

“EMBRACING THE PROMISE OF SPACE”

Statement by

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Mr. Chairman and Members of the Committee:

It is most important now that this Committee is helping to develop consensus about where America's human space flight program should be headed. I am grateful for the opportunity to express my personal views today on that subject.

A remarkably enduring American belief in the promise of space has sustained NASA human flight through seven Presidencies and twenty-one Congresses, through the grand accomplishment of the Apollo human landings on the Moon, followed by our return to more prosaic activities in low Earth orbit, through the end of the Cold War and of US-Soviet nuclear-armed rivalry, through the powerful post-Cold War trends of divestiture of governmental functions, through the Internet Revolution, and through the striking domestic cultural and attitudinal changes accompanying such tumultuous events.

However, four decades and 241 human flights placing 429 individuals in space have also demonstrated that this popular endeavor is intrinsically risky and expensive. Fourteen US astronauts and four Soviet cosmonauts have died in space. In addition, three others died in the Apollo 1 fire during essential tests on the launch pad in January, 1967. Human space flight has always been the major NASA priority, consuming today about seven billion dollars, one-half of NASA's total funds and a not insignificant component of the discretionary portion of the Federal budget.

Now, as this Hearing illustrates, many are questioning the wisdom of human flight itself in the wake of the Columbia disaster and of the CAIB Report: “Why spend all those Federal tax dollars year after year on just sending astronauts in orbit when we have so many other needs here on Earth?”, “Where are we going in space, anyway?”

Why Human Space Exploration?

Indeed, the fundamental problem is that we truly have no compelling destination in space for Americans. Since the 1970s, NASA thinking has been dominated by the internal dogma that the space station IS the destination. It was originally targeted to begin initial operations in the early 1990s. Instead, an ISS of limited capability is still years away and likely to do very little to advance human exploration of space. Furthermore, its promised benefits to commercial manufacturing and to medical research were eclipsed long ago by new technology and new manufacturing processes here on the ground. Most seriously for America now, it doesn't open the way to affordable future human flights beyond Earth orbit. Rather than beckoning as an orbital portal to expanding opportunities, space station is looking more and more like a costly orbital dead end.

There is a growing sense we have lost our way in space and are bogged down in low Earth orbit, driven by past domestic and political commitments rather than by genuine enthusiasm and excitement for the future. At this critical juncture we must once again infuse our human space flight program with a sense of exploration and adventure. We must once again commit ourselves to human space **exploration**.

Humans have been pushing beyond familiar locales throughout history for a variety of reasons including survival, curiosity, power, idealism, and economics. The Soviet Union initiated space

exploration for domestic and international prestige with Sputnik in 1957 and with Gagarin in 1961, quickly followed for the same reasons by the US with Explorer 1 and Glenn. (This pattern currently is being repeated by China four decades later). The US then raised the stakes in 1961 by initiating the Apollo project to the Moon as a Cold War priority presidential initiative. President Kennedy succeeded in focusing large resources to challenge the Soviet Union to a space race only we could win. The project objective was simple and clear--get an American to the surface of the Moon and back alive by the end of 1960s. Thus NASA was given a dramatic and popular human mission of exploration with the highest national priority and a fixed time scale.

To its lasting credit NASA won that race to the Moon, dramatically demonstrating American technological superiority to the world and to our Soviet adversaries. Most significantly in retrospect is that Apollo expanded forever all humanity's sense of its own potential. We must similarly challenge our current visions for future human space endeavors.

However, that Apollo success also removed the overriding national security need which had powered NASA through the 60s and early 70s. As a consequence, NASA was led to abandon further human space **exploration** as politically unsupportable and set off, unsuccessfully it turns out, to try to create a sustainable **utilitarian** role for humans in Earth orbit.

Where Should We Be Heading Beyond Earth Orbit?

So what should be our destination beyond Earth? Where is that place worth the inevitable risk to human life involved, and is compelling enough to attract sustained public support over decades?

Because NASA's only experience with human travel beyond Earth orbit ended in 1972, NASA in 1989 was not well prepared when a president actually did ask for a plan to go back to the Moon and on to Mars. NASA's backward-looking approach concerning the rationale for and implementation of future human flights to Mars was to cast it in the Apollo mode -- as a demonstration of US capability to get humans to Mars and back successfully on a politically realistic time scale, initiated by a high profile presidential initiative involving a significant increase in NASA expenditures. But, there wasn't then nor is there now any overriding national security need for a crash program to send Americans to Mars or Moon or anywhere else in space. Hence a costly political embarrassment resulted in 1989, leading subsequent administrations to be antagonistic toward any NASA efforts to develop and promote a more thoughtful understanding of the "how, when and why" of human travel beyond Earth orbit.

Why then should America commit now to send humans to Mars in the future? The Moon and Near-Earth asteroids are plausible targets for new human scientific expeditions during the 21st Century. Privately funded "adventure tourism" probably will spread from the Mt. Everest to Earth orbit and eventually to the Moon. Astronauts may play an important role in installing crucial equipment on distant space observatories as they did on Hubble. But, **only Mars offers a plausible habitat for humanity beyond Earth.** Only Mars offers Earthlings another potential venue, richly endowed with the essentials for life easily accessible from its surface. Carbon, Nitrogen, and Oxygen are abundant in its atmosphere. The US Mars Odyssey spacecraft recently discovered a far greater distribution of accessible ice than had ever been imagined previously. Space suits and sealed domes will still be required for humans on the surface, to be sure, but greenhouses using local resources are entirely feasible, as is production of liquid water and breathable oxygen for human use from the surface ice. Liquefied hydrogen and oxygen for transportation and portable energy sources are likewise feasible, especially as small nuclear power systems become available to supplement indigenous solar energy in coming decades.

Mars has as much land area as does Earth. Mars is the true space frontier, the legitimate abode for the dreams of the young for many generations to come. America should lead the world in that grand, positive human endeavor, using some of our enormous and visible technological capability to dramatically demonstrate our enduring commitment to Earth's future beyond the blood and conflict which inevitably will make up much of the 21st Century.

How to Make Humans Going to Mars Affordable and Popular

Firstly, American objectives for the first human expeditions to Mars must evolve beyond Apollo-like demonstrations of national technical capability, as in 1989, to leadership of a long-term international human space endeavor to determine directly Mars' habitability.

The international program of Antarctic exploration initiated in 1957 affords a powerful historical model of a highly successful long-term scientific exploration with unquestioned benefit to all inhabitants of planet Earth, often in ways not foreseen initially. Likewise, the multi-national relationships and

experiences of the International Space Station provide contemporary experience with the benefits and challenges of real collaboration on complex human space systems. The legacies of both Antarctic and ISS inevitably will influence international attitudes about going to Mars with humans eventually, and must be elucidated and fused.

So far, almost all open discourse and study of multi-national Mars human exploration has been non-governmental. NASA must now help lead an open process involving all space-faring nations as well as the public and private sectors in which these various experiences and viewpoints can be gradually fused into some consensus on overall objectives, as well as identification of various approaches to how and when such a journey might be carried out.

Secondly, NASA must lead a broad and open look at alternative technical approaches to human flight to Mars, recognizing that Apollo-like commitments to huge and expensive new launch vehicles are unrealistic. The timescale for the first human missions to Mars should be flexible, as should be the relationship to ISS operations and any Shuttle replacement programs. Alternatives to previously-publicized NASA thinking need to be included such as 1) Orbital assembly, fueling and launch, 2) Synthesis of likely human landing requirements with current robotic science missions and planning to provide for “Mars Outposts” and associated infra-structure to support eventual human missions which would be replaced by nearer-term automated launch vehicles, 3) Maximum use of advanced information technology, including tele-operated and autonomous systems, 4) Conceptual design of true deep space human spacecraft characterized by greater overall reliability than previous Earth orbital and Apollo spacecraft that never had to operate more than a few days from emergency return. Similarly, human deep space travel must incorporate a far greater degree of regenerative systems than previously, and finally 5) Plans for candidate earlier human flights for further scientific exploration of the Moon or of a Near-Earth Asteroid, or to future space observatory sites should be conceived and organized so as to provide maximum benefit to the eventual Mars endeavor.

Thirdly, NASA must develop an overall schedule for the Human exploration of Mars that 1) is comprised of a series of frequent affordable steps and milestones, 2) is not characterized by a significant early funding requirement, and 3) acknowledges the consensus of mission objectives and alternative technical approaches resulting from the first two items above.

Fourthly, and most important, the political leadership of this country must also insist on NASA developing and presenting a range of realistic alternatives to its current Shuttle/ Space Station plans that can enable a credible national commitment to a paced Mars human flight program. These alternatives necessarily should include multi-year suspensions of US human flight as NASA elected to do in 1975 -1981, when NASA suspended US human flight entirely after the Apollo-Soyuz mission until the first shuttle test flight in order to create the budget wedge enabling the Shuttle to be developed. Only by considering such painful alternatives can the relentless decline into mediocrity and irrelevance of US human space flight be reversed within realistic budget considerations. There is no “Business as Usual” pathway for the US into the future. The problems of being bogged down in Earth orbit will get worse...the choices even more painful... until US human flight likely will simply disappear.

Renewing Humanity’s Hope in Space

A commitment to lead the international human exploration of Mars can afford the American people and the world a powerful sense of a hopeful, promising future in space. The near-term challenges are not budgetary, but conceptual and attitudinal. It is time to show everyone that we are not bogged down in space—or on Earth—by embracing that most exciting, but feasible, vision of our future in space.

This will take realistic programmatic thinking and political courage.

CV
Bruce Murray

Dr. Murray, 71, is Professor Emeritus of Planetary Science and Geology at the California Institute of Technology in Pasadena, California. He has been at Caltech since 1960 and currently teaches courses in Planetary Surfaces and supervises graduate and undergraduate student research on Mars.

He was Director of the NASA/Caltech Jet Propulsion Laboratory from 1976 to 1982. Major projects under his term included the Viking landings on Mars and the Voyager mission through Jupiter and Saturn encounters. In 1979, he and Carl Sagan and Louis Friedman founded The Planetary Society, a 70,000 member international organization dedicated to exploring the Solar System and to the search for extra-terrestrial intelligence (SETI). He continues as Chairman of the Board of Directors.

Dr. Murray was a member of the Mars Television Teams on Mariner 4 (1965), Mariners 6 and 7 (1969), and Mariner 9 (1971-72). He was the Television Team leader for the Mariner 10 flyby of Venus and Mercury (1973-75). He was a member of the scientific teams of the Russian Phobos '88 Mission, and the unsuccessful Mars '96 Mission. He is a Participating Scientist on the U.S. Mars Global Surveyor mission (1997-present). He also was a Participating Scientist on the Mars Polar Lander and Mars Climate Orbiter missions which failed in late 1999 and also on the Mars Microprobe (DS-2) which likewise failed in December 1999. He served as a Consultant to the Mars Program Independent Assessment Team ("The Young Committee") which investigated those Mars failures of 1999. He previously served on various government advisory committees including the PSAC Science and Technology Panel, (1967-72) and the NASA Advisory Committee (1995-99) and was a Consultant to the Space Council (1990-92). His memoir "Journey into Space" (Norton, 1989) reflects this long involvement with space exploration.

Dr. Murray also has a long-standing interest in structured ways to analyze and visualize potential future outcomes of alternative societal and natural circumstances, beginning with his book "Navigating The Future" (Harper Row, 1975). He was a consultant to the "2050 Project", a collaboration between WRI, The Brookings Institution, and the Santa Fe Institute from 1991-95. From 1993 to 1999 he worked with the John and Mary Markle Foundation to determine how new information technology may be developed to facilitate deliberative discourse on critical issues. Currently, he is Co-Producer of the PBS Series "Closer to Truth" and of the accompanying website at <http://www.pbs.org/closetotruth/>.

Dr. Murray has published over 130 scientific papers and authored or co-authored six books. He received his college education at M.I.T., culminating in the Ph.D. in 1955. His full publication list and CV are available at <http://www.gps.caltech.edu/~bcm/HomePage/>.