the effects of an Office of Management and Budget error of about $3.8 billion in 2004 budgeting for the run-out cost of the Space Shuttle. Congress exacerbated this continued under-funding for *Constellation* through inflation-related cuts of about $1.5 billion in its 2006 and 2008 Continuing Resolutions.

In spite of these budgetary complications amounting to under-funding of some $12.5 billion over six years, and contrary to the Augustine-Crawley Commission's allegations, *Constellation* remained "executable" in 2009-2010, albeit with some delay relative to the original schedule. The Augustine-Crawley Commission did not look at the reality of the existing *Constellation* Program and its previously approved funding, but constrained itself to the cumulative cuts of $28 billion for FY2010-20 submitted in the Obama budget for FY2010. Clearly, *Constellation* would not be "executable" with such drastic cuts to the original funding plan.

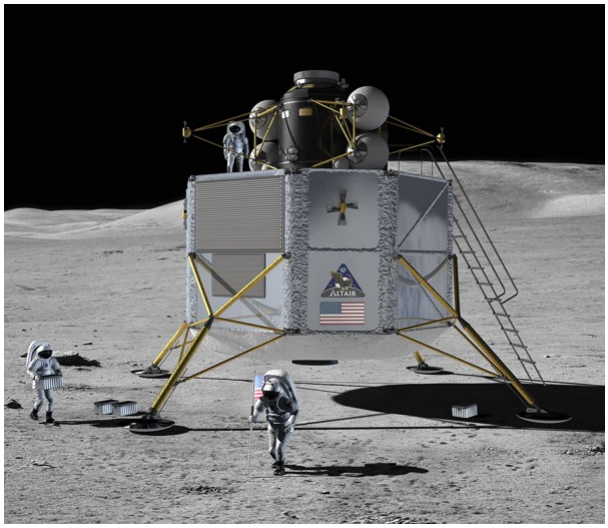

Fig. 3.2. Artist's concept of the *Altair* lander designed to convey astronauts to the lunar surface. It was cancelled along with other components of the *Constellation Program* by President Obama in 2010. (NASA photo JSC2007-E-113280)

Fig. 3.3. A prototype of the re-designed *Orion* multi-purpose crew vehicle (MPCV) on its way from Dryden Research Center in California to the Kennedy Space Center Visitor's Museum in Florida in the summer of 2011. (NASA photo)

New funding of about $4 billion per year for the next five years could restore and maintain *Constellation* and possibly remove dependency on Russia in 2015 for Space Station access (NASA's FY2011 budget of $18.5 billion is less than 0.5 percent of total federal spending.). If this budgetary augmentation to current space policy were made, the United States could indefinitely maintain its dominant position as the world geopolitical and technical leader in space.

With the 2004-2010 period of intense design and development for *Constellation* already behind us, President Obama's budget proposals would substitute the following policy elements:

1. **A NASA budget increase of $6 billion over five years.** These new dollars would be used largely to increase expenditures for space, Earth, and climate science. (This same $6 billion increase, if dedicated to *Constellation*, would give the U.S. its own *Orion* spacecraft and *Ares* launch vehicle for access to Space Station.)

2. **A "commitment to decide in 2015" on a specific approach to a heavy-lift rocket.** Such a launch vehicle would be required if future policy added flights to "lunar orbit, Lagrange Points, Asteroids, moons of Mars, and Mars." (With no commitment to any specific objective for a new heavy-lift, this policy position is made to order to be abandoned. It contains the technically and philosophically ludicrous suggestions that Lagrange points could be fuel depots without getting fuel from the Moon, and that a one-shot mission to an asteroid has greater historical and scientific value than a base on the Moon.)

3. **Technology development and test to increase space capabilities and reduce costs.** The objective would be to "establish the technological foundation for future crewed spacecraft for missions beyond Earth-orbit." (As with heavy-lift, the policy gives no focus for these technology efforts as valuable as they could be, particularly with the development of a domestically produced, large hydrocarbon fueled rocket engine like we had for Apollo. Claims of providing "more jobs for the country" are disingenuous, however, as many more thousands of jobs

disappear with the cancellation of *Constellation* and the retirement of the Space Shuttle).

4. **A "steady stream of precursor robotic exploration missions."** (A steady stream of such missions has been underway for two decades so this is nothing new. **Fig. 3.4.**)

5. **Restructuring of *Constellation* with the *Orion* spacecraft downsized to an emergency escape vehicle for the Space Station.** (*Orion* development has progressed to the point that this proposal amounts to its termination and the start of a new spacecraft program that will cost more than completing *Orion*. Contrary to White House claims, this logically does nothing to reduce dependence on Russia to carry Americans to the Space Station. Major additional costs would be incurred to fly the new *Orion* uncrewed to the Station and replace it periodically. **Figs. 3.1, 3.3.**)

6. **An increase in "astronaut days in space by 3500 over 10 years."** (No obvious means of doing this exists based on available Russian *Soyuz* flights to the Space Station and current biomedical limits on crew exposure to the space environment.)

7. **A "jumpstart" to non-NASA, "commercial space launch" capabilities for human space flight.** (With no known business case that would justify referring to such a capability as a "commercial" venture that private investors would support, and no definition of the final level of requirements and specifications NASA ultimately would demand, this fully subsidized initiative amounts to another,

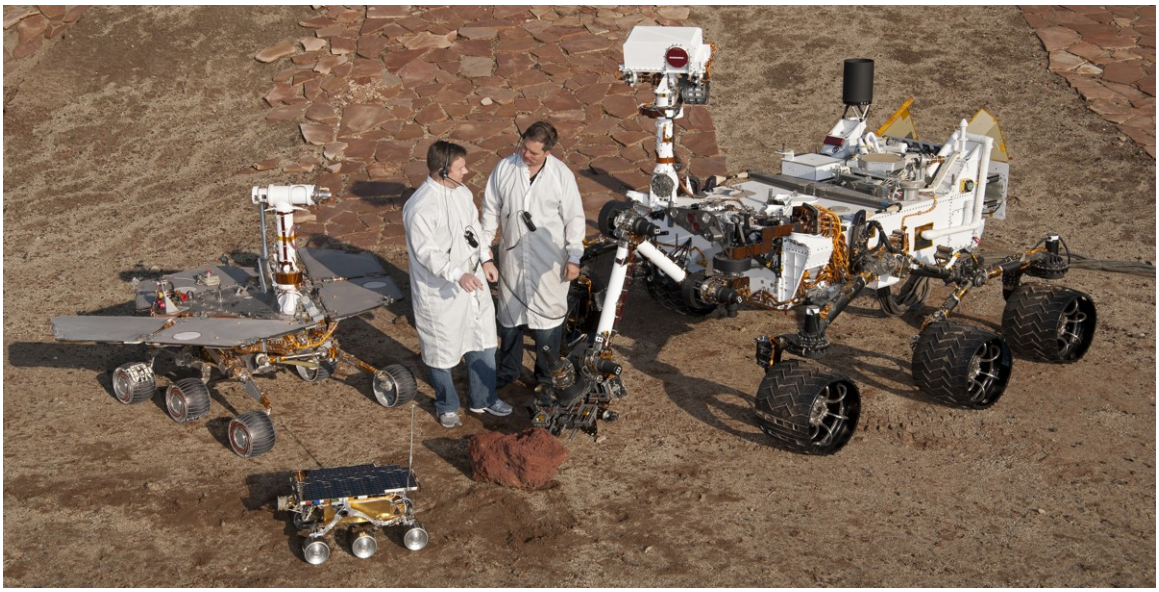

Fig. 3.4. Two Engineers with 3 generations of JPL Mars rovers. The smallest in front is a flight spare from the successful *Pathfinder* mission of 1997. At left is a test rover used for navigational aid in the successful *Mars Excursion Rover* missions of 2004 and continuing. At right is a test duplicate of the *Mars Science Lab*, *Curiosity*, successfully launched on Nov. 26, 2011 and scheduled to land on Mars on Aug. 6, 2012 UT. Further Mars robotic missions have been canceled by the Obama administration. (NASA/JPL photo).

probably under-funded program by government. It is not clear how much funding will be requested for this subsidy, but a total of about $4 billion of new money each year over ten years would have kept *Constellation* on track for a 2015 availability of *Orion* and a 2020 return to the Moon.)

8. **Placing the space program on a more ambitious trajectory.** (Clearly, the President's proposals are not as ambitious as the *Constellation* return to the Moon and Mars exploration program. Rather, the President takes American human space flight out of the calculations of other nations.)

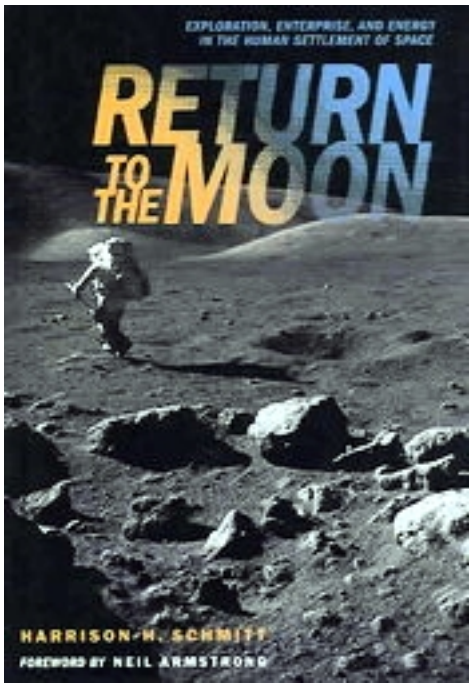

Fig. 3.5. The author's book, published in 2006, discusses at length the costs and economic and defense benefits of mining He-3 and shipping it from permanent lunar mining settlements back to the Earth.

Although many inherent logical, technical, and implementation flaws in the Obama policy are evident, it is important to examine the consequences for the United States if the President's promises could be kept in their entirety:

1. **The United States' human space flight capability will rapidly atrophy and then disappear by about 2020.** With this atrophy would come the rapid disappearance of the psychological geopolitical edge from which we have benefited immensely since World War II and particularly since Neil Armstrong stepped on the Moon.

2. **China will control lunar resources for terrestrial energy and space flight as well as dominate the Settlement of the Moon and eventually Mars.** China repeatedly expresses interest in harvesting helium-3 (He-3) fusion fuel present in the Moon's surface materials. A lunar settlement, sustained by the by-products of helium-3 production, constitutes the most cost and politically effective means of gaining this critical future energy resource. If the Moon comes under China's control, long-term geopolitical reality would be changed in the same way that the Middle East's control of oil dominates our current national security vulnerabilities. (**Figs. 1.3, 3.5**)

3. **Russia will control access to the International Space Station.** Prices per astronaut visit to the Station, including the astronauts of our non-Russian partners, will escalate from the $63 million today to whatever the traffic will bear. After the Space Station must be abandoned due to aging, probably no later than 2025, any future station will be left to China and/or Russia to build, crew, and use. (**Fig. 2.1**)

4. **Europe, Japan, and other nations with limited space capabilities will cut deals with China, India and Russia for space access.** A clear loss of international interest in space and other partnerships with the United States will result.

5. **Without a clear set of space objectives, NASA will be reduced to a Space Science Agency.** Past strong technical and professional synergism with national security will disappear.

6. **Subsidized human space flight development for national space projects will see cost escalation and schedule slips.** If this nebulous alternative to traditional NASA contracting received adequate funding, including needed reserves, then this potential problem might disappear; but, since Apollo, that is too much to expect in modern federal budgeting. Inevitable cost and schedule problems will follow inadequate initial funding, unanticipated or unknown technical issues, requirement and specification creep, and progressive NASA intrusion into design and implementation (**Fig. 3.6**). As taxpayer dollars will fund this effort, cost increases will be driven by the unfortunate and overly risk-adverse nature of mainstream media reporting, and political reactions by the Congress, White House, and NASA bureaucracy.

7. **Inevitable shrinkage and loss of innovation of the aerospace and defense industrial base will occur.** Combined with the Administration's and Congress' under-funding of advanced research, development, and test for national security systems, the lack of funding and focus on specific space objectives will worsen this progressive weakening of our essential development and manufacturing foundations. Congress clearly has the constitutional power to increase or decrease defense-related funding; however, it also has the constitutional obligation to provide for the "common Defence" relative to existing threats. Along with the President, Congress clearly is not addressing existing threats adequately.

8. **Engineering and science education and research will lose another major foundation.** The governmental and academic establishments continually underestimate the importance of national human space flight initiatives in stimulating academic education and research; but it is nonetheless still as real in the minds of young people today as it was after the launch of Sputnik in 1957.

Fig. 3.6. Construction work on the flight test model of the *Orion* MPCV began at the Michoud Assembly Facility on Sept. 9, 2011. (NASA photo JSC2011-E-120357).

In light of these obvious adverse consequences if all the President's promises are kept, and much worse if any are not, why would the President not just budget to properly restart, fund and

manage *Constellation*? Compared to trillions of dollars of other spending he has asked for, this would have added a relative pittance. Would not President John Kennedy, or Presidents Jefferson, Polk, Lincoln, Eisenhower, Johnson, and Reagan, have moved forward in space rather than backward, given the global challenges we face?

The depth of the current Administration's antagonism toward the historical vision of America, as well as toward a preceding President, is unprecedented. The philosophical wedge driven between citizens and their government reaches deeper than any time since just before the Civil War (**Fig. 3.7**). Our national future on Earth, as well as in the ocean of space, requires that this negative view of America, its people, and its future be overturned in upcoming elections.

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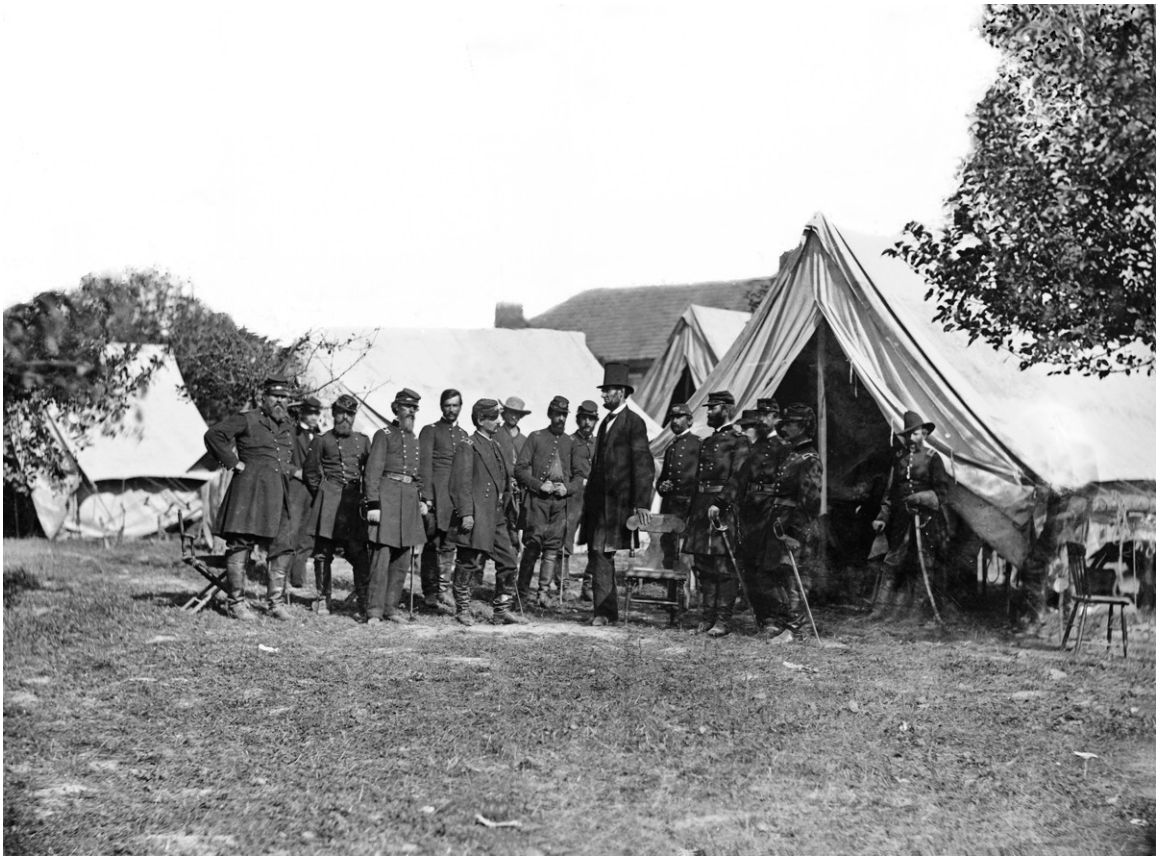

Fig. 3.7. A Mathew Brady photo of Abraham Lincoln with his troops after the Antietam Creek battle on Sept. 17, 1862. Gen. George B. McClellan is 6th from left, and Capt. George Armstrong Custer is standing at the tent at the far right. (Library of Congress, LC-DIG-cwpb-04352, public domain photo).

Chapter 4

America's Deep Space Vision

Settlement of the Moon and Mars versus Asteroid Visits

America's eroding geopolitical stature, highlighted by the July 21, 2011, end to flights of the United States Space Shuttle, has reached crisis proportions. Obama Administration officials now spin the nebulous thought of Astronauts flying many months to an undetermined asteroid in 2025 as an actual "National Space Policy". On the other hand, Republican candidates for President have not yet recognized the importance of international civil space competition in the federal government's constitutional function to provide for the nation's "common defence". Candidates appear to be uninterested in having the United States lead deep space exploration, including the establishment of American settlements on the Moon; or may actually consider Obama's unfocused proposals as being credible rather than realizing that those proposals would transfer geopolitical dominance to China and control of American space transport to Russia.

Although the Bush Administration and Congress did not follow through with adequate funding, at least the 2004 *Vision for Space Exploration* put forth by President Bush and approved by Congress was a legitimate formulation of a National Space Policy.

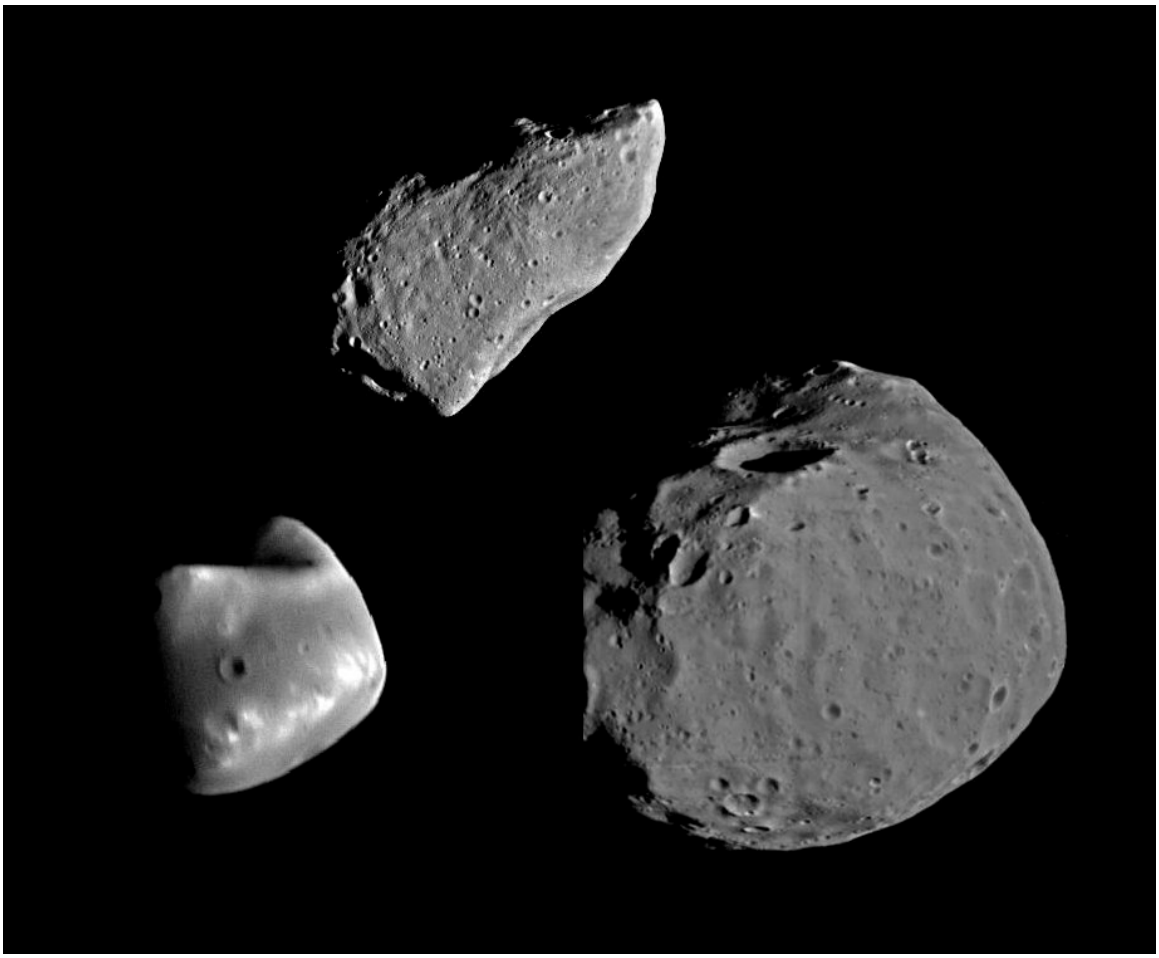

Fig. 4.1. (*top*) The asteroid Gaspra. (*bottom*) The Martian Moons, Deimos (*left*) and Phobos (*right*). All objects are scaled. Phobos has been suggested as a target for a manned landing. (NASA photo composite)

It implicitly recognized that America's best security interests would not be served by being dependent on Russia for access to space or by ceding to China both deep space exploration and access to space resources. Unfortunately, with the acquiescence of Congress in 2010, President Obama cancelled what had become known as NASA's *Constellation Program*— a program designed to maintain and expand America's hard-won position as the world's leading space-faring nation. Meanwhile, China is building a major new deep space launch facility in Hainan and developing new rockets and spacecraft to take over the exploration of the Moon from the United States and the free world.

A properly funded *Constellation Program*, would have returned Americans and their partners to the Moon, begun creation of the infrastructure and operational capabilities to settle there and go to Mars and beyond, and provided a timely replacement for the aging Space Shuttle. Assuming that the Obama Administration actually requests authorization and budget authority to implement a human mission to a near-Earth asteroid (NEO), including the required heavy lift rockets, specialized spacecraft, operational

Fig. 4.2. The *Phoenix* Polar Lander photographed by the Mars Reconnaissance Orbiter (MRO) on May 28, 2008 in the process of landing on Mars. The 10 km diameter Heimdall Crater in the background is actually 20 km beyond *Phoenix* outlined by the black square. The inset at bottom left is an enlargement of that square. (NASA/Jet Propulsion Lab-Caltech/University of Arizona photo PIA10705).

infrastructure, and hiring authority, how would such a mission stack up relative to returning to the Moon?

Mars Mission Preparation

Heavy Lift Launch Vehicles & Operational Experience. Both repeated trips to the Moon and an occasional asteroid mission require an Apollo Saturn V-class, heavy lift rocket to escape the Earth's gravity-well. Lunar exploration and an eventual commercially supported lunar settlement, however, would give a much greater, long-term return on investment of the same taxpayer dollars. Operational experience and multi-generational training gained at a Moon base or settlement is far more relevant to exploration and bases on the gravitationally similar Martian surface (3/8 gravity versus 1/6 gravity) than a mere "rendezvous and docking" with a near zero gravity asteroid.

Physiological Countermeasures. Understanding of the physiological countermeasures to space radiation exposure necessary for travel to Mars can be gained on the Moon sooner and at much lower risk with the added benefit of the future production of lunar water for radiation shielding. Of particular importance is determining whether the Moon's one-sixth Earth's gravity triggers physiological re-adaptation after astronauts experience the adverse effects of prolonged exposure to zero gravity during travel to Mars. This *cannot* be determined on a near zero-gravity asteroid. (The complexity and cost of physiological countermeasures on a Mars mission is critically dependent on knowing if this re-adaptation occurs in one-sixth gravity or not.)

Operational Approaches. Operational approaches for Mars landing and exploration, such as communications delays and lander concepts (**Fig. 4.2**), can be evaluated and simulated realistically during lunar operations but not during an asteroid mission.

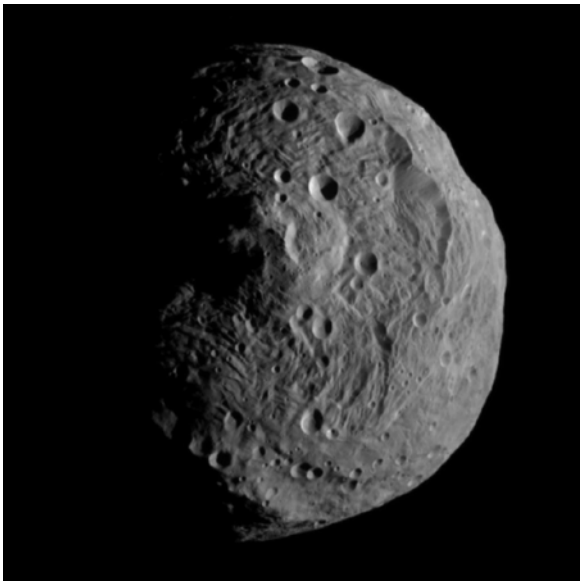

Fig. 4.3. The asteroid Vesta photographed by the *Dawn* spacecraft (NASA photo PIA14313).

Similarly, layered engineering defenses related to planetary biological protection and dust mitigation on Mars can be fully tested at a lunar base or settlement but not during a short visit to an asteroid. In addition, Mars atmospheric entry and descent vehicles and procedures can be tested in the low-density upper atmosphere of Earth more logically as an adjunct to a lunar exploration and settlement program than as part of a single purpose mission to an asteroid (**Fig. 4.2**). Entry, descent and landing by large spacecraft through the thin but operationally significant Martian atmosphere are challenges for which there currently are no known engineering solutions.

Commercialization of He-3 and other Lunar Volatiles. Commercial access to the fusion energy resource of the Moon, Helium-3, also opens the potential of interplanetary fusion rockets that would allow continuous acceleration and deceleration between Earth and Mars, thus lowering travel risk to humans exploring deep space. Further, the Helium-3 production by-products of hydrogen, oxygen, and water can significantly lower the cost and risk of deep space travel and space station re-supply. A one-time visit to an asteroid provides no technically or commercially viable alternatives in this arena.

Reduction of Risk for Mars Missions. Programmatically, the transition from a lunar exploration and commercially supported settlement initiative to one focused on Mars landing and exploration would be more straightforward than a one-shot asteroid visit. Lunar exploration overall imposes much lower risk to explorers and mission success than a brief visit to an asteroid and is far more applicable to the reduction of the risks of Mars transit and exploration.

Science

Solar System History. Far more new science related to the early history of the Earth and other planets can be gained through renewed lunar exploration, sampling and analysis than similar activities related to an asteroid. Most asteroid science has been and can be gained from meteorites and multi-spectral imaging by the Hubble and future Webb telescopes. Robotic missions to asteroids, like the *Dawn* spacecraft now at Vesta (**Fig. 4.3**), can answer most remaining questions about asteroids, particularly if sample returns are implemented in the future. Finally, the history and evolution of the Sun can be investigated extensively by studies of the long-term variations in solar wind composition and effects recorded in over-lapping layers in the lunar regolith (impact-generated rock debris). Such studies would not be productive on an accessible asteroid.

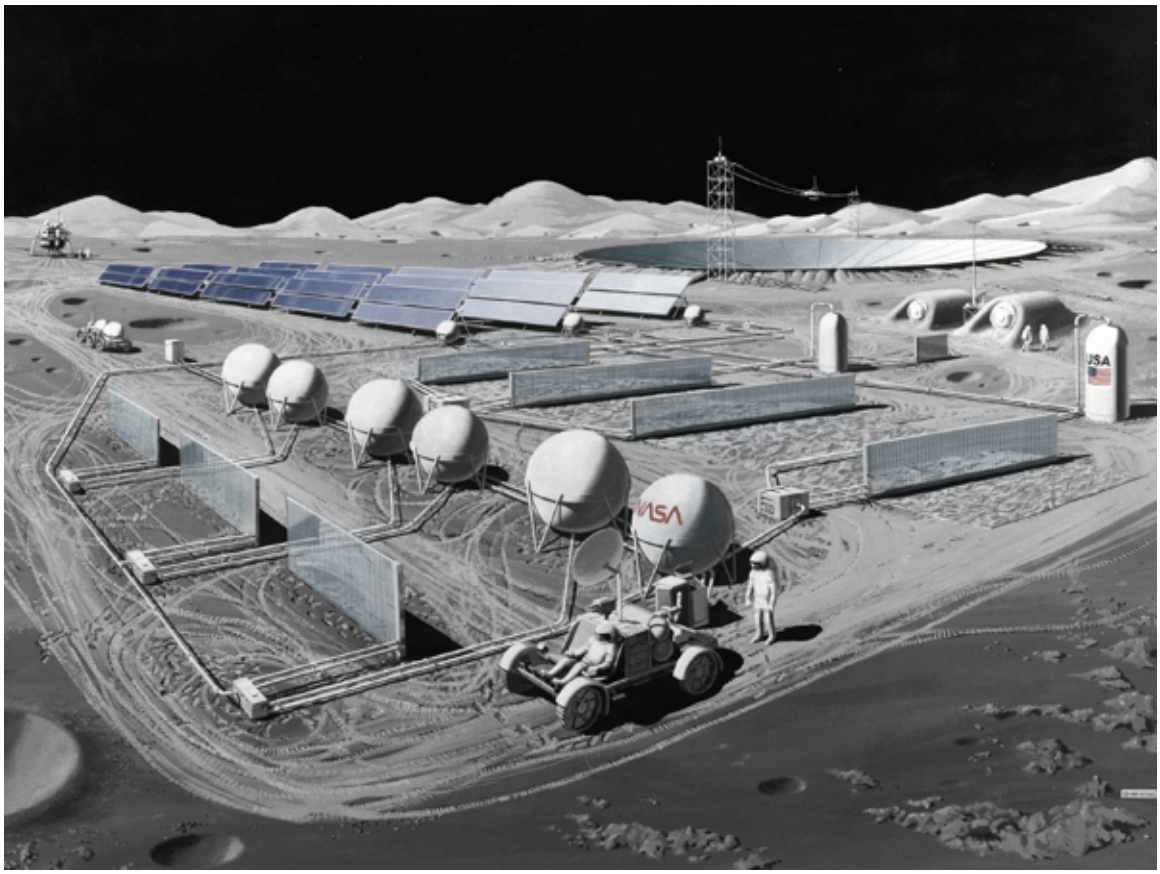

Fig. 4.4. An artist's early concept of a radio telescope and supporting solar power station on the Moon's far-side. The radio antenna design is fixed, similar to that at Arecibo in Puerto Rico. (NASA photo).

Astrophysical, Earth and Solar Observatories. A far-side lunar observatory shielded from both solar and terrestrial radio noise would be a boon to observational astronomy; however, no synoptic observational science of other parts of the universe, particularly in radio frequencies (**Fig. 4.4**), can be conducted in a practical way from an asteroid. Also, a multi-spectral polar Earth observatory at a lunar pole, with simultaneous solar observation, would establish long-term, continuous, full sphere monitoring of weather and climate as well as providing a coherent means of synthesizing more detailed but much less synoptic data gathered from near-Earth satellites. Asteroids, of course, provide no such climate, weather and atmospheric physics-related opportunities (**Fig. 4.5**).

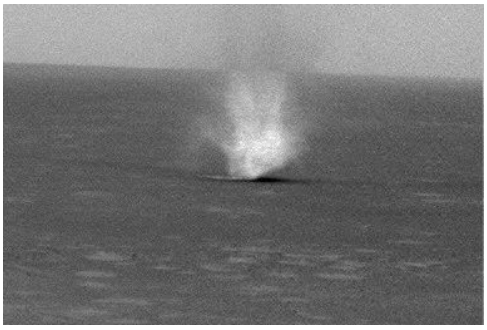

Fig.4.5. A dust devil on Mars photographed in Gusev Crater by the *Spirit* rover. One of many dust devils photographed in motion by the rovers similar to those seen spinning in the American Southwest deserts (NASA/JPL photo).

Resources and Commercial Opportunities

Commercialization of He-3 and other Lunar Volatiles. Terrestrially valuable energy resources, that is, Helium-3 fusion fuel and solar energy, exist on the Moon a short distance from

the Earth, but are not a practical option for shipment or transmission (**Fig. 4.6**) from an occasional passing asteroid. In this regard, much is known about the commercial parameters of potential lunar resources; however, little is known about the concentrations, physical and chemical form, or ease of access of potential resources on NEO asteroids. Also, gravity can assist in resource extraction and processing on the Moon but not on a near zero gravity NEO asteroid. Due to communication delays, possible resource mining and processing on an asteroid must be autonomous for relatively short intervals with only periodic human command input. This is unlike resource mining and processing on the Moon where it can be continuous either by human crews or by tele-robotic operation from Earth.

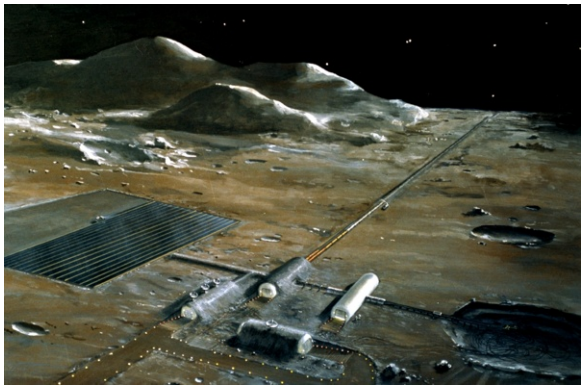

Fig. 4.6. A possible means of effectively launching He-3 and other volatiles mined on the Moon into lunar orbit for pickup and delivery to Earth. This artist's concept shows a "mass driver", i.e., an electromagnetic device designed to accelerate canisters up to orbital velocity. (NASA photo S78-23252).

Economics of Lunar vs. Asteroidal Resources. Unlike the available analyses for the energy resources of the Moon, the required financial envelope for potential commercialization of asteroid resources is completely undefined with major questions as to technical practicality. Once Americans permanently established themselves on the Moon, available lunar resources include readily accessible and relatively low cost consumables necessary for operations in space, including water, hydrogen, oxygen, helium, carbon and nitrogen compounds, and food products. Various solid elements and oxides also could support manufacturing of products for use at a lunar settlement or elsewhere in space.

Tourism. Lunar tourism will eventually become a viable commercial opportunity once launch and support costs are compatible with the heavy lift launch costs required by commercial energy production (about $3000 per 220 pounds); whereas, asteroid tourism, as well as asteroid mining, will remain the stuff of science fiction for the foreseeable future.

Launch Opportunities and Mission Operations

Frequency of Access. For hypothetically possible missions to near-Earth asteroids (NEOs) that cross the orbit of the Earth, very few asteroid rendezvous opportunities exist over time versus essentially continuous opportunities for the Moon. Time for human asteroid exploration will be short because of increasing energy requirement to return as the asteroid moves away from Earth. On the other hand, stay-times on the Moon have no such constraint.

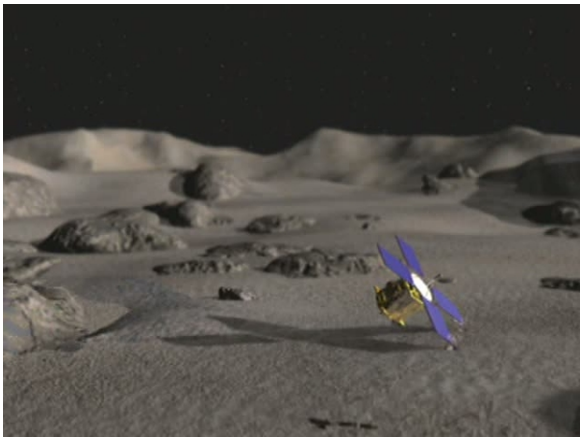

Fig. 4.7. A simulation of the *NEAR-Shoemaker* spacecraft landing on the asteroid Eros. Not designed to land, the Johns Hopkins engineers gently put it on the surface as its last mission achievement. The spacecraft in the animation has just made a small bounce covering the solar panel tips with dust and leaving two small craters. (NASA/JHU-APL photo).

"Rendezvous and Docking" at an NEO. Because of the near zero gravity of an asteroid, an asteroid mission is a "rendezvous and docking" mission requiring very difficult operational procedures (**Figs. 1.5**, **4.7**) in order for astronauts to explore and sample the materials found there. Asteroids in orbit between Mars and Jupiter, such as Vesta currently being imaged by *Dawn* (**Fig. 4.3**), require prohibitively long flight times for human visits until new, much more rapid propulsion technology exists.

Education

Stimulation of Learning and Ambition. An asteroid mission would provide flight opportunities to only a few astronauts and thus limit the interest of children and young people in preparing for careers related to space and technology. In contrast, an indefinite commitment to lunar exploration and commercially supported settlement offers a permanent set of career opportunities as a stimulus to STEM education and economic innovation throughout the country. Importantly, the Moon is a destination children and young people can see with their own eyes in the nighttime sky. That sight would become even more inspiring with the knowledge that men, women and families are living and working on the Moon as those youngsters look up to the sky…and to their futures… while other children look up to see Earth.

Leadership and National Security

Lunar exploration and settlement as a precursor to missions to Mars (**Figs. 4.8, 4.9, and 4.10**) and beyond would be far more productive and practical than a onetime mission to an asteroid. A return to the Moon also constitutes much less risky national policy in the still risky business of deep space exploration.

All public indications are that our Cold War II adversary, China, includes space in its vision of geopolitical dominance as well as in its plans for technological, educational and energy resource advancement. China's announced long-term space policy is focused on the Moon. The United States stands as the only viable bulwark of freedom on the planet. If the Federal Government ignores this challenge, as well as the commercial energy resources of the Moon and its role as an essential steppingstone to Mars, its constitutional duty to provide for the security of America will be fatally compromised. An asteroid mission constitutes an unacceptable diversion in our broader responsibility to future generations.

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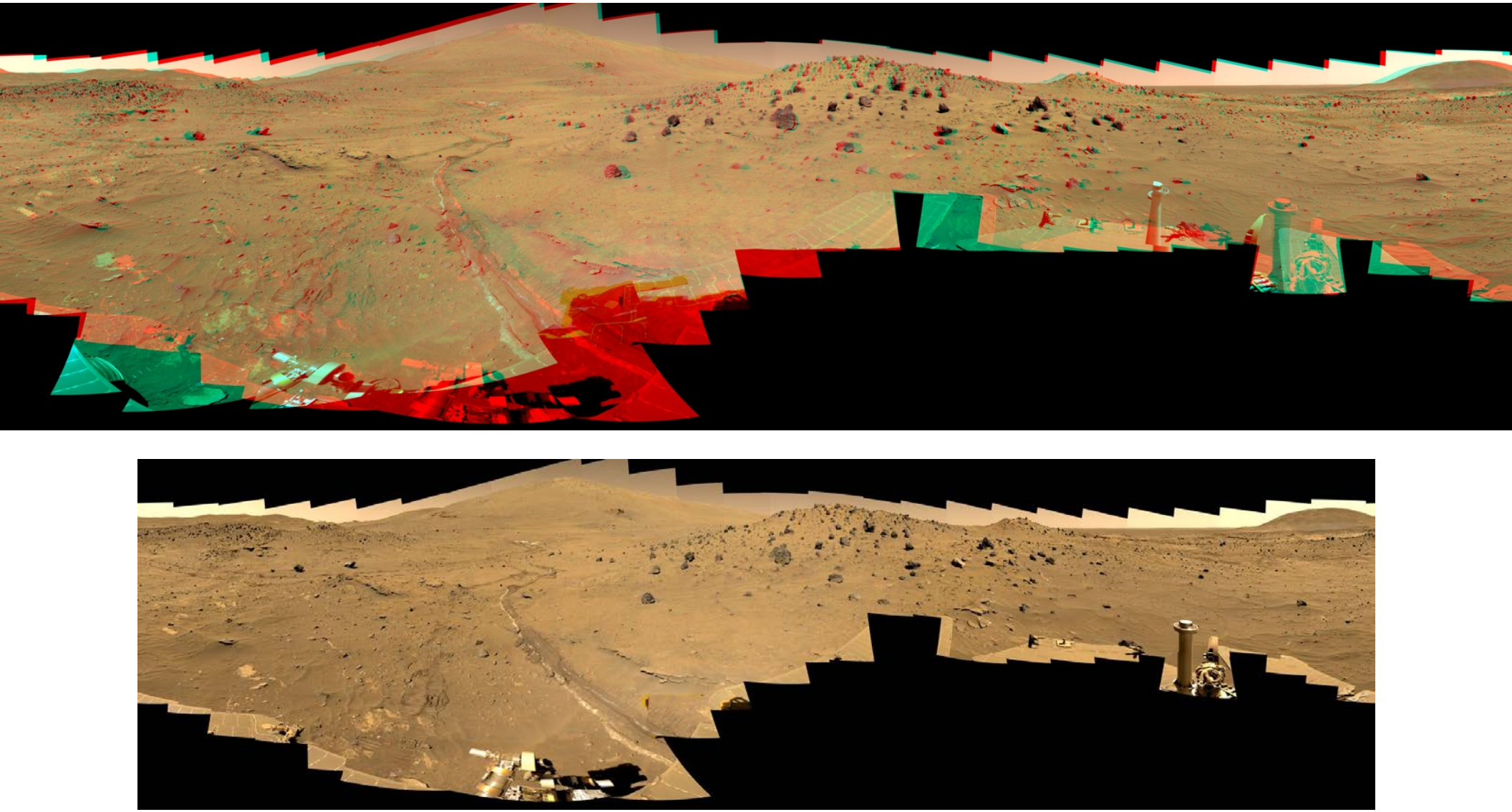


Fig. 4.8. One of the best 3D anaglyph pans by the ***Spirit*** rover in Gusev Crater on Mars. The rover is located at its winter parking site called 'Winter Haven'. The hill to the left of center in the distance is 'McCool Hill', named in honor of the Columbia shuttle astronaut, William C. McCool. On its right flank is a feature called 'Oberth' after the German rocket visionary, Hermann Oberth. This feature is likely a hydrothermal fumerole, and is shown in more detail in **Figs. 4.9** and **4.10**. (NASA/JPL photos PIA01905 (*top*) and PIA01907 (*bottom*), at http://photojournal.jpl.nasa.gov/catalog/PIA01905; etc. for PIA1907.)

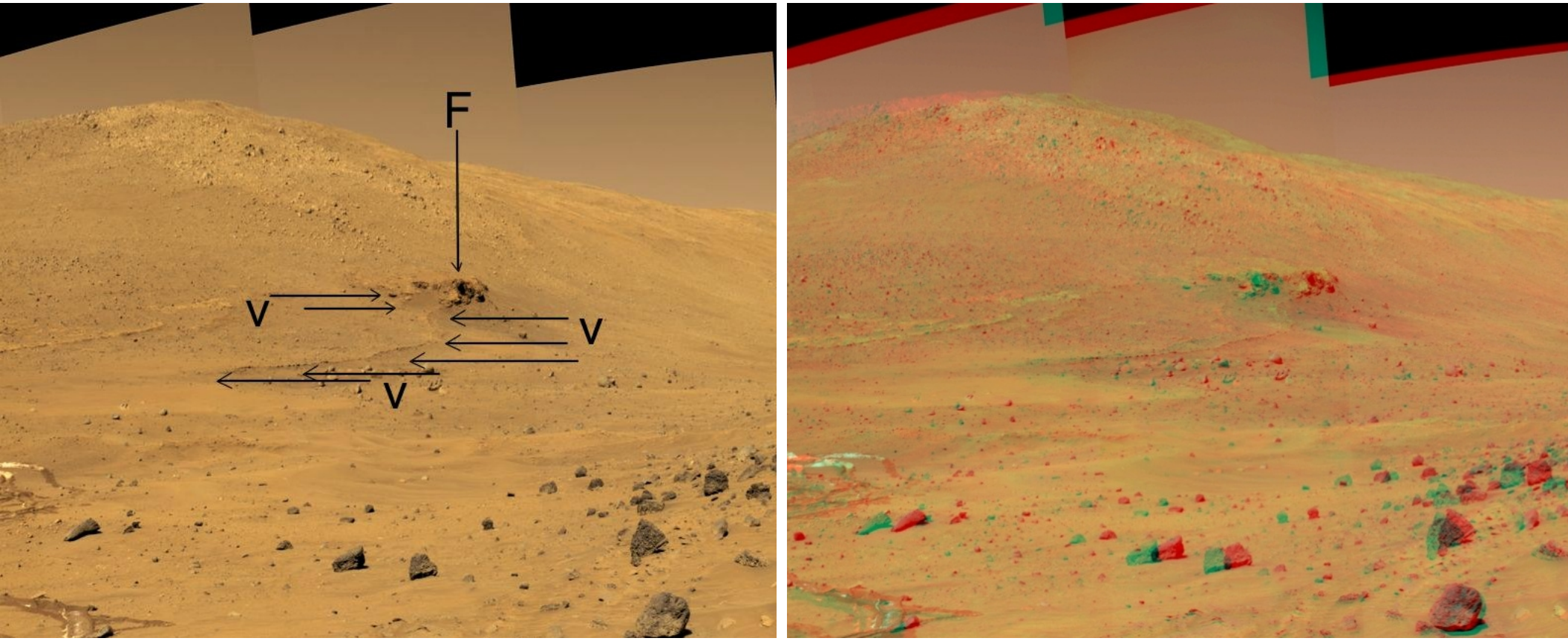


Fig. 4.9. McCool Hill and Oberth Fumerole in greater detail. '**F**' marks the position of the probable fumerole and the '**v**'s denote sinuous trails issuing from collapsed vents near the fumerole (*left*). The lower trail can be clearly seen in the 3D anaglyph at right as having been sculpted by water that flowed from the vent. The upper trail to the left of the left **v** is delineated by the lighter-colored sinuous layer, but the trough is not so apparent. This whole area has been characterized by Squyres and associates as having been formed by hydrothermal activity. (From NASA/JPL photos PIA1907 and PIA1905, respectively).

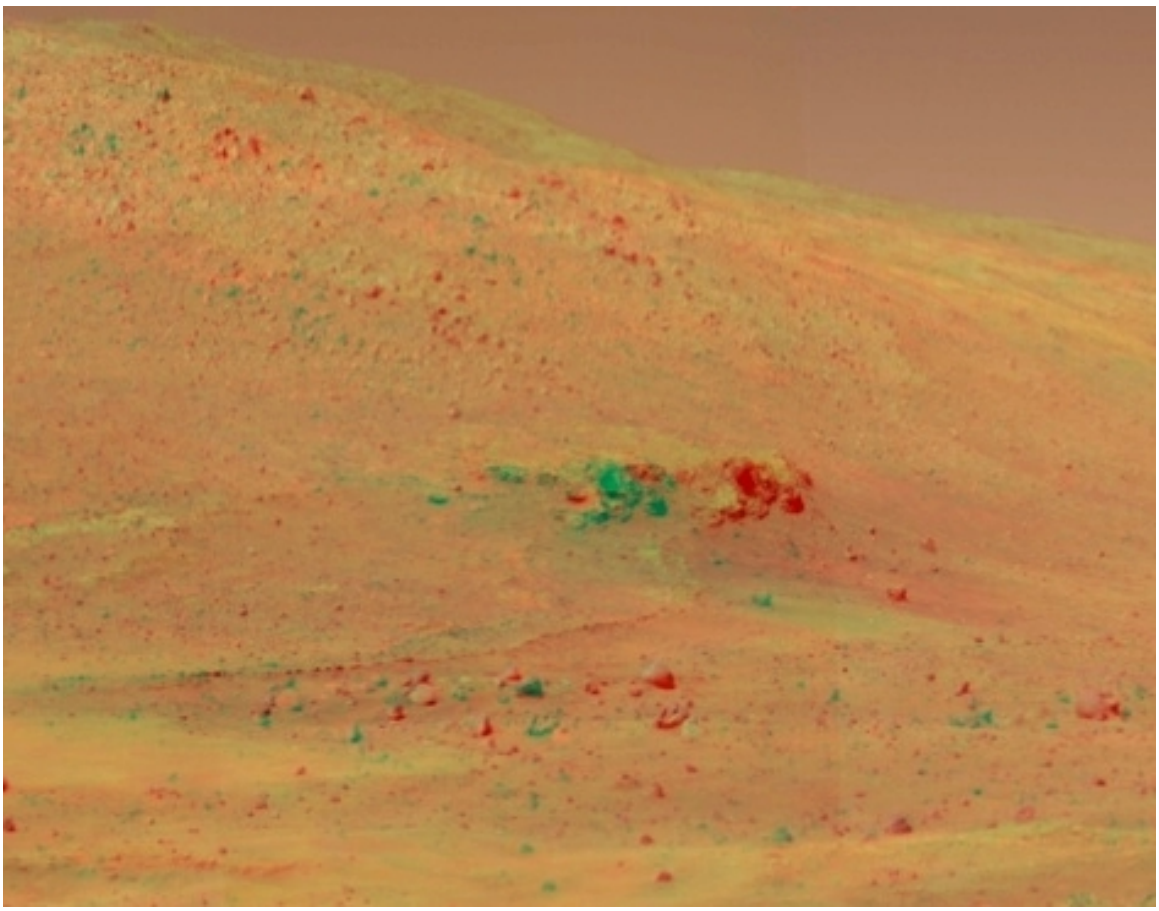
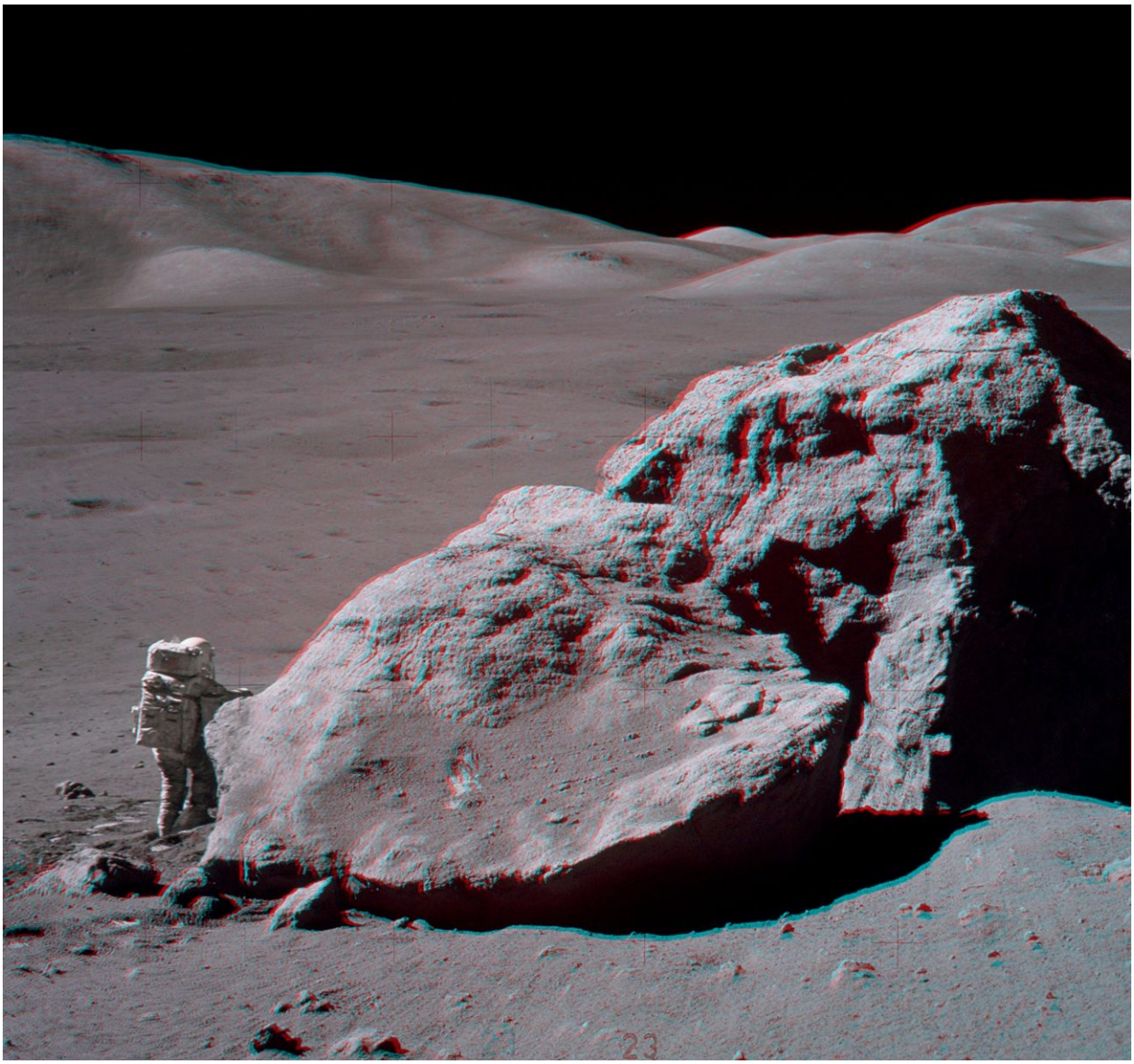


Fig. 4.10. 3D anaglyph showing an enlarged view of the fumerole, and especially the carving of the lower sinuous trench by the action of flowing water (cf. **Fig. 4.9**).



The author investigating the large Split Boulder at Station 6 on the slope of the North Massif

SCIENCE AND EDUCATION

CHAPTER 5

Monticello where Thomas Jefferson successfully pursued science and the useful arts (engineering)

Science and the Useful Arts

Constitutional Justification for Selected Federally Funded Research

The Founders understood the importance of science and technology in the long-term future of the United States. Without science and engineering advancement, in the face of advancement by others (**Fig. 5.1**), America could not compete with our ideological and economic challengers. Imagine our world if Nazi Germany had atomic weapons or the former Soviet Union had developed nuclear submarines or had reached the Moon before America.

The Founders demonstrated their understanding of the critical role of individual creativity in American progress by specifically delegating constitutional power to Congress "To promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and

Fig. 5.1. The Avro Canada *CF-105 Arrow*, arguably the most advanced jet interceptor of its time, canceled in 1959 by the Canadian government, forcing the emigration of highly-skilled engineers south to the U.S.A., and subsequent hiring by NASA and space-related companies. (Canadian Department of National Defence photo)

Discoveries." (Article I, Section 8, Clause 8). The economic and personal incentives for Americans to invent and publish have grown from this remarkable clairvoyance.

The Founders did not intend for the "Science and useful Arts" Clause alone to give broad constitutional justification for federal funding of scientific and technology research. Clearly, the Founders only meant for this Clause to apply to the fruits of research activities by individuals. Federal protection of intellectual property by copyright and patent law flows from this constitutional power.

Scientific and technological advancement funded by the Federal Government has a strong constitutional foundation in the Preamble's mandated promotion of the "common Defence and general Welfare." Specifically, the Congress has enumerated powers in this regard in Article I, Section 8. Implementation of those powers logically requires federal involvement in science and engineering research, as follows:

1. Clause 5 – fixing of "the Standard of Weights and Measures."

2. Clause 6 – detection and prevention "of counterfeiting."

3. Clause 7 – establishment and implied improvement of "post Roads" and, by logical extension, more modern means of delivering communications.

4. Clause 8 – evaluation of "Discoveries" in "Science and the useful Arts" for the purpose of "securing…exclusive rights" for "Inventors."

5. Clauses 12 and 13 – "support" of "Armies" and maintenance of "a Navy" (**Fig. 5.2**) and, by logical extension, future forces necessary to the "common Defence" (**Fig. 5.1**)

6. Clauses 15 and 16 – support of the "Militia" and their use to "repel Invasions."

Fig. 5.2. An *Aegis BMD* missile test launch (U.S. Dept. of Defense photo).

Clause 18 of Section 8 further gives Congress the power "to make all laws

necessary and proper for carrying into Execution the ***foregoing*** Powers, and ***all other Powers vested by this Constitution*** in the Government of the United States, or in any Department or Officer thereof." It should be noted by the added emphasis in bold that this Clause limits Congress to only the execution of the Government's constitutionally ***enumerated*** powers.

Fig. 5.3. A PAC-3 missile intercepting an incoming test ballistic missile. (U.S. Dept. of Defense photo).

Relative particularly to national security, clear Article I constitutional support therefore exists for federal sponsorship, directly or indirectly, of science and technology research that applies to the following:

1. Weapons of all kinds that can effectively support the functions of the armed forces.

2. Natural, agricultural, and other resources required for national security.

3. Military logistics technologies and transportation systems, including national highways, waterways, rail systems, and aeronautics and space systems.

Fig. 5.4. The *Patriot Advanced Capability-3* (PAC-3) missile test launch (U.S. Dept. of Defense photo).

4. Nationally critical energy systems and the basic sciences that underlie such systems the development of which lies beyond the capabilities of the people acting in their private capacities (**Figs. 3.5, 4.6**).

5. Potential future military technologies such as space and missile defense, external threat sensing, cyber attack, and so forth (**Figs. 5.4, 5.3**).

6. National border protection and enforcement.

7. Medical research applicable to the maintenance of a healthy population from which soldiers are drawn as required and to the treatment of wounded soldiers and veterans.

8. Climate and weather as they impact national security.

Under Article II, the Executive also has enumerated powers that require support from science and engineering research but which require budgetary concurrence by the Congress and, of course, congressional approval of necessary levels of supporting taxation or debt (**Figs. 5.5**, **5.6**). Article II, Section 2, Presidential powers include:

1. Clause 1 – acting as "Commander in Chief of the Army and Navy…and of the Militia…when called into the actual Service of the United States…".

Fig. 5.5. The successful launch of the *Ares I-X* rocket on October 28, 2009. This rocket was the first step in the development of the *Ares I* and *Ares V* launch vehicles. The *Constellation Program*, of which it was part, was cancelled by President Obama 3 months later in 2010. (NASA photo).

Fig. 5.6. A comparison of the *Ares I* (right) with the heavy-lift *Ares V* launch vehicles (left). Both rockets have been canceled, although data from the launch of *Ares I-X* (**Fig. 5.5**) may be used for developing alternative rockets. (NASA photo).

2. Clause 2 – negotiating and making "Treaties" on which the Congress must provide "advice and consent."

Also under Clause 2 of Article II, Section 2, Presidents have the power to appoint "…by and with Advice and Consent of the Senate…all other Officers of the United States…whose Appointments…shall be established by Law…" including individuals responsible for federally supported research in science and technology. Any appointments with significant executive powers not submitted to the Senate for confirmation, such as President Obama's "czars" are clearly unconstitutional.

Although the Congress, under Article I, Section 8, Clause 18, can legislate both responsibilities and constraints on the execution of the President's Article II power of Appointments, Article I limits Congress to its own enumerated powers. Constraining Congress even further, the Founders did ***not*** provide in Clause 18 for Congress to go beyond enumerated powers in defining the specific responsibilities of Presidential Appointments "established by law". Science and technology research necessary to support the authorized functions of Departments and Agencies, therefore, must adhere to the limits of the enumerated powers of Congress; that is, it would be

unconstitutional for Presidential appointees to be given budgetary authority to undertake activities that Article I does not state as being within the power of Congress to authorize or fund.

How, then, can "Appointments" in the Executive be given clear authority to carry out their constitutional responsibilities? First of all, through the Oath of Office, the President gains significant latitude in directing some such officers to assist him to "preserve, protect and defend the Constitution of the United States." This constitutional discretion expands further in the Article II, Section 2, Clause 1, designation of the President as "Commander in Chief of the Army and Navy of the United States, and of the Militia of the several States, when called into actual Service of the United States…" Departments such as Defense, Homeland Security, and Justice, as well as the Intelligence Agencies, can be managed directly by the President, but only within the bounds of the Bill of Rights and other Constitutional Amendments. In this, the President only needs Congressional concurrence on overall budgets.

Budget concurrence creates critical balance of power limitations on the President as Commander in Chief but cannot, constitutionally, be used to prevent Presidents or the Congress from providing for the "common Defence" in any significant way**.** Both entities share this mandated function. For not carrying out that mandate, Presidents can be impeached and Members of Congress can be removed in their next election cycle.

Article II, Section 2, Clause 1, further expands Presidential Executive power by stating "he may require the Opinion, in writing, of the principal Officer in each of the executive Departments, upon any Subject relating to the Duties of their respective offices…" This language indicates that the Founders expected Presidents to exercise significant control over the activities of all Executive Departments and, by extension, future Agencies that might be created by law.

The fact that the Constitution does not define the functions of any Executive Department, outside those implicit in enumerated powers, indicates an intent that this definition would be left to the interplay between the Congress and the Office of the President. The need for the Executive to deal with national defense and matters of state, treasury, commerce, law enforcement, and postal service derives from Articles I and II. The Founders, on the other hand, intentionally created what they hoped would be a balancing tension between the Executive and the Congress through Presidential executive power being moderated by Congress' power over the purse and specific enumerated legislative powers.

The President, with funding concurrence by the Congress, therefore has significant discretion in assigning science and technology research duties to federal Departments and Agencies so long as Congress can constitutionally fund their implementation. Development of weapons and intelligence gathering systems and systems that support the armed forces overall are obvious examples of the exercise of this constitutional discretion. Persuasive constitutional arguments also can be made for federal support of science and technology research in medicine, agriculture, energy, and natural resources based on the specific applicability to national security of research projects in these arenas.

Fig. 5.7. Part of the Superconducting Super Collider complex built near Waxahatchie, TX as it appeared deserted in 2008. It would have been the largest and most energetic particle accelerator in the world with a ring circumference of 87 km and an operating energy of 20 TeV per proton. The project was canceled in October, 1993 amidst controversial budget problems. (Public domain photo by Magnus Manske).

An increasingly healthy population and the obvious need for indigenous supplies of food, energy, and raw materials provide adequate justification for most of the research activities of related federal Departments. These arguments find strong support in history and in consideration of possible future national security threats and the need for improved and more diverse means of meeting those threats.

The Constitution, on the other hand, does not empower the Congress to provide funding for, nor can the President direct, research that does not have specific applicability to powers enumerated in Articles I or II. This fact calls into question the constitutionality of research on societal, economic, cultural, demographic, and educational issues that have no direct relationship to national security or constitutionally required congressional redistricting and that could be carried out through privately funded institutions, associations, cooperative State initiatives, and businesses rather than by the federal government. The 10th Amendment relegates decisions on the conduct of such soft research to the people or the States.

Fig. 5.8. A duplicate of the Golden Spike that joined the Union Pacific and Central Pacific Railroads on May 10, 1869 forming the first transcontinental railroad. (Public domain photo by Neil916).

Constitutional rationale for "big" science and technology projects that have costs (**Fig.** 5.7), time commitments, and national security implications and lie beyond those addressable by the private sector alone lies in their tangible contributions to the implementation of the Article I powers of the Congress and the Article II powers of the President. Since the nation's founding, federally supported or managed big science and engineering efforts have contributed to national defense or to treaty enforcement. Notably, such projects include canals, locks, dams, and levees beginning in the early 1800s; agricultural research through Land Grant academic institutions created in 1860s and 1890s; the Trans-

continental Railroad in the late 1860s (**Fig. 5.8**); construction of the Panama Canal at the turn of the 20th Century; aeronautical research that began early in the 1900s (**Fig. 5.9**); continuously upgraded defense and reconnaissance systems since the 1940s; the Manhattan Project of the 1940s; development of a Nuclear Navy and related power systems, communication satellites, and the Interstate Highway System in the 1950s; and the Apollo Moon-landing Program of the 1960s.

Even though strong constitutional support exists for significant federal funding of science and engineering research, the justification for such support becomes blurred relative to big and small, pure science projects exploring the edges of our understanding of nature. Although difficult to quantify, the constitutional rationale for selective support of pure scientific research lies primarily in the stimulation of educational initiatives that train the scientists and engineers that ultimately serve more direct constitutional functions, particularly national security.

Unfortunately, the once bright future for both federally and privately funded science and technology research has dimmed in the United States. Mismanagement of federal projects is endemic. A federal attack on private academic and research institutions has commenced through unconstitutional regulatory interference. Further, unless the next Congress and the next President contain and reduce the national debt and the cost and reach of both entitlements and unnecessary regulations, remaining taxpayers will have little money left to fund future research no matter how important and constitutional.

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Fig. 5.9 The 4th flight of the Wright brothers at Kitty Hawk, NC on Dec. 17, 1903 ended in a crash! The forward elevators are broken. The first flight set the record. (Library of Congress LC-DIG-ppprs-00614).

Chapter 6

WWII OWI job recruiting poster No. 55 (1943) by magazine illustrator George Rapp

Lack of Private Research Funding

The Fault of Congress and Academia

World War II changed the face of learning for those Americans who choose to enter college or university. The life and death necessities of the War period and the subsequent Cold War challenge of the Soviet Union brought unprecedented levels of defense-related federal funds into private and State-run institutions of higher learning and research. In addition to necessary federal requirements on how these dollars could and should be spent, there came increasing regulatory controls on institutional management largely unrelated to defense needs. The federal reach extends to employment, environment, internet services, institutional financial activity, financial aid and student data, campus security, and equity in athletics to name only a few areas now under the federal thumb.

Fig. 6.1. Entrance to Virginia Polytechnic Institute on Alumni Mall. The bridge connects Torgersen Hall (*left*), the Advanced Communications and Information Technology Center, with Newman Library (*right*). The bridge is also the library reading room and study hall for students. The State University has long maintained co-op working programs with industries throughout the South in which students alternate work semesters with study semesters, especially valuable in engineering fields. (Photo by EpicV27).

Since World War II, the private sector's interest in supporting students and research at colleges and universities has been discouraged by the increasingly anti-free enterprise biases of faculty and administrators. The real incentives for private funding of advanced education remain strong, however, primarily in the development of future, high quality employees and potential exclusivity to research results that give a competitive advantage in the supporter's field of interest. Unfortunately for students and the country, the attitude that "industry money is dirty money" infects most faculty and administrators in spite of the obvious long-term benefits to students and the nation. Government agencies, colleges, and universities continue to drive away this major potential source for revitalization of advanced education rather than working with the private sector to develop a mutually acceptable and beneficial framework for private funding.

To make matters worse, President Lyndon Johnson's Great Society's Higher Education Act of 1965 instituted federal student loan guarantees and grants (Pell Grants), bringing even greater federal regulation of how universities and colleges run their institutions. This Act stands as unconstitutional on its face under the enumerated restrictions of Article I, Section 8, and even more specifically under Clause 18 of Section 8. Clause 18, the "Necessary and Proper" Clause, specifically limits Congress' lawmaking to powers vested in the Constitution. No enumerated power to deal with education can be found in Section 8 or anywhere else in the Constitution.

The Higher Education Act of 1965 further violates equal protection provisions of the 5th and 14th Amendments by limiting those who qualify for educational assistance. The Act also ignores the Constitution's clear delegation of education powers to the States via the 10th Amendment that reads: "The powers not delegated to the United States by the

Constitution, nor prohibited by it to the States, are reserved to the States respectively, or to the people."

Fig. 6.2. U. S. Department of Education, an unconstitutional usurpation of 9th and 10th Amendment powers reserved to the people and to the States. (Public Domain photo).

The Obama Administration has made this disastrous situation even worse. The Secretary of Education, Arne Duncan, and Congress now exert national socialist control over students and their institutions by having eliminated the efficiencies and taxpayer default protection the private financial sector previously provided in the making, processing, and monitoring of student loans. The Administration also proposes to make Pell Grants a perpetual entitlement that will add hundreds of billions of dollars to our nation's unsustainable debt.

The previously mentioned 5th and 14th Amendments' provision of equal protection of the law inherently makes unconstitutional any government discriminatory takeover of societal functions that can be accomplished by sound business practices. Student loans, health insurance, and home mortgages illustrate current cases in point. Such takeovers also violate the people's natural, intensive rights under the 9th Amendment by the government assuming power over individual decision-making on the education of individuals. History further shows that the total cost in taxes to pay for government inefficiencies and subsidies, as well as loan defaults, will be far greater than reasonable profits and employment gained within the private financial sector.

Clearly, a public interest exists in targeted federal funding of education and research in State and private institutions in times of national security threats. Even the Government's necessary reaction to the educational demands of the Cold War, particularly after the 1957 orbiting of *Sputnik I* by the then Soviet Union, exacerbated the loss of the States' and private control over research institutions. Unfortunately, there has been willing compliance by recipient institutions with an increasing loss of educational liberty. Targeted national security funding, standing alone, can be constitutionally justified under the joint legislative and executive powers for national defense enumerated in Articles I and II. The reservation of educational powers to the States and the people by the Tenth Amendment, however, logically requires that, in contracting for research, the federal government cannot constitutionally regulate the management of the recipient institutions beyond the audits and record keeping required for overseeing the successful, fraud-free, outcome of the funded research. Any

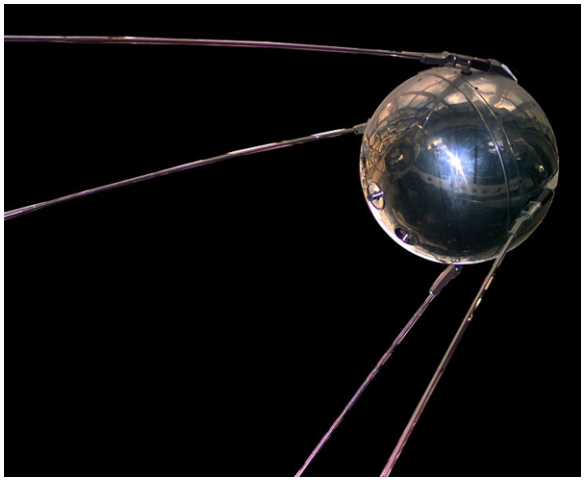

Fig. 6.3. Replica of *Sputnik I* in the U.S. National Air & Space Museum. (NASM photo).

Fig. 6.4. Lockheed Martin/Boeing F-22 Raptors, rated the most advanced and superior stealth fighters ever produced. The program was terminated in 2010 after 195 were built. (U.S.A.F. photo).

regulation or coercion outside these bounds clearly is unconstitutional. No national security claim can be made over the way an institution runs its normal educational business just because tax dollars fund students or research at that institution.

Factors other than constitutional over-reach also corrode higher education, and the growing gap between the supply and the demand for highly educated talent clearly undermines the nation's ability to compete internationally in development of commercial and national security technologies. For instance, the sad quality of pre-college education in math and science has steadily reduced undergraduate student interest in engineering studies. If a student never developed the skills in math or physics necessary to enjoy or even succeed at engineering, why beat one's head against that wall of educational deficiency?

Reduced undergraduate interest in engineering studies, even among those with the proper skills, also follows as a critical consequence of higher education's long dependency on federal research funds to fund graduate education. For example, the uncertainty in Government's continued commitment to major federal engineering projects (e.g., **Fig. 5.7**) and the steady decline in commitments to development of advanced technology for space, defense, and energy systems has not been lost on students who otherwise might have entered science or engineering fields. Students are fully aware of many major program cancellations and layoffs of engineers since the politically motivated demise of Apollo in the early 1970s and the premature and continuing cuts in advanced defense projects in the late 1980s and again under the current Congress and Administration (**Fig. 6.4**; also see **Fig. 5.1**).

The cryptic crisis in the broad education of the electorate, as well as in science and technology education of the most talented Americans, has caused a multi-decade erosion in the objective perceptions of voters and in the supply of young engineers available to serve in critical industrial, space and defense projects. The Congress has no choice but to begin to rapidly repair the damage done by their predecessors.

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For a wider discussion of *Education and the Constitution* see the other 3 essays on the same Downloads page, or directly at Nos. [13], [14], [15].

EPILOGUE

The 42nd Anniversary of humankind's first lunar landing by Apollo 11 on July 20, 2011, followed by the return of STS-135 on the next day, concluding the final flight of a United States Space Shuttle, places a capstone on the remarkable accomplishments of the post-Apollo generations of space engineers, builders and operators.

Those of us who were in attendance at the launch of *Atlantis* on July 8, 2011, felt both pride in this final accomplishment and sadness at another unnecessary, ill-conceived and excessively prolonged break in America's commitment to lead humankind in space. Pad 39A, the Vehicle Assembly Building, and the Crawler Transporter stand in the Florida sunshine as still functional but unwanted relics of past glories. Unfortunately, these momentous events also starkly frame the deficiencies in American space policy relative to long-term national interests. This policy began its slow decline in 1968-69 when the Johnson and Nixon Administrations began the process to end procurements of the Saturn V boosters and spacecraft advocated by Eisenhower and Kennedy for the Apollo Moon-landing Program.

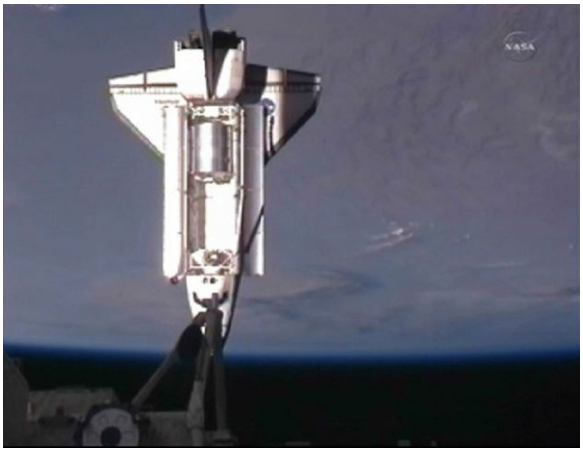
The absence of any significant national goals epitomizes current space policy. That policy lacks any coherent strategy to lead humankind in space and promote liberty there and on Earth. Failure of all Administrations and Congresses since Eisenhower and Kennedy to maintain a sustainable, indefinite commitment to human deep space exploration and settlement has undermined America's status in the world and the technological foundations necessary for national security and economic growth. We have reached a point where America and its partners depend on Russia for future access to the International Space Station. More critically, we will be ceding the Moon and deep space to China. This should be an intolerable situation to American taxpayers who paid for most of the Space Station and whose Astronauts blazed the trail for humankind to the Moon.

Illustration of the as yet unnamed Chinese space station complex comprising various habitat/work modules, several docking nodes, and 3 visiting *Shenzhou* spacecraft. *Cf.* **Fig. 2.2**. (China Manned Space Engineering Office photo).

President George W. Bush provided the Nation with a space policy in 2004 that met critical geopolitical requirements. If it had been properly funded by Congress, Bush's policy would have created a replacement for the Space Shuttle by 2010 and, more importantly,

Landing of STS-135, the final flight of the space shuttle *Atlantis.* (NASA Photo)

provided for a return to the Moon on the way to Mars. Mr. Bush, however, did not ask Congress for the funds necessary to fully implement his *Constellation Program*. *Constellation* nonetheless could have been executed fully when President Barack Obama took office in 2009, although with a several year delay in the availability of the Shuttle replacement spacecraft (*Orion*).



STS-135 *Atlantis* docking at the ISS on its final mission. (NASA photo).

President Obama, however, soon canceled *Constellation*, reflecting his personal bias against American exceptionalism and anything identified with Bush. His visions of largely unsupervised private contractors providing astronaut transportation to space and an unproductive visit to an asteroid are just that, unproven "visions" but hardly visionary. In light of increases of trillions of dollars in recent federal government spending, the $3 billion per year cost of implementing a "shovel ready" and "employment ready" *Constellation Program* appears, relatively, very small. The enormous geopolitical damage to America's world leadership role that its cancellation has brought about will cost us dearly in the future.

Atlantis's final arrival in Earth-orbit was historically comparable to the arrivals of the last covered wagon at Western destinations just before the Union Pacific, Central Pacific, Santa Fe and other railroads reached rapidly expanding local economies in the late 1800s. Unbelievably, and unlike the replacement of covered wagon technology with railroad technology, no American replacement exists for the Space Shuttle. Now that Obama has made NASA largely irrelevant in America's future, the next President and Congress must consider how to reverse this damage to national security and to the future motivation of young Americans.

Possible logo for the proposed new agency?

The next President must seriously consider focusing United States' space goals on deep space exploration. Until the Space Station must be shut down and deorbited, NASA can continue to be responsible for managing related international obligations. A separate and intense focus on deep space, however, could be accomplished by reassignment of most NASA functions to other agencies and the creation of a new National Space Exploration Agency (NSEA) [See **Prologue**]. This would be a proper tribute to the sacrifices made on behalf of America by the personnel of NASA and its contractors since 1958. A clear commitment to deep space would also restore America's geopolitical will to lead humankind into the future.

Originally published on the 42nd anniversary of the Apollo 11 lunar landing on July 20, 2011, at http:/americasuncommonsense.com/blog/downloads/ as Release #47, *Space Policy and the Constitution #5 – Former Senator Schmitt Reflects on America's Space Program: Past, Present and Future*, and revised for publication here.

Endpiece:
Apollo 17 Astronaut Harrison H. Schmitt discovered orange soil at Shorty Crater, Station 4, the most colorful view of geological material returned from the Moon. It is comprised of volcanic glass spewed by fire fountains from a depth of ~500 km beneath the surface. Its presence and associated volatile elements have profound implications for hypotheses on the Moon's origin. (NASA Photo AS17-137-20986 color-corrected by the editor and approved by the author).

Back Cover (overleaf):
A continuation of the view to the right of the lunar Rover at Station 7 seen on the front cover. By increasing the magnification of the page size to 150%, the Lunar Module *Challenger* can be seen as the small cube-shaped box 5.6 km away, beyond the left edge of Henry Crater underneath the arrow (composite of NASA Photos AS17-146-22350-51 by the editor).