Part III.

Reflections on the Space Age

Chapter 18

A Melancholic Space Age Anniversary

Walter A. McDougall

My sincere thanks to Steven Dick, Roger Launius, and the entire space history and space policy communities for inviting an old dilettante like myself to this event. Some of you good people I've not seen since we commemorated the 40th anniversary of Sputnik, and some of you doubtless I shall not have occasion to meet again. That alone makes this a somewhat melancholy affair for me. But I also have a sense that the 50th anniversary of the birth of the Space Age is draped with a certain melancholy. Do you sense a mood of disappointment, frustration, impatience over the failure of the human race to achieve much more than the minimum extrapolations made back in the 1950s, and considerably less than the buoyant expectations expressed as late as the 1970s? After all, one modest prediction went like this: "There are few today who do not look forward with feelings of confidence that spaceflight will some day be accomplished. All that we require is to make rocket motors somewhat larger than those already in existence . . . the pooling of skills already available, and a good deal of money . . . . We may reasonably suppose that a satellite vehicle is entirely practicable now and that travel to the moon is attainable in the next fifty years."[1] That was Dr. Hugh Dryden in 1953, on the occasion of the 50th anniversary of the Wright brothers' flight. (Indeed, if all of us interviewed by the media this month have accomplished anything I think we have at last disabused journalists of the notion that the Eisenhower administration was "surprised" by the first satellite launch.) But what that means is that all the satellites, space probes, and human missions launched over 50 years amount pretty much to what Dryden took for granted would happen. Moreover, the fact that the Moon landing was achieved just 16 years after he wrote this only compounds the disappointment that it proved to be a dead end.

That disappointment is also evident, I think, in the false expectation I expressed this past spring in an essay written for the Foreign Policy Research Institute. I began it like this:

1. Hugh L. Dryden, "The Next Fifty Years," *Aero Digest* (July 1953).

> It has gone down in history as 'the other world series': a championship match even more shocking than the Milwaukee Braves' upset victory over the New York Yankees in baseball's 1957 Fall Classic. That shot literally 'heard 'round the world' was Sputnik I, the first artificial Earth satellite that gave birth to the Space Age, and its 50th anniversary this October 4th is sure to inspire worldwide attention. By contrast, another anniversary of equal importance was all but ignored this past March. The birth certificate of that *other* age born 50 years ago was the Treaty of Rome which founded the European Community. Its charter members numbered just six and pledged only to coordinate some economic policies. But 50 years later Europe is a Union, not just a Community, counts 27 members, and has so deepened and broadened its purview that Europe today has become a veritable state of mind.[2]

In retrospect it has indeed been European integration—a boring, bureaucratic enterprise for the most part—that worked a metamorphosis across a whole continent over 50 years, whereas any global consciousness or Spaceship Earth mentality inspired by astronautics has worked no metamorphosis in national or international affairs. So perhaps it is fitting that the Sputnik anniversary passed without the great global eclat I predicted. For if Space Age technology had enabled a great portion of the human race to imagine itself a family sharing a fragile planet and cosmic destiny, then one might have expected a global celebration on the scale of that staged for Y2K. Instead, we got World Space Week sponsored by the United Nations Office for Outer Space Affairs. But the U.N. does Space Week every year between October 4 and October 10, the day the Outer Space Treaty was signed in 1967. And since the U.N.'s special attraction this year was Valentina Tereshkova, the first female cosmonaut, it reduced our species' first escape from its planet to a human interest story.

In the classroom October 4, I asked my 120 students if they knew the significance of the date. A few senior-citizen auditors and exactly one undergraduate knew the answer. My survey of Web sites was also deflating. *SearchEngineLand.com* reported that Google temporarily altered its logo in honor of Sputnik (and perhaps to hype its Lunar X Prize of $30 million to a private

2. Walter A. McDougall, "Will Europe Survive the 21st Century? A Meditation on the Fiftieth Anniversary of the European Community," 2 parts, Part I: "The Other Age Born in 1957," Foreign Policy Research Institute E-Note, *http://www.fpri.org* (August 3, 2007).

inventor of a Moonship).[3] But then, Google also alters its logo in honor of St. Patrick's Day and Halloween. Other Internet portals treated the anniversary, if at all, like any other feature story. Nor did Web surfers display much interest outside of techie and trekkie blogs. *InformationWeek.com* invited discussion of its brief story on Sputnik and received exactly zero posts. The anniversary page on *Makezine.com* received just four posts, one of which was this forlorn message: "I was happy to see a Sputnik post on this historic day. Thanks." Another site reported the European Space Agency's plan to launch 50 miniature "nanosats" in honor of the anniversary, but complained, "the event has not been widely covered. I found only very short pieces of information, such as a press release from Arianespace."

The *New York Times* essay on the anniversary was elegant, insightful, and graceful because John Noble Wilford wrote it.[4] But his tone was nostalgic, and he closed with decidedly downbeat judgments from Gerald Griffin, John Logsdon, and Alex Roland, plus Neil Armstrong's lament over "external factors or forces which we can't control." Indeed, if the commentary of space experts has had any unified theme it is that politics and economics—both foreign and domestic—have always dictated the scale and trajectory of space programs, rather than a revolutionary technology transforming politics and economics. In short, there has been no paradigm shift but instead international behavior as usual. To be sure, one could point to the Outer Space Treaty, international conventions on geosynchronous satellites, telecommunications, remote sensing, scientific cooperation, and so forth. But those achievements are simply comparable to what the otherwise rival nation states of the 19th and 20th centuries did when they established regimes to govern telegraphy, undersea cables, postal service, maritime law, standard time zones, air travel, radio, and rules for global commons such as the seabed and Antarctica.

Another noteworthy tribute (noted by John Krige as well) ran in the *USA Today* science supplement on September 25. After making the conventional point that turning civilian spaceflight into a race undercut its appeal after Apollo, the author quoted Roger Launius to the effect that support for human spaceflight has always been "a mile wide and an inch deep."[5] That apt remark reminded me of the chapter in *Critical Issues in the History of Spaceflight* in which Launius listed five rationales for space technology (noted also by Asif Siddiqi): 1) human destiny and perhaps the survival of our species; 2) geopolitics and

3. "Google Logo Celebrates Sputnik" (accessed October 16, 2007), *http://searchengineland.com/071004-111609php*; "50 'Nanosats' for Sputnik's Fiftieth Anniversary" (accessed October 16, 2007), *http://www.primidi.com/2004/10/13.html*.

4. John Noble Wilford, "With Fear and Wonder in Its Wake, Sputnik Lifted Us Into the Future," the *New York Times* (September 25, 2007).

5. Traci Watson, "Sputnik's Anniversary Raises Questions About Future of Space Exploration," *USA Today* (September 25, 2007).

national prestige; 3) military defense; 4) applications and economics; and 5) science and discovery. (Another whimsical way of listing those rationales is to say human beings do five things in space: work, play, fight, boast, and worship.) It seems in retrospect that what happened between 1955, when the IGY satellite program was announced, and 1961, when Yuri Gagarin orbited, was the elevation of prestige to an inordinate, artificial primacy in that mix of rationales. That spawned a crash program that space enthusiasts believed was, or should be, the norm when in fact it was a grotesque aberration made even worse by the 1970s decision to throw the baby (Apollo/Saturn hardware) out with the bathwater.

Where we stand today with respect to global vs. national identities and rationales for spaceflight can be deduced by recalling two wise sayings from the otherwise not-always-wise Robert S. McNamara. First, he said space is not a mission or a cause; it is just a place. Second, he said the budget *is* the strategy. So let us look at humanity's budget. Let us indeed "follow the money." According to The Space Foundation's latest estimates the world's allocations for activities in the place called outer space totaled $74.5 billion in 2006.[6] By coincidence, that is almost identical to the supplemental appropriations the White House requests every year for Iraq. (Hence, space advocates need no longer rely on the quip that U.S. consumers spend more on tobacco or cosmetic surgery than the space program because they need only observe that the U.S. government spends more existing tax revenue on one dubious exercise in overseas state-building than the whole world does on space exploration.)

Equally significant is the fact that just under $60 billion, or about 80 percent of global investment in space, is America's share, so ipso facto the priorities of the human race are really the priorities of one nation state. I understand where Neil DeGrasse Tyson and Jim Garvin are coming from when they say that America has been standing still, that China, Japan, and India may spark the next space race, and that a manned mission to Mars will likely plant "a whole sheaf of flags" in the ruddy dust. But apart from such high-profile human endeavors as the ISS or planetary exploration, space technology remains overwhelmingly a national activity overwhelmingly dominated by the United States.

ESA contributes $3.5 billion or just below 5 percent, and all other national programs (led by Japan and China) about $11.4 billion or 15 percent. The motives of ESA derive largely from science and applications. The motives of national programs such as those of Japan, China, India, and France run mostly to defense, economics, and prestige. Needless to say, no one spends a euro or a yen on "human destiny and the survival of the species."

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6. Data on space spending is Space Foundation, Colorado Springs, CO, "Government Budgets—The Space Report 2007 Update (October 11, 2007), *http://www.spacefoundation.org/news/story.php?id=419*.

The breakdown of American spending, precisely because of its scale, is even more telling. The biggest chunk—$22.5 billion—goes to the Pentagon, with another $20.5 billion going to black programs such as those of the National Reconnaissance Office and Geo-spatial Intelligence Agency. Thus, about $43 billion, or 58 percent of humanity's space budget, is spent on the defense of the U.S. and its allies. Perhaps that is necessary. It is a fundamental tenet of the national strategy that the United States maintain hegemony in the aerospace theater, and most other nations would much rather have America police that global commons than to see it contested or dominated by some other nation. But in the context of rationales and priorities, those budget numbers are the most telling evidence that defense outweighs all other spaceflight put together, several times over. By contrast, NASA, which is responsible for the human spaceflight program, science and exploration, satellite applications, new launch technologies, test-bed technologies, and even the "human destiny and survival" rationale if we count astrobiology and asteroid research, receives $16.6 billion. That amounts to 28 percent of U.S. space spending and 22 percent of global space spending.

To put it another way, if we add NASA's budget to that of the ESA and estimate that a third of the various national budgets are devoted to civilian pursuits, we arrive at a sum of about $24 billion or 32 percent of the Space Foundation's global figure. That means 68 percent—more than two-thirds—of planet Earth's space effort serves national defense and prestige. And that means the answer to today's question—"Has the Space Age fostered a new global identity?—is "No."

Has the Space Age at least fostered—especially among young people—a sense of awe, wonder, curiosity, and impatience to know, an urge to explore and a rekindled faith in progress, the future, and human nature, or perhaps even a postmodern, gnostic religious vision conflating transhuman evolution, biological or post-biological immortality, space colonization, and contact with extraterrestials? Those have been stock themes of science fiction authors like Isaac Asimov, Ray Bradbury, and Arthur C. Clarke, none of whom could be considered a crackpot.[7] Indeed, it was Captain Jacques Cousteau, not exactly a cult leader, who took the occasion of NASA's 1976 conference on "Why Man Explores" to echo Konstantin Tsiolkovskii's conviction that, in conquering gravity, humanity would conquer death. Perhaps the Space Age will alter the consciousness of a critical mass of people. Perhaps, as William Sims Bainbridge eloquently contends, such a quasi-religious consciousness may give rise to a new social movement transforming the scale and priorities of the human presence in space.

7. For the late Sir Arthur C. Clarke's wise reflections, see *Spectrum*, "Remembering Sputnik: Sir Arthur C. Clarke," *http://www.spectrum.ieee.org/print/5584*.

Perhaps, but not yet. Twice this year I myself was thrilled to experience anew the awe and wonder so many felt at the dawn of the Space Age. The first experience was a stroll on the surface of Mars! I luckily visited NASA headquarters on May 17, the very day Dr. Alfred McEwen of the University of Arizona revealed "Mars As You've Never Seen Before," courtesy of the Mars Orbiter and Phoenix rovers Spirit and Opportunity. The second experience a few weeks later occurred while I was on a VIP tour of JPL courtesy of Blaine Baggett, who is producing a documentary for the 50th anniversary of Explorer 1, America's first satellite. *Pace* Howard McCurdy (whose brilliant analysis of robots consigns them to the dying industrial age of human culture), I marveled at the magical robotic spacecraft designed and assembled in the hills above Pasadena. It is they who have made what Carl Sagan called the Golden Age of planetary exploration; and it is they who bear witness to what Samuel Florman called "the existential pleasures of engineering." Yet I also watched troop after troop of children on school field trips to JPL and could not help but wonder whether it made any impression on them. Can youth today feel the tingle that Homer Hickam felt the night Sputnik passed over West Virginia? Or have today's kids been so jaded by the far more spectacular virtual reality of Nintendo and Dreamworks that NASA cannot compete? Or will the excitement of virtual reality instead render brilliant young people impatient to accelerate the human thrust into space?

On young people—and the future—I have no authority to speak. But as an historian with some authority to pronounce on the past 50 years, I would suggest that the trajectory spaceflight has taken reflects the fact that the nation that drove the enterprise, the United States, has been perversely burdened by its responsibilities as defender of most of the world and is perversely ill-suited to what spaceflight requires. Not as ill-suited as that fraudulent technocracy, the Soviet Union, but ill-suited nonetheless. Given the costs, lead-times, and distances involved, the pioneering of space requires a coherent, sustainable, long-term approach, predictably financed and supported by a patient people willing to sacrifice and delay gratification even over a generation or more. Americans do not fit that description. Likewise (and I defer here to political scientists such as John Logsdon) the U.S. government does not exactly fit the description of a streamlined technocracy, given its checks and balances, contesting parties, rival bureaucracies, frequent elections and personnel turnovers, mixed public and private sectors, gigantic distractions both foreign and domestic, and reliance in all cases on a meandering, manipulable public opinion. Indeed, given those handicaps and the mistakes and false starts bound to occur in a venture of such scope and novelty, perhaps Sir Arthur C. Clarke was correct when he recently said, all disappointment aside, that a great deal has been accomplished in the first 50 years of the Space Age. Not least, I would stress, the cosmic advances in space science which, so far at least, have been strangely ignored in our proceedings.

Will the United States continue to dominate humanity's agenda in space? Or will we pass the baton to others, such as several countries in Asia? Or will

some new, genuinely cheap and safe launch technology emerge to permit rapid expansion of the human footprint in space without any government having to lead? When and if that occurs, then private and corporate activity may indeed become an independent variable capable of transforming geopolitics and geoeconomics. When and if that occurs, a new generation of the sort McCurdy awaits may indeed hearken to Siddiqi's plea that we cease fearing our own imaginations. When and if that occurs, a tired old baby-boomer such as I will eagerly take Charles Murray's advice "to get a grand mission . . . give it to a new generation, and get the hell out of the way."[8]

8. Charles Murray, and Catherine Bly Cox, *Apollo: Race to the Moon* (New York, NY: Simon & Schuster, 1989).

Chapter 19

Has Space Development Made a Difference?

John M. Logsdon

In his paper in this volume, J. R. McNeill writes that "It is in fact too soon to tell what the real significance of the Space Age may be. At the moment, space exploration, space flight, space research, all seem at most secondary next to the dominant trends of contemporary history. . . . The big things would probably be much the same, for better or for worse." He adds "space programs changed the history of our times, but not (yet) in any fundamental ways." Walter McDougall in his paper adds that he senses "that the fiftieth anniversary of the birth of the Space Age is draped with a certain melancholy. Do you sense a mood of disappointment, frustration, impatience over the failure of the human race to achieve much more than the minimum extrapolations made back in the 1950s, and considerably less than the buoyant expectations expressed as late as the 1970s?"

I beg to disagree, at least in part. The assignment for this paper was to discuss this question: "Has the Space Age fostered a new global identity, or has it reinforced distinct national identities? How does space history connect with national histories and with the histories of transnational or global phenomena . . . ?" It is an interesting mental exercise to imagine what today's world would be like, at least in the urbanized Northern hemisphere, if all space systems were shut down for 24 hours. I believe that we would quickly realize that those systems have become deeply integrated into the infrastructure of the modern world, and that neither the modern nation state nor the global economy could operate effectively without them. If the overall history of most of the past 50 years has not been fundamentally affected by the development of space capabilities, it is my view that the history being made today and in the recent past is in meaningful ways a product of how nation states and the private sector have incorporated the possibilities made available through space technology into their everyday operations.[1] In this sense, the ability to operate in outer space is part of history, not an independent variable shaping it.

1. Most of the papers in Steven J. Dick and Roger D. Launius, eds., *Societal Impact of Spaceflight* NASA SP2007-4801 (Washington, DC: Government Printing Office, 2007) provide evidence and analysis in support of this assertion.

THE IMPACTS OF SPACE DEVELOPMENT

That reality may be part of the problem in identifying the impact of space development during its first half-century. As various capabilities have become operational, they have been subsumed into the larger pattern of human activity and not usually thought of separately as "space." McNeill suggests that "Some things would have been a bit different without spy satellites, communications satellites, weather satellites, earth-observation satellites, and so forth," but, in his view, not dramatically different. He asks whether "the current surge of globalization has derived some of its momentum from an enhanced awareness that we are all in the same boat, all stuck on the same small blue dot spinning through the darkness? Or could it owe something to instantaneous communications via satellites?" His view is that "the best answer is: yes, but not much. If no one had ever seen photos of the earth from space, and if information from India and Indonesia still arrived by telegraph and took a day or two to reach other continents instead of a second or two, would globalization be substantially different?"

For at least the latter of his two questions, my answer would be "yes." It is really difficult to imagine today's world absent instantaneous information flow, and space systems are a crucial part of the global information transmission network that makes such flow possible. Whether the view of Earth from cosmic distances—Earthrise over the barren lunar surface or the "pale blue dot" most recently glimpsed by the Cassini spacecraft as it orbits Saturn—has created a global consciousness is more debatable. Certainly, the Earthrise image became the icon of the environmental movement in the 1970s and references to "Spaceship Earth" still appear in admonitions of the Green movement. But, as McDougall comments, "any global consciousness or Spaceship-Earth mentality inspired by astronautics has worked no metamorphosis in national or international affairs."

Somewhat the same can be said for the other space capabilities that McNeill cites. For nations with global or regional security interests—during the Cold War, the United States and the Soviet Union, and today an additional small number of other nation states—the ability to obtain near-real-time information on potential security threats is a stabilizing element in international security affairs. But space-derived intelligence information is merged with intelligence from other sources, and it is not possible to measure its independent contribution to avoiding or ameliorating (or abetting) conflict. Information regarding the variables determining short- and longer-term weather patterns obtained from meteorological satellites is integrated with other information; there are many projections of the billions of dollars and hundreds of lives not lost due to better weather forecasts.[2]

2. See, for example, the discussion in Henry R. Hertzfeld and Ray A. Williamson, "The Social and Economic Impact of Earth Observing Satellites" in Launius and Dick, *The Societal Impact of Spaceflight,* pp. 237-263.

McNeill does not discuss the impact of satellites delivering positioning, navigation, and timing services. But such satellites, most notably to date the U.S. GPS system, have become the basis for a global utility with multiple applications from guiding precision weapons to their targets to providing the timing information that makes the Internet possible. Again, one does not often think of the space-based source of these capabilities; what matters is the application, not the means that enables it.

Though not the focus of this and the other papers in this volume, it would be remiss to avoid discussing the impact of space capabilities on warfighting in an assessment of the importance of the last 50 years of space development. So far, only the United States has made its approach to power projection and fighting wars strongly dependent on the use of space systems. It is well beyond the scope of this paper to discuss whether that commitment to space as a military tool was a wise one, endowing the United States with decisive military advantages. But certainly space capabilities are central to what has been described in the United States as a "revolution in military affairs."[3]

It is instructive to observe that countries pursuing rapid social and economic development—China and India are probably the best examples—are investing significant amounts of their scarce financial and human resources in space development. They seem convinced that space capabilities can have fundamental impacts on their future history.

I conclude, then, that by its contributions to the various ways in which everything from international conflicts to day-to-day life unfolds, space development has indeed been a significant influence in recent human history, though one whose specific contributions are difficult to separate out. Comparing a world today without the capabilities provided by space systems to one in which those systems are fully integrated would, I believe, support the validity of this judgment.

Forty Years of Frustration

McDougall senses a feeling of "melancholy" because space development has not moved beyond what was predicted for it more than a half century ago. I would substitute the word "frustration" for "melancholy." Both visionaries such as Arthur C. Clarke and hard-nosed analysts at the Rand Corporation by the early 1950s had indeed spelled out most of the various domains in which space capabilities, once they were technologically and financially achievable, could contribute to human life in important ways. What happened in that decade is interesting to remember. First of all, these space visions became part of popular culture well before the first satellites were launched. Those raised in

3. See, for example, Steven Lambakis, *On the Edge of Earth: The Future of American Space Power* (Lexington, KY: University Press of Kentucky, 2001) for a discussion of the link between space capabilities and military power.

the 1950s (I was among them) had available in print, in film, and on the then-new medium of television multiple images of a future transformed by space activity. The 1952 *Collier's* cover declaring "Man Will Conquer Space Soon" was typical of the message we were receiving.[4]

At the same time, the leaders of the two Cold War superpowers decided that developing the technologies needed to operate in space were linked to their countries' core national interests. More quickly than anyone could have anticipated at the start of the decade, the U.S. and Soviet governments provided the funds needed to develop a broad array of space capabilities, primarily, as McDougall notes, on the basis of national security considerations. But to those steeped in the space visions of the decade, it seemed that the predictions of Clarke, von Braun, and their colleagues might soon become reality. We did not sense the contingent character of government commitment to space, which linked space to broader geopolitical interests.

The acme of this linkage was, of course, Project Apollo. As I wrote in 1970, by his decision to use American trips to the Moon as a way of symbolizing U.S. power vis-à-vis the Soviet Union, President John F. Kennedy "linked the dreams of centuries to the politics of the moment."[5] By backing up his decision to go to the Moon with a war-like mobilization of human and financial resources to achieve the lunar landing goal, Kennedy created a sense that what was in fact a crash program aimed at a specific political goal was instead a U.S. national commitment to achieve on an accelerated schedule the various elements of the 1950s space vision. This sense was reinforced by NASA Administrator James Webb's argument to Kennedy that the real goal was "preeminence"—a clearly leading position in all areas of space activity. Not only human spaceflight, but all areas of space science and applications, grew rapidly in the 1960s.

Thus it is not surprising that the space community in 1969, as the Apollo goal was achieved, proposed to take the next steps, including large space stations, a lunar base, human missions to Mars, and increasingly ambitious robotic missions. Their expectations were quickly dashed, as President Richard Nixon in March 1970 announced that "We must think of [space activities] as part of a continuing process . . . and not as a series of separate leaps, each requiring a massive concentration of energy." The president added "Space expenditures must take their proper place within a rigorous system of national priorities. . . . What we do in space from here on in must become a normal and regular part of our national life and must therefore be planned in conjunction with all of the other undertakings which are important to us."[6]

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4. Excerpts from the *Collier's* series on space can be found in John M. Logsdon et al., eds. *Exploring the Unknown: Selected Documents in the History of the U.S. Civil Space Program*, Vol. I, Organizing for Exploration, NASA SP-4407 (Washington, DC: Government Printing Office, 1995), pp. 176-200.

5. John M. Logsdon, *The Decision to Go to the Moon: Project Apollo and the National Interest* (Cambridge, MA: MIT Press, 1970), p. 7.

6. President Nixon's statement can be found at *http://www.presidency.ucsb.edu/ws/index.php?pid=2903&st=&st1=* (accessed April 6, 2008).

This perspective was bound to frustrate those who, in the immediate aftermath of the lunar landings, thought that the government commitment to space that had fueled Apollo would continue. What is unfortunate is that this frustration continues today; in the almost four decades since Nixon set forth the policy that has in effect guided civilian space decisions since, the space community has not adjusted its expectations to a much slower-paced but perhaps ultimately more sustainable approach to space development. Apollo created a large government-industrial-scientific complex optimized for carrying out fast-paced development and operation efforts. That complex exists, albeit in a diminished form, today, and it continues to be frustrated that its aspirations are not fully supported by the White House, Congress, and ultimately the American public. That the space community still hopes to recapture something approaching the Apollo approach to space is what is "melancholy." As Howard McCurdy has commented

> The reality of space travel depleted much of the vision that originally inspired it. Space-flight engineers have not developed technologies capable of achieving the dream; advocates have not formulated alternative visions capable of maintaining it. At the same time, no alternative vision of sufficient force has appeared to supplant the original dream. Advocates still embrace the original vision of adventure, mystery, and exploration. They continue to dream of expeditions to nearby planets and the discovery of habitable worlds. The dreams continue, while the gap between expectations and reality remains unresolved.[7]

That being said, I think one can look back at what has been accomplished over the past 50 years and agree with the late Sir Arthur C. Clarke's observation: "On the whole, I think we have had remarkable accomplishments during the first 50 years of the Space Age. Some of us might have preferred things to happen in a different style or time frame, but when our dreams and aspirations are adjusted for reality, there is much we can look back on with satisfaction."[8]

WHAT ABOUT SPACE EXPLORATION?

McNeill comments that "Space exploration, as opposed to the totality of space programs, could well be relegated to the status of historical footnote. . . . [E]xploration programs are another matter: they are especially expensive and they probably won't cure cancer or defeat terrorism, so they are at high risk of being phased out. . . . If

7. Howard E. McCurdy, *Space and the American Imagination* (Washington, DC: Smithsonian Institution Press, 1997), p. 243.

8. Arthur C. Clarke, "Remembering Sputnik" at *http://spectrum.ieee.org/oct07/5584* (accessed March 30, 2008).

so, in time space exploration will be forgotten, a dead end, a historical cul-de-sac." He adds "On the other hand, it could be that space exploration will thrive, find new budgetary champions in the corridors of power." McNeill suggests that "Space exploration may survive on one or another basis, but it still will not loom large in terms of human history unless something really new and interesting happens." If that occurs, "then the first 50 years of space exploration will look like the beginning of something of epic significance." If it does not, "it will look like a small step for mankind that led nowhere, and did not amount to much in the balance before being consigned to the dustbin of history." McNeill concludes, and I concur, that "It is indeed too soon to judge whether the whole enterprise is a gigantic folly diverting money and talent from more urgent applications, a noble calling consonant with our deepest nature, or something else altogether."[9]

In the first 50 years of the Space Age, only 27[10] Americans ventured beyond Earth orbit to begin the exploration of the solar system by voyages to the Moon. In reality, that sentence is not completely accurate. While many space advocates saw Project Apollo as the beginning of a long period of human space exploration, the political leaders who provided the funds for Apollo certainly did not do so out of a commitment to space exploration. Given the dead-end character of Apollo and the fact that it was driven by geopolitical considerations, I do not think there is much that can be said about its historical contributions as an exploratory undertaking. The history of human space exploration is yet to be written. Whether it will begin to be written in the next few decades is today's most pressing space policy question.

McNeill cites one of his colleagues, Felipe Fernandez-Armesto, as suggesting that space exploration has been a "gigantic folly."[11] He is not alone in that view. The *Economist* recently commented that "a scandalous amount of money has been wasted on the conceit that voyaging across the cosmos is humanity's destiny"[12] Aerospace executive Rick Fleeter in October 2004 criticized advocates of space exploration for taking "as axiomatic that space's highest and true calling is achieving societal goals of research and exploration into the unknown." In Fleeter's view, "Hauling this burdensome baggage of an aristocratic calling, now bankrupt both ideologically and financially, is not helping space—it is hindering our community from reaching our potential to

9. McNeill is talking here about both human and robotic space exploration. It is my view that robotic exploratory missions of some character will continue for the foreseeable future, although ambitious multi-billion dollar undertakings may be few. To me, the key issue is whether governments in the early 21st century will support human exploration beyond Earth orbit.

10. Two people—Eugene Cernan, and John Young— both made a trip to lunar orbit without landing and a second trip to the lunar surface. One person—James Lovell—went into lunar orbit on the Apollo 8 mission and then looped around the Moon on the ill-fated Apollo 13 mission.

11. Felipe Fernandez-Armesto, *Pathfinders: A Global History of Exploration* (New York, NY: Norton, 2006), p. 399.

12. The *Economist,* September 29, 2007: 23.

serve humanity." This is so, he argued, because these "old ideas are rigid and anachronistic, no longer pointing us to a brighter tomorrow, but rather back toward a dead end of technological progress for its own sake."[13]

I suggest that there is no compelling evidence one way or the other to assess the validity of these assertions, since the actual experience of human space exploration is so limited. In addition, the belief that sending humans beyond Earth orbit is the correct next step in space development is gaining political acceptance around the world. Leaders of the United States and, more recently, France have committed their countries to the support of human exploration, beginning with a return to the Moon before 2020 and including eventual voyages to Mars. To me, the issue is whether this round of human exploration will be designed to answer, at least for this century, the question of whether such steps are indeed a "gigantic folly," or part of future human history.

The requirements for sustained human exploration beyond Earth orbit were perceptively stated by Harry Shipman in his 1989 study, *Humans in Space*.[14] Shipman says that the future of human activity beyond Earth orbit depends on the answer to two questions:

1. Can extraterrestrial materials be used to support life in locations other than Earth?
2. Can activities of sustained economic worth be carried out at those locations?

Depending on the answer to those questions, Shipman suggests, the following outcomes are probable:

CAN SPACE COMMERCE EMERGE?	CAN IN SITU MATERIALS BE USED TO SUPPORT HUMAN LIFE?	
	NO	YES
NO	Space science only	Research and tourism
YES	Robot mines, factories, and labs	Full space settlement

13. Rick Fleeter, *Space News*, October 18, 2004: 10. Fleeter's remarks were in response to an op-ed essay I had published in the same venue two weeks earlier.

14. Harry Shipman, *Humans in Space: 21st Century Frontiers* (New York, NY: Plenum Press, 1989), p. 17.

Humanity may be at a branch point in future space development, one that could provide the answers to Shipman's questions. There is on the table a bold proposition, put forth by U.S. President George W. Bush in January 2004—that the nations of the world, led by the United States, accept as the guiding purpose of their governments' space programs carrying out "a sustained and affordable human and robotic program to explore the solar system and beyond."[15] It seems as if space leaders in other spacefaring countries, and those eager to become more active in space, are also embracing exploration beyond Earth orbit as an essential element in their future activities. For example, 14 space agencies[16] in May 2007 issued a statement of Global Exploration Strategy that argued "This Global Exploration Strategy will bring significant social, intellectual and economic benefits to people on Earth." The document argued that "space exploration is essential to humanity's future." It added that [Emphasis added by the author.] "*Opportunities like this come rarely. The human migration into space is still in its infancy. For the most part, we have remained just a few kilometers above the Earth's surface—not much more than camping out in the backyard."*[17]

The key words here are "opportunities like this come rarely." I would go even further. Never before has a major government, in this case the United States, committed itself to an open-ended vision of space exploration. The pressing issues are: Will the United States sustain that commitment in coming years? Will other countries join the United States in such a long-term exploratory effort? Or will others follow a different path, developing an exploration program of their own? Finally, will space exploration by humans prove not to be sustainable, and thus will humans focus their space efforts on robotic exploration and space applications that provide direct benefits here on Earth?

These are the key questions for the next period of spaceflight. Only after they are answered can we state with any assurance that space exploration was "a false start that led no where and did not amount to much in the balance before being consigned to the dustbin of history."

Other outcomes are also possible, as space dreamers have reminded us. Looking back 50 years from now, it may be that our evaluation of the historical significance of space exploration can be much more definitive, and much more positive.

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15. The White House, *A Renewed Spirit of Discovery: The President's Vision for U.S. Space Exploration,* January 2004.

16. NASA; Canadian Space Agency, European Space Agency; CNES; DLR; Italian Space Agency; British National Space Center; Russian Space Agency, Roscosmos; Ukrainian Space Agency; Indian Space Research Organization; Chinese National Space Administration; Korean Aerospace Research Institute; Japanese Aerospace Exploration Agency; JAXA; and Australian Commonwealth Scientific and Industrial Research Organization.

17. Each of the 14 agencies issued the document in some form. See, for example, *www.nasa.gov/pdf/178109main_ges_framework.pdf.*, p. 3 (accessed April 6, 2008).

Chapter 20

Has There Been a Space Age?

Sylvia Kraemer

Our conference opened with the observation by John Logsdon that how one remembers the Space Age depends mightily on who does the remembering. I would add that how we remember the Space Age today is also likely to depend on one's angle of repose, or that point in our shared history at which we have acquired sufficient stability to pause and to reflect on the relative importance of striking features in the cultural and political/economic landscape that surrounds us.

So I will begin with some observations that cause me to question whether U.S. or global space activity since Sputnik warrants its characterization as defining an "age." Whether space has fostered globalization or increased nationalism is part of this question. Then I will comment on the ways in which space activity has nonetheless left an indelible and lasting mark on our world.

When we refer to any development as defining an age of human history, we imply that it has been a singular agent of historical change. The notion that space activity is one such development may appeal to those who equate events that receive extensive media attention with the things that are historically important. And space activity has certainly helped to shape the careers of millions of engineers, scientists, and managers in corporate America and within the federal government and many of our universities. For these individuals space activities have defined a substantial portion of their lives.

But space activity has some strong competition as a claimant to defining our world. First, I would offer the Cold War, in which space was an important salient but not principal provocateur. That role of preeminence is held by ideology—ours as well as that of the Soviet Union. No less important were the post-World War II geopolitical changes wrought by the emergence of the United States as the world's dominant "superpower" and the regional realignments in Europe, the Middle East, and Southeast Asia. As we know only too well, those realignments have challenged our military, economic, and diplomatic independence to an arguably unprecedented degree. I also think a strong case can be made for the emergence, popularization, and ramifications of digital communications and information technologies as the defining phenomenon of the "age" following the end of the Cold War.

The panel was also asked to consider whether space activity fostered a new global identity, or reinforced distinct national identities. Here I think a two-handed response is unavoidable. On the one hand, nations do take pride in being able to demonstrate to everyone that they, too, can launch and sustain space missions, including human missions. Along with this we have the national security implications—not only for the United States, but for everyone else—of being able to deliver catastrophic weapons to adversaries' soil and military assets wherever they might be. The same can be said for nations' ability to spy on each other continuously from space and to use satellites for tactical advantages in the field with space-based surveillance and targeting.

Has the ability to amplify national military capabilities in space, one of the most visible manifestations of national technological capacity, strengthened nationalism? We tend to assume it has, but I think that notion is debatable. We might recall the premise, built into President Eisenhower's space policy and illustrated in the case of the Soviet Union, that international belligerence is less sustainable when nations can accurately assess one another's military capacities. So we can debate whether the enhancement of military capabilities by space weaponry, reconnaissance, and targeting actually fosters nationalism or simply elevates the geopolitical balance of powers to a higher plane.

And now, to the other hand: Our ability to observe Earth from space has unquestionably reinforced our understanding that Earth is a solitary and probably unique traveler through space, its natural plenitude the single greatest treasure bequeathed to humankind, whether by a divine creator or the mysterious "fickle finger of fate." But the indirect contribution to globalization may be more important than this more obvious visual paradigm.

To begin with, Earth imagery from space has brought to fruition the historic process of global discovery that began in earnest during that previous "Age of Reconnaissance" of the 14th and 15th centuries. Secondly, by engaging scientists from around the world in the shared investigation of Earth's dynamic climate and physical geography, as well as the relationship of its dynamic processes to those of the Sun, space activity has reinforced the cosmopolitanism of intellectual life—an essential component of genuine "globalization."

I believe that the contribution of space activity to globalization has been far greater than its contribution to nationalism. Indeed, space travel has been largely a product of nationalism, rather than one of its sources. And I believe that a symbiotic relationship between space activity and globalization will prevail over whatever uses individual nations may wish to make of their ability to operate in space. This is because the nation state is being overtaken by the globally invested corporation as the primary means of aggregating economic and allied political interests. Moreover, thanks to now ubiquitous "outsourcing," the functions of government are increasingly carried out by corporations wielding enough financial power to buy favorable, or at least neutral, government policies.

Space activity has contributed to this process by enabling virtually instant communication of information and wealth across national boundaries. If the more adventurous super-rich like Richard Branscomb have their way, in the future we will move around the globe with a speed comparable to that at which information and money now move around the world. We might even be able to travel around the globe in less time than it takes today to get by air from New York to Boston. If and when that day occurs, the great cities of the world will have more in common with each other than they have with their respective hinterlands, and space travel will have, indeed, reshaped us into one world.

Chapter 21

Cultural Functions of Space Exploration

Linda Billings

> Culture: a "historically transmitted pattern of meanings embedded in symbols, a system of inherited conceptions expressed in symbolic forms by means of which [people] communicate, perpetuate and develop their knowledge about and attitudes toward life."[1]

What role has space exploration played in the cultural environment of the U.S. and the world? What has space exploration meant, or done, for the vast majority of people on Earth outside the space community? Has this role or function varied across cultural boundaries (for example, gender or nationality), time, or space? Where, or what, has space exploration been in public discourse? Has space exploration had subcultures as well as a dominant culture? In short, what cultural functions has space exploration performed? How have people remembered, represented, and made use of space exploration?

All these questions may be addressed from a broad range of perspectives. The papers in this volume illustrate in a variety of ways that space exploration means different things to different people at different times and in different geographical and sociocultural places. Official and dominant cultural narratives of space exploration are not the only sites where meaning is constructed. The so-called "public" makes meaning out of space exploration in its own ways. Just how space exploration has affected aspects of social life such as material culture, education, aesthetics, values and attitudes, and religion and spirituality is an interesting question in its own right. In her paper in this volume, University of California, Irvine, historian Emily Rosenberg documented how the Apollo-era U.S. space program influenced art and architecture and produced "space spectaculars" for the newly dominant mass medium of television. "Space was the star of this historical moment," she said. Ultimately, she concluded, space exploration might mean many things, or it might mean nothing. National Air and Space Museum historian Martin Collins noted that the traditional narrative

1. Clifford Geertz, *The Interpretation of Cultures* (New York, NY: Basic Books, 1973), pp. 14, 34.

of space exploration as a lone, heroic, and progressive enterprise "still resonates, but in a much diminished way."

In a 1945 letter to President Eisenhower accompanying the now-famous July 1945 report, *Science: The Endless Frontier*, White House Office of Scientific Research and Development Director Vannevar Bush wrote "The pioneer spirit is still vigorous within this nation. Science offers a largely unexplored hinterland for the pioneer who has the tools for this task. The rewards of such exploration both for the nation and the individual are great. Scientific progress is one essential key to our security as a nation, to our better health, to more jobs, to a higher standard of living, and to our cultural progress."[2] *Science: The Endless Frontier* laid out a U.S. scientific research and technology development program for the post-World War II era.

By substituting the words "space exploration" for "science" in this passage, Vannevar Bush's post-World War II rhetoric becomes indistinguishable from the rhetoric of contemporary space exploration advocates. An example of current rhetoric is a so-called "elevator speech" developed by NASA's Office of Strategic Communications Planning in 2007 to offer a rationale for the civilian space program:

> NASA explores for answers that power our future. NASA exploration powers inspiration that engages the public and encourages students to pursue studies in challenging high-tech fields. NASA exploration powers innovation that creates new jobs, new markets, and new technologies that improve and save lives every day in every community. . . . NASA exploration powers discovery that enables us to better understand our Solar System and protect Earth through the study of weather and climate change, monitor the effects of the Sun and detect objects that could collide with Earth. Why explore? . . . Because exploration powers the future through inspiration, innovation, and discovery.[3]

In considering what space exploration has meant, or done, for the vast majority of people who are not a part of the "official" space community, what role do these official narratives play? Do people construct their own narratives and make their own meanings, in consideration of their own, specific cultural boundaries of gender, nationality, time, or space? Media commentaries on the 50th anniversary of the launch of Sputnik and the beginning of the Space

2. Vannevar Bush, Director of the Office of Scientific Research and Development, *Science: The Endless Frontier. A Report to the President*, July 1945. United States Government Printing Office, Washington: 1945. (letter of transmittal, n.p.)

3. NASA Message Construct, NASA Office of Communications Planning, June 1, 2007.

Age tended to repeat familiar and official narratives. The *New York Times* reported, for example, "Sputnik changed everything: history, geopolitics, the scientific world. It launched careers, too. . . . Sputnik lifted us into the future." The *Houston Chronicle* asserted, "Today the U.S. reigns over a growing cast of nations . . . on a vast new frontier," framing contemporary space exploration as the geopolitical enterprise it was depicted to be in the 1960s. Writing in the *Los Angeles Times*, Matthew Brzezinski (author of *Red Moon Rising: Sputnik and the Hidden Rivalries that Ignited the Space Age*) characterized space exploration since Sputnik as geopolitics as usual.

In contrast, the *Toronto Globe and Mail* offered a different 50th anniversary perspective on the meaning of space exploration. In an editorial entitled "Venturing into space and finding Earth," the paper made the claim that "the most significant achievement of the space age is a better understanding of the vulnerability of our own home planet."

University of California, Santa Barbara, cultural studies scholar Constance Penley is one of a small number of researchers who have explored alternative or subordinate narratives of space exploration. To young people and others for whom the official narrative of space exploration may not have been meaningful, she noted during comments at this meeting, the makers of *Star Trek* offered an alternative narrative, "a sustainable and inclusive vision" of a human future in space.[4] *Star Trek* producers have done a better job than NASA has of articulating a widely appealing vision. Today young people "are not interested in space unless they can participate in some way," Penley said, and while NASA "lives and dies by popular culture," they have just barely begun to engage with 18-35-year-olds via now-dominant social networks such as MySpace that provide broad opportunities for participation. Penley mentioned NASA Ames Research Center's creation of a meeting and working space on the social networking site Second Life and Ames's hosting of a public "Yuri's Night" party in 2007 as first steps toward a more participatory space program. She also mentioned private-sector initiatives to expand public participation in space exploration, such as the Google-sponsored Lunar X Prize competition to land a robotic explorer on the Moon.

During the meeting, Yale University historian, Bettyann Kevles showed how artists working in a range of media, from science fiction to dance to music, have interpreted and remembered the Space Age, making space exploration meaningful in ways not typically considered outside the space community. Kevles played an excerpt of a jazz suite composed and performed by saxophonist Jane Ira Bloom under commission by NASA's space art program. It is not clear what interest space exploration holds for contemporary artists.

4. Constance Penley, *NASA/TREK: Popular Science and Sex in America*. (New York, NY: Verso, 1997).

Margaret Weitekamp, the Curator at the National Air and Space Museum in charge of the museum's Social and Cultural Dimensions of Spaceflight collection, offered her views on how social and cultural products of the Space Age tell a story of space exploration that may converge with and diverge from the official narrative that tends to be embodied in the space hardware and technology that people typically think of as artifacts of the Space Age.

Finally, Alan Ladwig contributed a unique perspective to the discussion on what space exploration means to different sorts of people. As a NASA official in the 1980s and 1990s, Ladwig managed a variety of programs including the space agency's Teacher in Space and Journalist in Space programs and the Shuttle Student Involvement Program. These programs were intended to give people outside the traditional aerospace community a chance to engage directly in the experience of spaceflight. The space agency was not enthusiastic about implementing these programs, and in fact NASA did not proceed with the Journalist in Space program. Ladwig advocated organizing public events to engender public discussion about what space exploration means to different sectors of society. Precedent has been set: In the 1970s, the Committee for the Future held a series of syn-cons (synthetic convergences) to find out what space exploration means to different sectors of society[5]; the National Commission on Space, appointed by President Reagan in 1985 to develop a long-term plan for space exploration, held public forums around the country in 1985 and 1986 to solicit public opinion about the human future in space; and in 1992, NASA Administrator Daniel S. Goldin presided over a nationwide series of town meetings designed for the same purpose.

With China's efforts in space exploration typically framed in public discourse as a "race" with the West, it is clear that what we call the Space Age has not yet fostered a new global identity. Will 21st century space exploration achieve this goal? Here at the beginning of the new century, it is clear that the enterprise of space exploration has gone global. Will a new global identity emerge?

The 21st century cultural environment for space exploration is radically different from the cultural environment that nurtured the U.S. space program through its first 50 years. It remains to be seen whether NASA can, or will, respond to shifting public interests and concerns and give the people the kind of space program they want. The first step in reconfiguring the space program to survive and thrive in the 21st century is to involve citizens in the process, to ask what sorts of visions they have for a human future in space.

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5. Barbara Marx Hubbard interview by David S. Cohen for the Light Connection (accessed December 21, 2007), *http://208.131.157.96/fce/content/node/30*.

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Robert G. Kennedy, III, PE, took Heinlein's advice about a liberal education to heart. He is a registered professional mechanical engineer (robotics specialty for military, nuclear, and industrial applications) in Tennessee and California. He minored in Soviet studies and holds a special master of arts in national security studies, and speaks, reads, and writes Russian, Latin and, to a lesser degree, Arabic and Classical Greek. In 1994, he was selected as the American Society of Mechanical Engineers Congressional Fellow for that year, working for the Subcommittee on Space in the United States House of Representatives. Also in 1994, he was invited to present *Robert A Heinlein: The Competent Man* at the Library of Congress. In 1997, he published, manufactured and distributed the Russian CD-ROM *40th Anniversary of Sputnik: Russians in Space*. Also in 1997-1999, he served on the *Where To?* panel in the inaugural issues of The Heinlein Journal published by The Heinlein Society. He is an amateur military historian, published artist and writer on strategic affairs in the *Journal of the British Interplanetary Society* among other venues, and past chair of the American Society of Mechanical Engineer's (ASME) Technology & Society Division. He currently resides with his spouse and numerous cats under his own vine and fig tree in the Manhattan Project city of Oak Ridge, Tennessee.

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the most recent edition of Encyclopedia Britannica. Dr. Logsdon has lectured and spoken to a wide variety of audiences at professional meetings, colleges and universities, international conferences, and other settings, and has testified before Congress on several occasions. He has served as a consultant to many public and private organizations and is frequently consulted by the electronic and print media for his views on space issues. Dr. Logsdon is a member of the NASA Advisory Council and of the Commercial Space Transportation Advisory Committee of the Department of Transportation. In 2003, he served as a member of the Columbia Accident Investigation Board. He is a recipient of the Distinguished Public Service and Public Service Medals from NASA, the 2005 John F. Kennedy Astronautics Award from the American Astronautical Society, and the 2006 Barry Goldwater Space Educator Award from the American Institute of Aeronautics and Astronautics. He is a Fellow of the American Institute of Aeronautics and Astronautics and the American Association for the Advancement of Science, and a member of the International Academy of Astronautics and former Chair of its Commission on Space Policy, Law, and Economics. He is a former member of the Board of Directors of the Planetary Society and member of the Society's Advisory Council. He is faculty member of the International Space University and former member of its Board of Trustees. He is on the editorial board of the international journal *Space Policy* and was its North American editor from 1985–2000. He is also on the editorial board of the journal *Astropolitics*.

Dr. Logsdon has served as a member of a blue-ribbon international committee evaluating Japan's National Space Development Agency and of the Committee on Human Space Exploration of the Space Studies Board, National Research Council. He has also served on the Vice President's Space Policy Advisory Board, the Aeronautics and Space Engineering Board of the National Research Council, NASA's Space and Earth Sciences Advisory Committee, and the Research Advisory Committee of the National Air and Space Museum. He has served as the Director of the District of Columbia Space Grant Consortium. He is former Chairman of the Committee on Science and Public Policy of the American Association for the Advancement of Science and of the Education Committee of the International Astronautical Federation. He has twice been a Fellow at the Woodrow Wilson International Center for Scholars and was the first holder of the Chair in Space History of the National Air and Space Museum.

Robert MacGregor is currently a graduate student in the history of science program at Princeton University. Before coming to Princeton he studied at Rice University in Houston, Texas, where he received a B.S. in chemical physics and a B.A. in history. Robert has also studied at Moscow State University in Russia where he studied Russian language, history, and culture. His current work focuses on the processes in the U.S. government that lead to the formation of NASA between the launch of Sputnik in October 1957 and the signing into

law of the National Air and Space Act in July 1958. In the future, he plans to delve into the history of the Soviet space program and the early amateur rocket societies in Germany, the United States, and the Soviet Union.

Hans Mark became Deputy Administrator of NASA in July 1981. He had previously served as Secretary of the Air Force from July 1979 until February 1981 and as Under Secretary of the Air Force since 1977. Dr. Mark was born in Mannheim, Germany, June 17, 1929. He came to the United States in 1940 and became a citizen in 1945. He received his bachelor's degree in physics from the University of California, Berkeley, in 1951 and his doctorate in physics from the Massachusetts Institute of Technology in 1954. In February 1969, Mark became director of NASA's Ames Research Center in Mountain View, California, where he managed the Center's research and applications efforts in aeronautics, space science, life science, and space technology. He has taught undergraduate and graduate courses in physics and engineering at Boston University, Massachusetts Institute of Technology, and the University of California (Berkeley and Davis campuses). Following completion of graduate studies, Dr. Mark remained at MIT as a research associate and acting head of the Neutron Physics Group, Laboratory for Nuclear Science until 1955. He then returned to the University of California, Berkeley, as a research physicist at the University's Lawrence Radiation Laboratory in Livermore until 1958. He subsequently served as an assistant professor of physics at MIT before returning to the University of California's Livermore Radiation Laboratory's Experimental Physics Division from 1960 until 1964. He then became chairman of the University's Department of Nuclear Engineering and administrator of the Berkeley Research Reactor before joining the NASA team. Dr. Mark has served as a consultant to government, industry, and business, including the Institute for Defense Analyses and the President's Advisory Group on Science and Technology. He has authored many articles for professional and technical journals. He also coauthored the books *Experiments in Modern Physics* and *Power and Security*, and coedited *The Properties of Matter under Unusual Conditions*. He also published *The Space Station: A Personal Journey* (Duke University Press, 1987), and *The Management of Research Institutions* (NASA SP-481, 1984). When Dr. Mark left NASA in 1984, he became Chancellor of the University of Texas system, a post he held until 1992. He then became a senior professor of aerospace engineering at the University of Texas at Austin. In July 1998, he took a job at the Pentagon as the director, defense research and engineering. In January 2001, he returned to the department of aerospace engineering and engineering mechanics and the University of Texas at Austin.

Walter A. McDougall is the Alloy-Ansin professor of international relations and history and the University of Pennsylvania. His honors include the Pulitzer Prize for history, election to the Society of American Historians,

and appointment to the Library of Congress Council of Scholars. McDougall graduated from New Trier High School in Illinois in 1964 and Amherst College, Massachusetts in 1968. After serving in the U.S. Army artillery in Vietnam, he took a Ph.D. under world historian William H. McNeill at the University of Chicago in 1974. The following year he was hired by the University of California, Berkeley, and taught there until 1988, when he was offered the chair at Penn. McDougall is also a Senior Fellow at Philadelphia's Foreign Policy Research Institute where he edited its journal *Orbis* and now codirects its History Academy for secondary school teachers. His articles and columns have appeared in the *New York Times*, *Wall Street Journal, Los Angeles Times, Commentary*, and other national publications. An unabashed generalist, his books include *France's Rhineland Diplomacy 1914-1924: The Last Bid for a Balance of Power in Europe* (1978), *. . . the Heavens and the Earth: A Political History of the Space Age* (1985), *Let the Sea Make a Noise: A History of the North Pacific From Magellan to MacArthur* (1992), *Promised Land, Crusader State: The American Encounter with the World Since 1776* (1997), and *Freedom Just Around the Corner: A New American History 1585-1828*. His current project, *Throes of Democracy: The American Civil War Era 1829-1877*, will appear early in 2008. A lover of books, music from Bach to Bob Dylan, chess, sports, and politics, McDougall lives with his wife and two teenagers in suburban Philadelphia.

J. R. McNeill was born in Chicago on October 6, 1954. He studied at Swarthmore College and Duke University, where he completed a Ph.D. in 1981. Since 1985 he has taught some 2,500 students at Georgetown University in the history department and school of foreign service, where he held the Cinco Hermanos chair in Environmental and International Affairs before becoming University professor in 2006. His research interests lie in the environmental history of the Mediterranean world, the tropical Atlantic world, and Pacific islands. He has held two Fulbright awards, a Guggenheim fellowship, a MacArthur grant, and a fellowship at the Woodrow Wilson Center. He has published more than 40 scholarly articles in professional and scientific journals. His books are *The Atlantic Empires of France and Spain, 1700-1765* (Chapel Hill: University of North Carolina Press, 1985); *Atlantic American Societies from Columbus through Abolition* (coedited, London: Routledge, 1992); *The Mountains of the Mediterranean World* (New York: Cambridge University Press); *The Environmental History of the Pacific World* (edited, London: Variorum, 2001); *Something New Under the Sun: An Environmental History of the Twentieth-century World* (New York: Norton, 2000), co-winner of the World History Association book prize, the Forest History Society book prize, and runner-up for the BP Natural World book prize, and translated into six languages; and most recently *The Human Web: A Bird's-eye View of World History* (New York: Norton, 2003), coauthored with his father William H. McNeill. He also edited or coedited five more books, including the *Encyclopedia of World Environmental*

History (New York: Routledge, 2003). He is currently working on a history of yellow fever in the Americas from the 17th through the 20th centuries.

Amy Nelson received her Ph.D. from the University of Michigan and is currently an associate professor of history at Virginia Tech. A specialist in Russian and Soviet Culture, her current research focuses on the significance of non-human animals in Russian-Soviet History. She is writing a collective biography of the Soviet space dogs and, together with Jane Costlow (Bates College), is editing a volume of essays entitled, *The Other Animals: Situating the Non-Human in Russian Culture and History.* Nelson is the author of *Music for the Revolution. Musicians and Power in Early Soviet Russia* (Penn State University Press), which received the Heldt Prize for "The Best Book by a Woman in Any Area of Slavic/East European/Eurasian Studies," from the Association of Women in Slavic Studies in 2005. Her recent publications include, "A Hearth for a Dog: The Paradoxes of Soviet Pet Keeping" in *Borders of Socialism: Private Spheres of Soviet Russia,* ed. Lewis Siegelbaum (New York, 2006) and "Accounting for Taste: Choral Circles in Early Soviet Workers' Clubs" in *Chorus and Community*, ed. Karen Ahlquist, (Chicago, 2006).

Michael J. Neufeld is chair of the Space History Division of the National Air and Space Museum, Smithsonian Institution, Washington, DC. Born in Canada, he received history degrees from the University of Calgary and the University of British Columbia followed by a Ph.D. in modern European history from The Johns Hopkins University in 1984. Before Dr. Neufeld came to the National Air and Space Museum in 1988 as an A. Verville Fellow, he taught at various universities in upstate New York. In 1989-1990 he held Smithsonian and NSF fellowships at NASM. In 1990, he was hired as a Museum Curator in the Aeronautics Division, where he remained until early 1999. After transferring to the Space History Division, he took over the collection of German World War II missiles and, from 2003-2007, the collection of Mercury and Gemini spacecraft and components. In fall 2001, he was a Senior Lecturer at The Johns Hopkins University in Baltimore. He was named Chair of Space History in January 2007. In addition to authoring numerous scholarly articles, Dr. Neufeld has written three books: *The Skilled Metalworkers of Nuremberg: Craft and Class in the Industrial Revolution* (1989), *The Rocket and the Reich: Peenemünde and the Coming of the Ballistic Missile Era* (1995), which won two book prizes, and *Von Braun: Dreamer of Space, Engineer of War*, which is forthcoming in September 2007. He has also edited Yves Béon's memoir *Planet Dora* (1997) and is the coeditor of *The Bombing of Auschwitz: Should the Allies Have Attempted It?* (2000).

Emily S. Rosenberg is professor of history at the University of California, Irvine. Two of her books, *Spreading the American Dream: American Economic and Cultural Expansion, 1890-1945* and *Financial Missionaries to the World: The Politics*

and Culture of Dollar Diplomacy, 1900-1930, deal with the intersections of culture and economics in U.S. international relations. Her most recent book, *A Date Which Will Live: Pearl Harbor in American Memory* (also translated into Japanese), examines the issue of collective historical memory in a media age. She is a coauthor of *Liberty, Equality, Power: A History of the American People* (5th ed., 2007). She has served as president of the Society for Historians of American Foreign Relations (SHAFR); an editor of the *Oxford Companion to United States History*; a board member of the Organization of American Historians; and coedits the *American Encounters, Global Interactions* book series for Duke University Press.

Asif A. Siddiqi is assistant professor of history at Fordham University in New York. He specializes in the social and cultural history of technology and modern Russian history. His forthcoming book, *The Rockets' Red Glare: Spaceflight and the Russian Imagination, 1857-1957* (Cambridge University Press, 2008) is the first archive-based study on the social, cultural, and technological forces that made Sputnik possible.

Michael Soluri is a New York City-based photographer. His work has been published in editorial magazines like *Wired, Time, Discover, BBC Horizons,* and *GEO*, as well as in corporate, institutional, and nonprofit multimedia communications. He is a contributing editor and photographer for *Discover*, *Space.Com* and *Ad Astra*. Profiled in *Photo District News* and on *Space.Com* for his expertise in the photography and editing of human and robotic space exploration, he has lectured at the Smithsonian Institute and at the National Science Foundation. In an 18-month photographic documentation of the last service mission to the Hubble Space Telescope, Soluri secured exclusive access to the integration of flight hardware, EVA tools, engineering personnel, and the crew of SM4 that resulted in the first creatively controlled portrait session of an astronaut crew in more than 25 years. He was also invited by the crew to present a photo seminar on making more communicative, insightful photographs during their historic mission to the Hubble Space Telescope. In addition, since 2005, Soluri has been following and documenting the project scientists and technicians with NASA's New Horizons mission to Pluto and the Kuiper Belt. Currently published in eight languages, Soluri is coauthor and picture editor of *What's Out There—Images from Here to the Edge of the Universe* and *Cosmos—Images from Here to the Edge of the Universe,* for which he secured Stephen Hawking to write these books' forewords. He was a contributing editor for *The History of Space Travel*, a special edition of *Discover* commemorating 50 years of spaceflight. A former professor of photographic studies at the Rochester Institute of Technology, Soluri is currently adjunct faculty at Pratt Institute in New York City. He holds an MFA in photography from the Rochester Institute of Technology.

Margaret A. Weitekamp is a Curator in the Division of Space History at the National Air and Space Museum, Smithsonian Institution, in Washington, DC. As curator of the Social and Cultural Dimensions of Spaceflight collection, she oversees over 4,000 individual pieces of space memorabilia and space science fiction objects. These social and cultural products of the Space Age—including toys and games, clothing, stamps, medals and awards, buttons and pins, comics and trading cards—round out the story of spaceflight told by the museum's collection of space hardware and technologies.

Her book *Right Stuff, Wrong Sex: America's First Women In Space Program* (published by the Johns Hopkins University Press) won the Eugene M. Emme Award for Astronautical Literature given by the American Astronautical Society. The book reconstructs the history of a privately funded project that tested female pilots for astronaut fitness at the beginning of the Space Age. In addition, Weitekamp has also contributed to the anthology *Impossible to Hold: Women and Culture in the 1960s*, ed. Avital Bloch and Lauri Umansky (New York University Press, 2005). Weitekamp won the Smithsonian Institution's National Air and Space Museum Aviation/Space Writers Award in 2002 and served as an interviewer for *The Infinite Journey: Eyewitness Accounts of NASA and the Age of Space* (Discovery Channel Publishing, 2000). She spent the academic year 1997-1998 in residence at the National Aeronautics and Space Administration Headquarters History Division in Washington, DC, as the American Historical Association/NASA Aerospace History Fellow. She is a 1993 Mellon Fellow in the humanities. Weitekamp received her B.A. summa cum laude from the University of Pittsburgh and her Ph.D. in history at Cornell University in 2001. Before joining the Smithsonian Institution, Weitekamp taught for three years as an assistant professor in the women's studies program at Hobart and William Smith Colleges in Geneva, New York.

Acronyms and Abbreviations

AAAS	American Academy of Arts and Sciences
ABM	Antiballistic Missile
ABMA	Army Ballistic Missile Agency
AEC	Atomic Energy Commission
ARPA	Advanced Research Projects Agency
ASAT	Anti-Satellite
CaLV	Cargo Launch Vehicle
CERN	European Organization for Nuclear Research
CIA	Central Intelligence Agency
CLV	Crew Launch Vehicle
CNES	French National Space Agency (Centre Nationale des Études Spatiales)
CNSA	China National Space Administration
CNTA	China's National Tourism Administration
COPUOS	United Nations Committee on the Peaceful Uses of Outer Space
COSPAR	Committee on Space Research
DOD	Department of Defense
DOT	Department of Transportation
EEO	Equal Employment Opportunity
ELDO	European Launcher Development Organization .
ELV	Expendable Launch Vehicle
ESA	European Space Agency
ESRO	European Space Research Organization
EVA	Extra Vehicular Activity
FSA	Farm Securities Administration
GLONASS	GLObal Navigation Satellite System
GPS	Global Positioning System

ICBM	Intercontinental Ballistic Missile
IGY	International Geophysical Year
INKhUK	Moscow Institute of Artistic Culture
ISPM	International Solar Polar Mission
ISS	International Space Station
ITAR	International Traffic in Arms Regulations
JSC	Johnson Space Center
LEM	Lunar Excursion Module
MAD	Mutual Assured Destruction
MESA	Modularized Equipment Stowage Assembly
MLS	Manana Literary Society
MMU	Manned Maneuvering Unit
MNC	Multinational Corporation
MRI	Midwestern Research Institute
MRO	Mars Reconnaissance Orbiter
NACA	National Advisory Committee for Aeronautics
NAMC	Navy Air Materials Center
NASM	National Air and Space Museum
NASP	National Aero-Space Plane
NDEA	National Defense Education Act
NEAR	Near Earth Asteroid Rendezvous
NEP	New Economic Policy
NGO	Non-Governmental Organization
NKVD	People's Commissariat Internal Affairs
NSC	National Security Council
NSDD	National Security Decision Directive
NST	Nuclear and Space Talks
OCST	Office of Commercial Space Transportation
ODM	Office of Defense Mobilization
OPF	Orbiter Processing Facilities
OSI	Office of Special Investigations
OTA	Office of Technology Assessment

PAO	Public Affairs Office
PSAC	President's Science Advisory Committee
R&D	Research and Development
SAC	Strategic Air Command
SALT	Strategic Arms Limitation Talks
SAO	Smithsonian Astrophysical Observatory
SAR	Synthetic Aperture Radar
SDI	Strategic Defense Initiative
SEI	Space Exploration Initiative
SIG (Space)	Senior Interagency Group for Space
SLBM	Submarine-Launched Ballistic Missile
SOHO	Solar and Heliosperic Observatory
SRTM	Shuttle Radar Topography Mission
START	Strategic Arms Reduction Treaty
TCP	Technological Capabilities Panel
TVA	Tennessee Valley Authority
UAH	University of Alabama in Huntsville
UNESCO	United Nations Educational Scientific and Cultural Organization
USAAF	United States Army Air Force
USAF	U.S. Air Force
VAB	Vehicle Assembly Building
VDNKh	Exhibition of Achievements of the National Economy
VSE	Vision for Space Exploration
WPA	Work Projects Administration

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