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SPACE TIMES

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IN THIS ISSUE:

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American Astronautical Society

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President's Message

As I was driving to work this morning, June 24, I was listening to a promotional music CD I'd recently received in the mail from a group called Prometheus Music. The album is called *To Touch the Stars: A Musical Celebration of Space Exploration*. Although the music style might not appeal to everyone, its songs like "Fire in the Sky," "The Pioneers of Mars," and "Dance on the Ceiling," were fun and inspirational. While I don't intend to turn this note into an ad for this particular group, I mention it to make the point that we need more things like this album—more TV shows, more movies, more mainstream press coverage, and the like—to inspire our kids to aspire to become scientists or engineers (or astronauts!) and to inspire their parents to enthusiastically support the space program with their hard-earned tax dollars. These are critical times for space programs—not just for the NASA exploration missions but also for civil environmental satellites, defense space systems, and international collaboration. Never in recent memory has there been more attention paid to opportunities in space, and never has there been a greater need for the support of the community to turn those opportunities into reality.

Yesterday, June 23, the Coalition for Space Exploration met here in Washington to coordinate the efforts of the public affairs and government affairs experts from industry and professional space associations to build support for the president's vision for space exploration. While we were meeting, the NASA administrator was announcing a transformation of the NASA organization. And a few hours later, we were invited to hear Presidential Science Advisor John Marburger, NASA Associate Administrator for Exploration Systems Craig Steidle, and White House Chief of Staff Andy Card give a pep talk and an update on the new vision for NASA. It was quite a day, but it wasn't over for me. That night, I had the privilege of speaking with the members of this summer's NASA Academy class at the Goddard Space Flight Center. The program's participants, nineteen college students and recent grads, are among the very best and brightest young people in the country. The vision we professionals are being handed to support and execute is *their* future even more so than it is ours. But the responsibility to inspire them and to provide opportunities to them is *ours*.

The AAS is now a full member of both the Coalition for Space Exploration and the Space Exploration Alliance, and our members as space professionals are important participants in the exciting events unfolding around us. Halfway through my first year as your president, I couldn't be more proud of my affiliation with the AAS; I hope you are proud of your affiliation, too. Together, we face the challenge of strengthening the space program because it's simply the right thing to do. We can only "Touch the Stars" if the United States and our international partners have a strong program, supported by our governments and executed by professionals. Let's keep reaching.

Jon Malay

ON THE COVER

Mike Melvill stands victoriously atop *SpaceShipOne*, the spacecraft he piloted on June 21, 2004, to become the first person to reach space aboard a privately developed vehicle. Built by Scaled Composites of Mojave, California, and financed by Paul Allen, *SpaceShipOne* reached an altitude of one hundred kilometers during its sub-orbital flight. The spacecraft landed safely ninety minutes after take-off. (Source: Jeff Foust)

American Astronautical Society's Response to the Report of the Aldridge Commission

The Executive Order creating the President's Commission on Implementation of U.S. Space Exploration Policy (Aldridge Commission), signed by the President on January 27, 2004, directed the Commission "to provide recommendations to the President, in accordance with this order, on implementation of the vision outlined in the President's policy statement entitled 'A Renewed Spirit of Discovery' and the President's Budget Submission for Fiscal Year 2005." On June 16, 2004, the Commission responded to the President in a report containing fourteen thoughtful and compelling recommendations.

The members of the American Astronautical Society (AAS), a professional society dedicated exclusively to astronautics, have been participants in America's space program throughout its history. We appreciate the challenges faced by the Commission in compiling its recommendations in the short time allotted. The AAS recognizes that the Commission's recommendations are the first important step toward formulating an executable implementation plan for space exploration. AAS members intend to be on the front lines of developing and executing that plan.

The manner and pace in which the Commission's recommendations are executed will have profound effects on the careers and personal aspirations of AAS members who are dedicating their professional lives to the exploration and development of space. With this in mind, we offer the following thoughts on the recommendations, presented in the order in which they appear in the report.

- **Establishment of a space exploration steering council.** Establishment of such a group reporting to the president would provide an important voice in top-level policy-making and integration of interagency activities. Lessons learned from previous incarnations of White House space councils should shape the creation of this new council.

- **Greater participation by the private sector.** Three recommendations address this topic, constituting perhaps the most important message in the report. Given the scope and duration of the exploration initiative, it is clear that the resources NASA (or even an international coalition of space agencies) could bring to bear would be inadequate. It will be many years before a business case can be made for commercial investment at the level inferred in the report, but at some point in the future, the private sector—including non-aerospace companies—will need to start carrying a major part of the load or else this expansive effort will stagnate.

- **Transforming NASA.** The organization and management of the space agency are a major thrust of the report. Three recommendations include 1) transformation of NASA into a "leaner, more focused" agency; 2) creation of three organizations within NASA to provide advice on technology and risk mitigation, independent cost estimates, and high risk/high payoff technology development; and 3) conversion of NASA field centers into federally funded research and development centers (FFRDCs).

  The AAS believes these changes merit serious consideration, recognizing that they could have significant long-term impacts, hopefully including visible improvements in productivity, effectiveness, and creativity. However, it is more important to get it right than to get it quick. Many thousand dedicated space professionals, key research facilities, and the work of at least a generation will be affected.

- **International collaboration.** The Commission feels that "It is hard to envision a national space program based on exploration solely by the United States or any future human spaceflight mission that would be flown only by Americans." However, the report suggests that international participation agreements will be pursued "after establishing the vision architecture and determining what the United States is willing to cede." This approach could alienate potential international participants, who expect

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AAS Welcomes TBSG Government Technologies LLC

AAS welcomes Telecommunications & Business Strategies Group, Ltd. (TBSG) as our newest corporate sponsor. TBSG is a management consulting firm specializing in marketing strategy and business planning for the technology industry. Check http://www.TelecomStrategies.com for more information.

The Coalition for Space Exploration: Commitment and Action at Work

The AAS has joined a committed group of representatives from the aerospace industry, trade unions, and fellow professional societies in the Coalition for Space Exploration. The Coalition's mission is to support the vision for space exploration announced by President Bush in January 2004 so as to ensure that the United States will remain a leader in space, science, and technology. Two parallel Coalition teams have been formed: the public affairs team, established in January, and the government affairs team, which was formed in February. AAS President Jon Malay and Executive Director Jim Kirkpatrick are participating in the government affairs team, which is co-chaired by Michelle Robbins of Lockheed Martin and Roselee Roberts of Boeing. In addition to tracking the progress of space exploration policy and rendering advice and guidance to the public affairs team on messages and audiences for the public outreach efforts, the government affairs team has been creating and disseminating team white papers on Capitol Hill. Team members are working aggressively with budget, authorization, and appropriations committee members and staffs to garner support and generate enthusiasm for the nation's vision for space exploration. The team has been meeting at least once weekly since February, often with key members of Congress and staff.

The public affairs group was created to fund, direct, and develop appropriate public outreach activities, such as advertising, web communication, editorial, and media placement efforts—all of which are intended to generate momentum and enthusiasm for the vision. This team is chaired by Jeff Carr, director of communications for United Space Alliance. Brian Chase of the Space Foundation has volunteered to coordinate activities between the two Coalition teams. The Foundation has also created an "action center" at its headquarters in Colorado Springs for coordinating the public affairs activities, developing and distributing source materials for editorial and public communications, and maintaining the www.spacecoalition.com web site. The government affairs web site is www.space-exploration.us, which provides a wealth of information about the vision, details of its implementation in the president's budget request for FY 2005, and the legislative activities currently underway. AAS members and readers of *Space Times* are strongly encouraged to go to these web sites to learn more about the Coalition and the vision for space exploration—and to get involved in supporting the vision. ■

Most of this article is drawn from the Coalition's pamphlet, "Continuing the Journey One Step at a Time."

Final Call For Officer and Director Nominiations

Each year the Society must elect (or re-elect) a slate of eleven officers and one third of the Board of Directors. A Nominations Committee will select qualified candidates, who will then be placed on the ballot and voted on by the membership in the fall. What can you do? Consider being a candidate for the Board of Directors—or maybe an officer. Perhaps you have a friend or colleague who would be interested in a leadership role in AAS as we move toward our fifty-first year. A current list of officers and the composition of the Board is listed on the inside cover of *Space Times*. If you have a name for the Nominations Committee to consider, please contact the AAS Business Office.

Competitive Slate For Elections? Your Opinion is Requested

How do you feel about being offered more than one candidate for officer and director positions on the annual ballot? AAS has historically expected the Nominations Committee to recommend one qualified candidate for each elective position. Members are then presented with a ballot that allows them to either validate the entire proposed slate or write in an alternative choice. The Executive Committee is interested in knowing how strongly members feel about having a competitive slate for the annual elections. Please email the AAS with your opinion on this issue (aas@astronautical.org).

The Launch of *SpaceShipOne*: Rutan's Successful Approach to Space Flight Development

A clear goal, committed funding, and strong leadership focusing on the simplest solutions combine to produce dramatic, flying results.

by David West Reynolds

A brisk desert wind sweeps across the open landscape. It is 5:15 a.m. on the morning of June 21, 2004, and the sun is rising over the hills in Mojave, California. As the world's first private spacecraft is readied for its first brush with space, we are here to watch the dawn of a new era in space flight.

Burt Rutan's *SpaceShipOne* and its carrier plane, *White Knight*, funded by philanthropist and Microsoft billionaire Paul G. Allen, represent revolutionary thinking in aerospace development. Today Rutan has invited a large audience to watch his team prove that they have, in the words of Tom Wolfe, the right stuff.

In the area of commercial space development, many people make promises; few deliver. Remember LunaCorp's commercial moon rovers, "on the Moon by 1999?" *Facta non verba*, say skeptics: give us deeds, not words. Working in a hidden hangar at Mojave, Rutan has kept quiet to the point of being secretive. As with all of Scaled Composites's thirty-four manned aircraft to date, the world-famous designer unveils his work when he is ready to show what it can do.

Rutan's openness today demonstrates the degree of his confidence. Tens of thousands of people have responded to his invitation, and I am among 550 journalists attending alongside VIPs such as Buzz Aldrin and rocket scientist Konrad Dannenberg. NASA, we are told, has sent one person.

Stu Witt, the manager of Mojave Airport, asks the crowd to stay behind the fences and "not rush the airfield like in 1908," drawing a direct comparison between today's event and Wilbur Wright's famous demonstration flight in France. Is this stretching things? I wonder.

* * *

I am accustomed to the great milestones of aerospace being ancient history. The "greatest generation" of aerospace seemed to have done its deeds in the 1950s and 1960s, mostly before I was born. In my own time, astronaut space progress seemed to come to a halt after the *Columbia*'s first launch in 1981. The shuttle never went anywhere new, and the International Space Station seemed like a weaker version of the more capable and productive Apollo *Skylab* of the 1970s. My generation grew up with stories about an exciting astronaut future that never came to pass. The "higher and farther" heyday of the X-15 and the Apollo landings came to seem like a mythic age of heroics fading into golden legend, to live on only in the poetry of latter-day Homers like Wolfe.

White Knight and *SpaceShipOne* appeared on the tarmac with a jet turbine roar. The exotic curves and strange shapes of the vehicles looked at once "retro" and futuristic. Elegant, beautiful, gleaming, extraordinary: this was what the twenty-first century was supposed to look like. Onto the runway before my eyes taxied a vision of the future we were promised.

The sight of *SpaceShipOne* moving toward me brought alive images from history and imagination in my

The Messerschmitt Komet *was a German rocket plane of World War II that pioneered spectacular velocities and climb rates: it could hit almost 970 kilometers per hour and climb 12,000 meters in three minutes. It was the only rocket interceptor ever fielded. Through "convergent evolution,"* Komet's *fuselage profile very closely resembles the profile of* SpaceShipOne. *(Source: Jeffrey L. Ethell)*

mind's eye. The fuselage looked almost identical to the *Messerschmitt Komet* and reminded me of a cutaway rocket sketch I had seen in one of Wernher von Braun's school notebooks from when he was sixteen. With its fully faired-in canopy *SpaceShipOne* also resembled the Bell X-1, with added empennage. And the carrier plane air-launching a ship that would rocket up to above one hundred kilometers, here was a reincarnation of the flight profile of the legendary X-15 itself. In 1970s science-fiction television (Gerry Anderson's *UFO*), I had watched this concept taken farther, with a custom-designed carrier plane air-launching an astronaut vehicle which rocketed all the way into space. Now I was looking at the reality of exactly that scenario.

At 6:30 *White Knight* lifted upward into the clear blue sky like a jet-powered seagull, circling toward the release altitude of about 14,000 meters. An hour later we had to look almost straight into the sun to see the rocket contrail bursting from a barely-visible speck that the plane had dropped. The contrail weaved a little and then shot straight up, gaining speed and moving unbelievably fast. An adrenaline gasp rose from the crowd, as if we could feel the G forces that test pilot Mike Melvill was experiencing inside *SpaceShipOne*.

At 8:15 the spacecraft touched down at the airstrip amidst tumultuous cheers, even from the reporters who were supposed to be covering this objectively. People marveled at the portent and wondered what it might mean, as Rutan predicted a coming era of low-cost space access and space tourism made practical and affordable within a generation. This time the predictions were coming from a man of uniquely demonstrated credibility. The Federal Aviation Administration gave Stu Witt Mojave's certification as the first inland spaceport and handed to Mike Melvill the first astronaut wings awarded to a private pilot.

Konrad Dannenberg has witnessed much of the history of rocketry first-hand. A propulsion engineer for Wernher von Braun in Germany and in America, Dannenberg watched the *SpaceShipOne* launch as an honored guest invited personally by Rutan. "For me," Dannenberg said, "it was an unforgettable display which is in the same class as the first successful launch of a rocket in Peenemünde, now more than sixty years ago. I will never forget the excitement I felt during both of these events."

Made famous by Chuck Yeager's successful first flight through the sound barrier in 1947, the Bell X-1 rocket plane closely resembles SpaceShipOne *in fuselage shape and its completely faired-in canopy. Besides* SpaceShipOne*, the X-1 is the only other supersonic vehicle to have employed manual flight controls. (Source: NASA)*

Succeeding Where Others Fail

SpaceShipOne took off almost literally under the shadow of previous failures by Rutan's peers. The vertical assembly building for the *Roton* loomed high over the launch site of *SpaceShipOne*, the building's chipped "Rotary Rocket Company" sign deteriorating like memories of the failed *Roton* project. And in spite of grand claims by many of the more than two dozen teams that have signed up for the Ansari X Prize, Rutan seems to have no really credible competition. At this writing, not one of the other teams has yet fielded a manned test launch, and the prize expires on January 1, 2005.

At "the other space agency," as Rutan calls NASA, progress with X-planes and similar projects has been only somewhat better in recent years. At Mojave many of us remembered the pad explosion that wiped out the DC-XA Delta Clipper project in 1997. On the other hand, few of us could recall the last piloted NASA X-plane that actually got off the drawing board and reached a successful conclusion. X-33, X-34, X-38...how many hundreds of millions of dollars and studies, and no piloted aircraft? Rutan has put a three-seater *SpaceShipOne* one hundred kilometers high just three years after shaking hands on his project's funding in 2001, and he has done it for $20-30 million.

Compared to others working at the edge of the envelope, one cannot deny that Rutan's operation is distinctively productive, quick, and inexpensive. His rapid progress recalls the heady days of the 1960s when a few years meant radical advances in aerospace technology, a pace that seems worlds removed from NASA's shuttle-era stasis. As Rutan pointed out, for the price of a minor NASA paper study he has developed and constructed not just a space vehicle but an entire manned space program from scratch: a rocket motor, a launch vehicle, a simulator and training system, new avionics, a mission control center, and a rocket motor test facility.

Having reached almost Mach 3 on its first flight to space, SpaceShipOne *is engineered to control well at supersonic speeds, but the vehicle also functions as a good glider. Like craft such as the X-1, X-15, and the space shuttle orbiter,* SpaceShipOne *glides in for recovery and landing. Seen here on a test flight,* SpaceShipOne *has a relatively low landing speed of 145 kilometers per hour. (Source: Scaled Composites)*

Why did Rutan succeed where others have failed and where NASA seems stalled? Rutan combines the vision and passion of a dreamer with the pragmatism of an accomplished aerospace engineer in a fashion we have not seen since Wernher von Braun. But clearly there is more to Rutan's success than this unusual balance. "He tries to do things the way Wernher did," said von Braun colleague Dannenberg. "Keep it simple, go step-by-step, build up a good team and depend on them. I believe he succeeded in doing it."

For the price of a minor NASA paper study Rutan has developed and constructed not just a space vehicle but an entire manned space program from scratch.

Keeping It Simple

The new hybrid engine design in *SpaceShipOne* combines the virtues of both solid and liquid fuel and avoids the traditional drawbacks of either. Where solid-fuel rockets are notoriously hard to control, and explosive liquid rocket fuels can be difficult and dangerous to work with, *SpaceShipOne*'s engine employs a rubber-like compound as fuel and nitrous oxide as oxidizer. In Rutan's patent-pending design, the nitrous oxide self-pressurizes in its separate tank, obviating entirely the need for a turbopump to feed it into the combustion chamber where the fuel slug is contained. The engine nozzle is an uncomplicated, single-use, disposable ablative construction that is simply replaced after each full use rather than super-engineered like a classic Rocketdyne tubular-shell regenerative cooling engine.

Rutan's team spent a great deal of time reviewing and selecting the best possible propulsion system rather than spending that time working through the difficult development of a more complex design. The result of this careful selection and minimized development is an exceptionally safe, reliable, affordable, and easy-to-use system, requiring none of the elaborate safety precautions that attend high-energy fuels.

The "feathered" re-entry system employed by *SpaceShipOne* adopts a completely different approach than that endured by the X-15 upon its return from similar altitudes. Frederick C. Durant III, engineer and former assistant director of astronautics at the Smithsonian National Air and Space Museum, observes that Rutan's new system is pioneering an unexplored aerodynamic regime. Pivoting the empennage and half of the wing surfaces upward at ninety degrees upon apogee gives *SpaceShipOne* an extremely high drag for its low weight. Like a badminton shuttlecock, the vehicle begins to decelerate significantly at high altitude, rather than plunging like a lawn dart at very high speed into the thicker layers of the atmosphere as did the X-15. The X-15 looked (nobly) burnt and battered after its high-speed re-entries, while to my astonishment *SpaceShipOne* touched down still as shiny as if it had never left the showroom. Re-entry heating was apparently negligible. Along the way, the feathered re-entry configuration self-rights itself, allowing a "carefree" and safe re-entry phase that needs no piloting. Through the use of an ingenious, extremely simple device, Rutan sidestepped one of the toughest challenges of reaching and returning from extreme altitudes.

Rutan was the first to admit that achieving orbital velocities and altitudes represents a challenge of another order of magnitude with dramatically higher velocities and re-entry stresses. But if a descendant of his system can help future spacecraft avoid the fiery trial that destroyed *Columbia*, this alone would form a substantial legacy of *SpaceShipOne* and a striking testament to the value of spending effort search-

ing for the simplest solution rather than maximizing sophisticated technology.

The architecture of the *White Knight/SpaceShipOne* system has allowed Rutan the luxury of incrementally testing the entire vehicle, an option not available to teams attempting ballistic rocket development. Rutan has pursued cautious, step-by-step progress, with data acquired at each stage factored back into development. This method minimizes unknowns at each step and has resulted in a very successful system that was robust enough to weather the failure of the trim system at apogee and return safely and without incident, relying on backup systems for control. The approach exhibits the kind of prudence that enabled von Braun's entire Saturn rocket series to launch without a single failure. "A good engineer is a conservative engineer," Rutan said after the launch. "We are willing to take risks in order to achieve breakthroughs, but we work to understand and minimize those risks."

Rutan's personnel group is very small, numbering less than two dozen at the time of the launch, and they stand behind him much like von Braun's famous rocket team did. Of his own approach, Rutan says simply, "You take a few real smart guys, you mix them with a bunch of guys that don't mind sweating really hard, and you give them something fun enough that they put their hearts in it... and you'll be shocked at what you can do."

Rutan's small team size also means that accountability can be high, and responsibility is not dissipated by committee decisions. Accountability and responsibility are important motivators that have at times seemed alarmingly absent in "the other space agency."

I have to confess that I did not think much of the Ansari X Prize when it was first announced, especially when I heard that one of the teams was trying to redevelop the V-2: what kind of "progress" is the re-construction of a museum piece? And if any of the unlikely efforts did succeed, how valuable anyway would it be to produce a ballistic hop to just 100 kilometers—half of what Nikita Khrushchev once dismissed as a "flea jump?"

Prize founder Peter Diamandis says that the goal of the Ansari X Prize is to "usher in a golden age of space flight." True space flight requires reaching orbit, and whether the X Prize flights will lead to the development of orbital vehicles very much remains to be seen. But if the Ansari X Prize produces nothing more than the proven innovations of feathered re-entry and a new hybrid fuel system, Diamandis's vision will have fostered worthwhile milestones that have the potential for profound impact on space access.

The Ansari X Prize also contributed a critical element to Rutan's success: a crystal-clear goal. *SpaceShipOne* has been precisely developed to meet the requirements of the X Prize (three seats to 100 kilometers with a two-week turnaround). As Apollo showed, in stark contrast to its much less successful sequels, a clear goal is vital for effective space development. "Thanks to the X Prize for the inspiration," Rutan said. After seeing that launch and reflecting on what had happened in Mojave, I finally felt inclined to echo his words. ■

***David West Reynolds, Ph.D.*, is the author of *APOLLO: The Epic Journey to the Moon* (Harcourt, 2002) and director of the San Francisco-based science/media organization Phaeton Group (www.phaetongroup.com).** **This article was supported by Phaeton Group Space Division.**

The Next Logical Step? Space Stations and the Future of American Human Space Flight

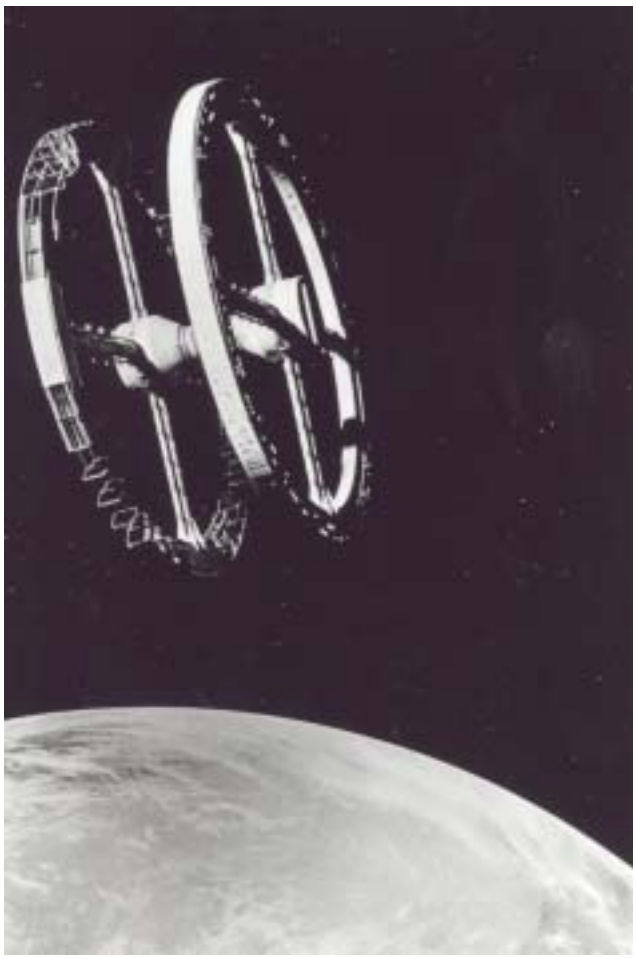
President Bush's space vision may terminate U.S. participation in the International Space Station in the middle of the next decade, but the decision does not take away from the valuable role orbiting facilities can have for exploration and other space goals.

by Roger Handberg

Politics giveth and politics taketh away. That aphorism neatly summarizes the state of the American human space flight program since its inception in the 1950s. The new presidential initiative announced in January 2004 puts the United States on the road to the Moon yet again and ultimately to Mars and beyond. This is the third attempt; President Richard Nixon rejected such a proposal in 1969, and the second in 1989 died from congressional indifference and rejection. The goal is to revitalize America's effort by providing leadership for the next phase: the movement beyond Earth orbit by humans. Other states are welcome to join the effort, but the overtones are that the United States will lead, others will follow. That has been the usual pattern historically. One facet of—or more accurately, omission in—that program is the question of the International Space Station (ISS) and successor space stations.

The Next Logical Step

From the earliest days of the space age after World War II but before *Sputnik* in October 1957, the concept of a space station was the centerpiece of most plans for humans in outer space. As Roger Launius calls them in the title of his recent book, space stations were "base camps to the stars." In the early 1950s, Wernher von Braun with artist Chesley Bonestell provided the vivid vision of a space station orbiting Earth as a workplace and home of humans; the majestic "wheel" in space fed the imagination of a generation. By comparison, real space stations look like Tinker Toy arrangements, ungainly and awkward despite their lonely prominence in the heavens.



The "wheel" space station from the movie 2001: A Space Odyssey *(1968), shown here, was based on Wernher Von Braun's model and remains the classic concept for a space station in the minds of many. (Source: NASA)*

From the earliest days of the post *Sputnik* period, space stations were considered as military outposts and centers for scientific research. The Soviets embarked on a series of space stations beginning with the Salyut series in 1971 and culminating in the *Mir* space station. The *Mir* was deorbited in the spring of 2001. The United States also pursued the concept of a space station as part of its 1960s Apollo lunar landing program. For reasons of time and technical difficulty, a space station was not built; rather, a lunar orbit rendezvous approach was chosen. The first American *Skylab* space station, using converted Saturn equipment, reached orbit in 1973 but fell back to earth in 1979 after only three expeditions to the station. NASA had earlier lost its bid for a large-scale continuation of the Apollo effort with a proposal to return to the Moon and push on to Mars. That proposal included an Earth-orbiting space station along with a lunar-orbiting space station in order to facilitate movement through translunar space.

Instead, the balance of the 1970s and early 1980s was spent building the space shuttle, the only portion of the 1969 plan approved, as the vehicle to service an Earth-orbiting space

station. In response, NASA portrayed a space station as the "next logical step" if human space flight was to become routine and less costly. The space station would provide a safe haven and work location for astronauts without requiring that they be lifted to orbit repeatedly. After intense lobbying by NASA, President Ronald Reagan approved a space station concept in 1984, announcing it at the State of the Union Address.

For NASA, the balance of the 1980s was spent struggling to overcome congressional skepticism and internal struggles over the program's direction and leadership. By 1993, a thoroughly frazzled space station program avoided cancellation by a single vote in the House of Representatives. The Superconducting Super Collider, a multibillion-dollar physics project, did not survive the congressional process that same year. Later in 1993, the space station program was recast by incorporating the Russian Federation. The space station program was transformed from Space Station Freedom, a direct challenge to the defunct Soviet Union, to the ISS with multiple international partners. Two partners, Canada and Russia, were placed squarely in the critical path of station construction, meaning a failure by either could significantly impact completion of the ISS.

The ISS moved forward through the late 1990s by fits and starts as various budgetary and technical issues were painfully resolved. As it turned out, construction of the ISS in space proved manageable. As construction picked up, the entire assembly process came to an abrupt stop when the space shuttle *Columbia* broke up during re-entry on February 1, 2003. The United States entered a period of suspended animation while the Columbia Accident Investigation Board (CAIB) examined the record and answered why the shuttle breakup occurred. Simultaneously, the U.S. space shuttle program entered a flight hiatus of indefinite length. After the *Challenger* accident in January 1986, over two years passed before a return to flight occurred.

Riddled with budgetary and technical problems since its conception, the International Space Station will lose U.S. involvement by the end of the next decade. (Source: NASA)

Ancillary to the CAIB investigation, there arose a brisk discussion about future directions for the U.S. human space flight program—life after the shuttle, in effect. One popular analogy was that the United States was on a merry-go-round of repeated shuttle flights to low Earth orbit (LEO) and back. Human missions remained restricted to LEO with no real effort made at moving beyond that location. NASA was criticized for the timidity of its vision for humans entering outer space. What was lacking was any real acknowledgement that NASA's choices are always constrained by its political masters, especially Congress. NASA's attempts at large-scale human programs were ridiculed as being simply the acting out of some "Apollo complex." This translated into announcing large-scale crash programs with no political backing, so the programs promptly fell to Earth and burned in the legislative process. The space shuttle and the ISS remain two legacies from those earlier efforts. The larger issue became the tunnel vision these two programs by their existence imposed on American crewed flight efforts. Moving beyond was difficult when NASA continually struggled just to run in place.

Has the Next Logical Step Become Illogical?

On January 14, 2004, President George W. Bush announced a new American exploration initiative. As presently described, the human space flight portions of that long-range effort will move through several stages. First, the ISS will be completed using the space shuttle for transporting crew and modules to orbit. Those construction efforts should conclude in the 2010-2012 window (the exact date may depend upon when the space shuttle returns to flight). Upon the ISS's completion, the space shuttle will be shut down and relegated to museums. Second, the United States by approximately 2016 will terminate its research activities on the ISS. Those research activities will concentrate upon questions related to human space flight—especially long-duration events. Third and concurrently with the first two, the shuttle replacement for

Russia's Mir *space station, shown here with the space shuttle* Atlantis *docked to it in 1995, provided a platform for investigating the physiological impacts of long-duration human space flight. (Source: NASA)*

crew movement to orbit and beyond, the Crew Exploration Vehicle (CEV), will be designed and brought on line by 2014. Crews and cargo will travel to orbit using different vehicles. This sequence of events puts the United States on the path of conducting its civil human space flight program exclusively as an exploration endeavor. This kills for good NASA's commercial ambitions, so prominent in the shuttle's early years until the 1986 *Challenger* accident.

What drops off the map literally for the United States around 2020 is the ISS. The ISS under this scenario will not be replaced, or at least the United States will not be intimately involved in its replacement. The American budget commitment is to Project Constellation; a replacement space station becomes a sideshow or diversion. Possibly a truly international space station might emerge given the growth in the number of states interested in human space flight. Earlier, with the ISS, cost factors plus American willingness to bear a disproportionate share of the cost meant other states were relieved of the necessity to lead. Many of the ISS partners became less than charmed by U.S. unilateralism regarding ISS decisions, but that burden was ultimately bearable when the United States picked up the tab. A truly international space station, without the United States, would demand that all partners participate and pay their pro-rata share of the total bill. Multilateralism will get a workout. U.S. participation and willingness to pay therefore will no longer be an excuse for partner inaction. Whether the United States would be allowed access to any successor space station becomes an interesting question given the nation's reluctance to allow certain states access to the present ISS.

If ideology is the driver, then the logical answer is that the private sector will build the ISS successor for commercial purposes. In this scenario, space tourism might be an important factor, although that assumes the cost to reach orbit will significantly decline over time. This variant of a space station would be based on private investments made in anticipation of future profits. In principle, the United States should be able to access the space station provided it pays the requisite fees. This, however, assumes the private owners are friendly towards the United States—or at least their government sponsor is willing to allow such a visit. Both the international and commercial scenarios are long term with indefinite dates for station construction and occupancy. Their likelihood at this point is unclear given the existing gap between rhetoric and funding.

The third scenario is that a space station may be constructed by another state such as China. Chinese ambitions are, at least at this time, rhetorically open-ended, although fiscal realities are forcing adjustments. For the United States, China may prove reluctant to allow access, a *quid pro quo* for present U.S. policies regarding the ISS.

Why a Space Station?

All of the above scenarios assume the United States actually desires access to a space station if available. Clearly, political pronouncements do not negate the value of an Earth-orbiting space station. As a matter of policy, space shuttles are presently to fly only to the ISS since it will act as a safety net in the event of trouble with the vehicle. That safety need apparently vanishes with the CEV's arrival. So, once the ISS is de-orbited, the CEV crews in effect will be relying upon near-perfect flight operations by this new, untried flight vehicle—a scenario eerily similar to that of space shuttle flights before the *Columbia* accident. Crew safety is job one today but apparently not tomorrow. The logic is baffling and defies recent flight experience. If the shuttle is truly that unsafe and the CEV so safe, then the former should be grounded imme-

diately rather than waiting until 2010 or 2012.

This subterranean safety issue is disguised by the fact that the CEV remains a paper concept at best. Thus, the crew safety question is among many that are unresolved. Improving safety will obviously be a program priority, but one must remember that *Apollo 1* in 1967, *Challenger* in 1986, and *Columbia* in 2003 were thought safe until disaster struck. Space flight remains a dangerous endeavor—a reality one ignores until disaster strikes.

Space stations can also act as base camps where supplies and equipment can be pre-positioned. Any flight to orbit is expensive and time-consuming to organize, prepare, and launch. Going to the store for more supplies and spare parts is not really an option once in Earth orbit. Building a supply cache in orbit becomes more rational than attempting just-in-time deliveries à la Walmart. Launch failures and other events can drastically disrupt schedule: witness the long delay while the Russians built and launched the *Zvezda* service module or the hiatus after the *Columbia* accident. Lifting crews repeatedly to orbit just increases their risk factor.

One argument against the ISS is that the station does not orbit in a location favorable for launching voyages to the Moon and beyond. In truth, the ISS was placed in its particular orbit for political reasons, accommodating the Russians when they joined the ISS program. With the new exploration initiative, if a space station is thought necessary, it will be placed where it accommodates the larger exploration goal. Unfortunately, the ISS lacked such a larger purpose, making a politically-driven placement acceptable. International partners will likely join the exploration program, although their participation will likely be looser, paralleling the American effort rather than becoming tightly integrated into the program's core components. There is dissatisfaction with NASA's stewardship of the ISS program. Some Europeans in fact see the ISS and now the exploration initiative as an American attempt to continue dominating the human space flight agenda.

Against that background, the United States may need to readdress the question of a space station. Such a structure can be much less complex if its purpose becomes to serve as a bunkhouse for whatever crews are present. The human role would become one of preparing and sending payloads out to the Moon and marshalling resources for voyages further out into the deep. The original 1984 American space station proposal envisioned that eight functions would be accomplished. That number continually shrunk as costs escalated.

Now the question concerning what a space station should do becomes much simpler: providing living quarters for personnel when on site. The space station may be powered down and put into hibernation when there is no operational need; research and commercial operations will be conducted on other space structures including those with human crews and those only tended by humans. The ISS began as a program trying to be everything for everyone; that will no longer be the space station's purpose. The station becomes a helper, not an end product. Space stations did not become illogical, obsolete, or unnecessary just because the political winds changed directions. The winds may change again. ■

Political pronouncements do not negate the value of an Earth-orbiting space station.

Roger Handberg **is professor of political science at the University of Central Florida.**

Shuttle Retirement and the Uncertain Future of U.S. Space Transportation

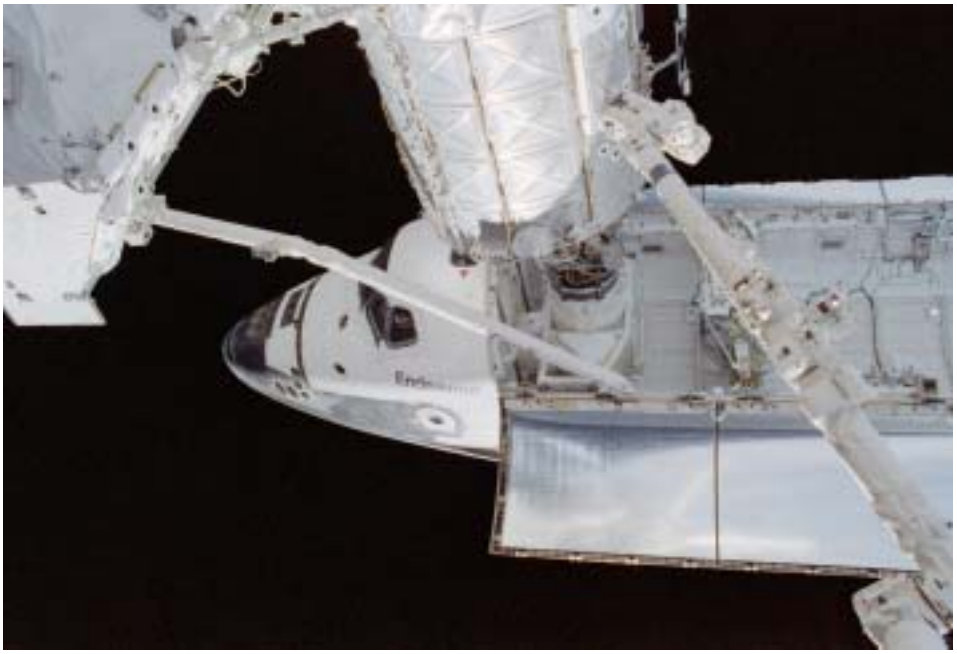
Space policymakers need to think carefully about the ramifications of the sweeping changes that Project Constellation proposes for the nation's space transportation systems. Is the United States ready to abandon certain capabilities?

by Frank Sietzen, Jr.

In the aftermath of President George W. Bush's announcement on January 14, 2004, of a new space vision for the nation, much of the attention within the space community has focused on the cost of the various elements of the plan and how the administration proposes to pay for them.

What has eluded many journalists and analysts, however, is a serious consideration of the issues arising from retirement of the space shuttle and its capabilities in both human space flight and heavy-lift cargo launch. Parallel to the decision to end crewed flights of the shuttles upon completion of the International Space Station (ISS) has been an internal review of the merits of converting the shuttles into some form of evolved unmanned cargo system. At the same time, the likely launch system for Project Constellation's Crew Exploration Vehicle (CEV) will be a modified version of one of today's existing Evolved Expendable Launch Vehicles (EELV), the Atlas 5 or Delta 4.

Using these existing launch systems as the basis for Constellation's launcher needs makes sense in this cost constrained environment. But the mix of launch vehicles and crewed spacecraft currently postulated for Project Constellation will take the nation in a very different direction in space transportation than the path it has followed for three decades. To date, however, few of the longer-term ramifications of these decisions have been addressed. The time to do so is now, for ending U.S. human heavy-lift capability in favor of a series of more flexible but limited launch and cargo systems will reach into the future choices of civil and military spacecraft for decades to come.



The space shuttle was designed to be a remarkably versatile vehicle, outfitted with a sizable payload bay, a robotic manipulator arm, and the capacity to carry humans and heavy payloads to and from Earth orbit. (Source: NASA)

What Will Follow the Shuttle?

Under the current plan, the shuttle fleet is to be retired once the assembly of the ISS has been completed. NASA Administrator Sean O'Keefe has stated that this was to be 2010 at the latest, although the delay in return to flight could conceivably change this end date by a year, perhaps more. The initial operational capability of the Crew Exploration Vehicle is projected to come online around 2012 or 2013, with possible human crew flights to ISS following soon thereafter and initial lunar landings of the CEV lunar versions occurring between 2015 and 2020. Thus a two- to three-year gap between the end of the crewed shuttle flights and the crewed CEV flights is likely.

More importantly, a parallel decision has been made to separate crew and cargo from the same vehicle and prepare manifests for Progress-like cargo services flanking the crewed CEV flights. This change in NASA space transportation planning, which first emerged under the previous Orbital Space Plane program, assumes that ei-

ther the agency or industry will design, build, and provide an American Progress-like capability.

But it also makes assumptions about payloads and launch services that have not been the focus of much discussion. The space shuttle system was designed and evolved to service large payloads from a staging area in low Earth orbit. Large deployables, such as *Galileo*, *Magellan*, and the Tracking and Data Relay Satellite System satellites required upper stages to move them from the shuttle's reach to their final destinations. The Interim Upper Stage and the Payload Assist Module were used for this purpose. Briefly, NASA planned to use a cryogenic upper stage aboard the shuttles, but such plans were abandoned for safety considerations following the *Challenger* accident. Attendant to the heavy-lift servicing capabilities of the shuttles, the orbiters were to be employed in a variety of on-orbit assembly and servicing missions, from Landsat refueling to satellite recovery to launch and construction of the space station itself. The Hubble Space Telescope servicing missions are obvious examples of using a large crewed spacecraft platform to support a large orbiting asset. Shuttles were also used to launch large national security and defense-related payloads.

The shuttle fleet offered a trio of space capability features: large heavy-lift up-mass, presence of human crews using the spacecraft open bay and robotic manipulator, and large down-mass. There are no spacecraft in existence or planned by any entity that replicate all of these capabilities in a single vehicle.

Thus one question that should be posed to space transportation planners is: *Is NASA certain that there will not be a need in the foreseeable future for the type of low Earth orbit, crewed heavy-lift and servicing capability now resident in the space shuttle configuration?*

Is NASA certain that there will not be a need in the foreseeable future for the type of low Earth orbit, crewed heavy-lift and servicing capability now resident in the space shuttle configuration?

Many at NASA have deemed this evolution away from the type of crewed spacecraft represented by the shuttles as maturity; they argue that the nation no longer needs a "one size fits all" government-funded, government-operated, crewed heavy-lift system. A fair enough consideration, except that in the current round of analysis for Project Constellation, it is precisely this type of capability that will be needed at some point in the evolution of the Moon-Mars heavy-lift needs.

It is believed that it will be cheaper and more efficient to develop a series of cargo and crew vehicles that together will offer the kind of low Earth orbit capability that now resides singularly in the expensive and fragile shuttles. But shouldn't such an evolutionary path be framed first by understanding the broad range of payloads and services that all three sectors—civil, military, and commercial—will need over the next ten to twenty years, not just NASA alone? And where will the technology base investments come from to sustain the actual development of such a mix of vehicles, beyond the CEV/EELV and shuttle-evolved systems likely to be used in the initial stages of the Constellation program? As of yet, there is no clear plan to get from here to there.

Launch Technology Uncertainty

The future of the large U.S. expendable launch vehicle families will also be impacted by the Bush policy. In its original policy construct, the EELV program was to provide heavy-lift commercial and governmental launch services for twenty years. When the program downselected to a pair of launcher families in December 1996, strong indications existed at the time that the eventual replacement in the far future would be some form of reusable launch ve-

Designed to meet government and commercial heavy-lift needs, the Evolved Expendable Launch Vehicles' role in the nation's new space exploration vision is not yet defined. This photo shows the Boeing Delta 4 Heavy in December 2003; its maiden launch will occur later in 2004. (Source: The Boeing Company)

hicle (RLV), possibly one arising from the X-33/VentureStar technology demonstrations. It is useful to reference a comment Lockheed Martin's Dave Urie made three years earlier, when the progenitor to Lockheed's eventual entrant in the X-33 contest, the AeroBallistic Rocket, was then being proposed in the halls of the Pentagon. Urie told the author that if that vehicle were brought to operational status, its success would depend on capturing all three elements of the launch market—civil, military, and commercial. In other words, a successful reusable launcher and a successful EELV could not exist in the same marketplace.

But the technology path to such a future government RLV technology effort has been stillborn by Project Constellation. Both the Space Launch Initiative (SLI) and Next Generation Launch Technology (NGLT) programs have been, or will soon be, terminated. Two reasons were given for this action. First, NASA retrospectively claimed that the SLI was headed towards development of a lower cost launch system to service ISS payload needs. (In contrast, SLI's Dennis Smith told a Space Transportation Association roundtable in March 2002 that configuration studies driving the SLI designs included payload requirements of the commercial satellite community in addition to NASA-unique needs.) Now, however, derivatives of either the CEV or some not-yet-developed commercial transfer vehicle would provide such a function, negating the need for the government to fund technology development of such a vehicle. And secondly, the cost environment facing NASA made continued spending on the launch technology packages represented by SLI and NGLT impossible.

Another element in this process, a so-called partnership among NASA, the Defense Department (DoD), and the U.S. Air Force to "share" technology in launcher development, seems to have evaporated since the January 14 Bush pronouncement. One part of the joint efforts, the DoD National Aerospace Initiative (NAI), failed to receive funding from Congress last year. So it would appear that one should not look to the Pentagon for future extensive investments in affordable or reusable heavy-lift launch technologies.

The advanced engine programs once funded by SLI and briefly by NGLT for booster engines and upper stages appear to be headed for a dead end, following millions in investments by both NASA and its industry partners. NASA's primary contribution to the joint Integrated High Payoff Rocket Propulsion Technology program (IHPRPT) was contained in these two programs now headed for termination. Of the remaining IHPRPT partners, only the Air Force has consistently funded its share of the program, which was to lead to specific performance improvements in launch vehicle engines over the next decade. In the Constellation program, there appears to be no place for NASA's IHPRPT contribution.

Thus another question for planners: *What is the appropriate role of the federal government in funding advanced technology development for new rocket engines and upper stages in the Constellation era?*

What is the appropriate role of the federal government in funding advanced technology development for new rocket engines and upper stages in the Constellation era?

Without a follow-on launcher to the shuttles, and with the CEV not intended for large capacity cargo lift, another question may well be asked: *Should the future of the EELV fleet be reconsidered?* The primary purpose behind the EELV, driven by the DoD Space Launch Modernization Plan (the "Moorman report"), was to reduce launch costs by 25 to 50 percent over the existing vehicles of the time, mainly Titan 4. While EELV flights have only just begun, it would appear that Delta 4 and Atlas 5 have met that goal. But what should the next step be in government funding for launch systems, post shuttle and into the middle years of EELV operations?

A Partially Reusable EELV?

The next generation of government launchers must strive to reduce launch costs at least by another 50 percent, or more desirably an order of magnitude, beyond the costs of the existing two sets of EELVs. To meet such a goal will almost certainly require introducing reusability into such a vehicle architecture.

That might not be reusability as many have envisioned; perhaps "recoverability" would be a better word. If the most expensive parts of a launch vehicle's first-stage configurations could be retrieved and reused in another vehicle, significant savings could be obtained over a fully expendable vehicle, especially if the development cost of a fully reusable design is unaffordable.

Another caution is in order, for in a sense we have traveled this way once before. To provide heavy lift and lower cost launch services for the Star Wars program, the Pentagon studied large, partially reusable, heavy-lift vehicles in two late 1980s programs: the Advanced Launch System (ALS) and the National Launch System (NLS). The ALS featured a recoverable engine unit. Neither vehicle was ever put into pro-

duction or testing, although funding for and testing of an engine candidate for the boosters, the Space Transportation Main Engine, was conducted. At the same time, in the early to mid-1990s, NASA itself embarked upon a series of advanced launcher studies and programs, some on its own and some in cooperation with DoD. These included the DC-X, X-30, X-33, X-34, and more recently the X-38 crew lifeboat. With the exception of the DC-X, none of these programs yielded a single test flight, and none were developed to actual operational status.

None of NASA's advanced launcher programs, including the X-33, a model of which is shown here as it touches down on a lakebed, ever yielded an operational vehicle. (Source: NASA/Tom Tschida)

Stability of Commitment

Other than Boeing's original design for an EELV that was rejected in the downselect process, which consisted of a engine pod that could be retrieved during booster ascent, post-ALS studies have focused on either fully expendable or fully reusable systems. The partially reusable ALS and the larger, fully expendable NLS were projected to cost in the $14-15 billion range (1988 dollars). A follow-on study to NLS called Spacelifter also was projected to cost in the same general range. Figures used for an operational RLV derived from the X-33 were in the over $30 billion range (1999 dollars). None of the rhetoric used in the previous decade to hail the federal commitment to new launch systems was ever matched with consistent funding, or even programmatic planning, save EELV. NASA's own track record in committing to development of any post-space shuttle launch system has been spending initial resources, followed by eventual abandonment for the "next" great idea. None of these great ideas, however well they were advertised, ever yielded a launch solution.

A last question, then, for planners: *Why should industry believe that the launch systems developed for the Constellation program will be fully funded and supported across a shifting climate of political and space priorities? Why will this effort yield any different results than all those that have gone before?*

If a new series of EELV designs are to be seriously pursued as candidates to bridge the gap between today's fully expendable launchers and a fully reusable, commercially capable RLV, who would pay the development costs? And could those costs be lowered to below the late 1980s' set of ALS-NLS-Spacelifter vehicle designs? That would require a long-term development plan for heavy lifters, a roadmap for government technology investments, and a clear definition of the part that industry would need to play in this process. Such a roadmap would need to be a serious, sustained commitment for federal research and development for launch technology, more stable and dependable in scope than any of the pathways NASA or DoD has followed in the recent past.

A detailed space launch technology roadmap, however, is nowhere to be found in either NASA's post-shuttle plans or in DoD's post-EELV considerations. Crafting such a roadmap should begin now, while NASA is preparing for sending humans beyond Earth orbit. The value of using shuttle investments in boosters and tankage to sustain a heavy lifter for Project Constellation is not a substitute for longer range planning. Although efficient, it remains a stopgap solution that would temporarily preserve much of the current shuttle launch system workforce, provide for less development cost, and migrate the shuttle's operational competence during the Moon stage of Constellation. But what about the next stage?

During the next twenty years, when the evolutionary path to manned Mars missions approaches under the current timetable, the large lift requirements of both NASA and DoD will require a new launch solution beyond today's existing fleet. As the clarity of vision emerges as to the shape those mission models contain, so will the need for advanced space launch technologies made mature by government-industry partnership processes.

Conclusion

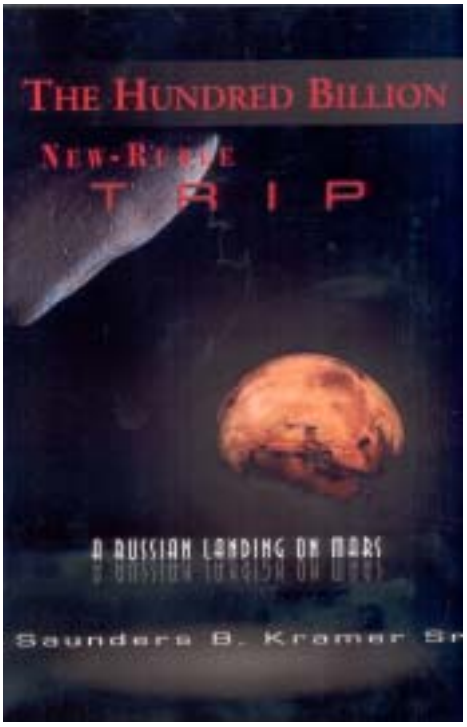
In the end, it will not be today's space program actors but future generations of Americans and others that will live with the ramifications of the framework of the retirement of the space shuttle system, or the replacement of the EELV, as well as the pacing of the transition to the CEV. Questions that arise from this framework should be asked before it takes final form and policy, for it will shape the evolution of human and heavy-lift space flight for decades to come.

Such analysis should be conducted in transparency and in the open, akin to a national conversation—not a blame game or an attempt to preserve existing bureaucratic structures, but a true review of the implications for space transportation arising from the Bush initiative. For given the history of space flight, a cautionary tale is in order: what we do is ultimately more important than what we say. ■

***Frank Sietzen, Jr.,* is a writer, author, and strategic communications planner. He is co-author of *New Moon Rising: The Making of America's New Space Vision and the Remaking of NASA*, published by Apogee Books in July 2004, and author of *Creature of Compromise: The Political Origins of the Space Shuttle*, to be published in 2006 by Texas A&M University Press. The views expressed here are his own.**

Two AAS Members Pen Space Fiction Novels

by Jim Kirkpatrick



The Hundred Billion New-Ruble Trip: A Russian Landing on Mars by Saunders Kramer. Philadelphia: Xlibris, 2003. 300 pages. ISBN: 1-4010-9526-7. $29.69 (hardcover, Xlibris).

Seraphim Sky by Jon Malay. New York: iUniverse, 2003. 272 pages. ISBN: 0-595-27447-1. $25.95 (hardcover).

Two AAS members, Saunders Kramer and Jon Malay, recently have written and successfully published their first novels. Saunders is a founding member of the Society and has maintained active membership for the past fifty years. Jon is the current AAS president and joined AAS in 1989. For both, their novels are first efforts at writing fiction, and they relied on their career experiences to help shape the details of the story lines and accuracy of the information.

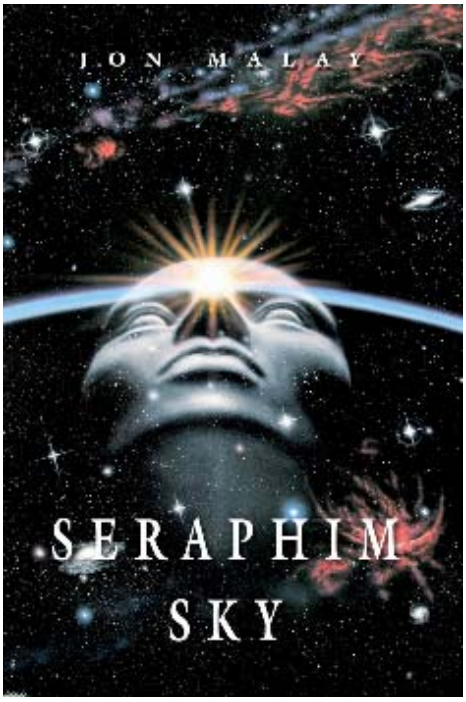
Saunders's book, *The Hundred Billion New-Ruble Trip: A Russian Landing on Mars*, focuses on a successful journey to Mars by a Russian crew between 2013 and 2015. The United States does not compete in this venture for reasons made clear in the book but closely follows the mission, which includes discoveries of solid evidence of a prior visit to Mars by intelligent beings from another star system. During the return trip to Earth, an encounter with a comet enlivens that portion of the expedition. Carefully woven into the tale are several romances, the sort of occurrences which the author feels are likely to occur on so long an expedition with a highly motivated and attractive crew. The international public follows the crew's saga with some admiration, considerable envy, and the usual contingent of skeptics.

Saunders wrote the first chapters fifteen years ago (by typewriter), with the remainder written and refined until the book was published last year. He began the book partly due to his feeling that much written about Soviet-American space cooperation was biased and untrue. His background as a senior staff member at Lockheed Missiles and Space Company enabled him to construct the story line and lay out the design of the Mars mission conceptually before writing a single word. He had help in editing and reviewing from his sons and a professional colleague and went through countless revisions until he was satisfied with the finished product.

His experiences at finding a publisher were mixed: an initial interest by Random House did not pan out, and he discovered that many publishers do not like to publish unrecognized authors. He finally decided to use Xlibris (www.xlibris.com) as his publisher, after seeing an ad in *The New York Times*. The cost was $1800, which included a selected custom printing arrangement. His goal is to sell a few thousand copies, and he is currently looking for a way to market his book in Russia, feeling strongly that the subject of his novel would have great appeal to a Russian audience. Although Saunders invested thousands of hours in writing his novel, he considers it time well spent and has already decided to write a sequel. His book can be ordered online at www.xlibris.com/TheHundredBillionNewRubleTrip.html.

Seraphim Sky by Jon Malay is a genre-bending story that blends the techno-thriller characteristics of technology and Washington political intrigue with elements of both cosmology and spirituality. Set mostly in the mid-1980s before the *Challenger* accident with a final chapter that takes place in the current day, his story centers on the at-sea, in-space, and inside-the-beltway experiences of a Navy intelligence officer who becomes a NASA astronaut mission specialist. The hero and his space shuttle crewmates survive a near-disaster in space, but the circumstances of these events provide him alone with a mystical experience of the universe. It's the kind of book that could well have come from a collaboration of Tom Clancy, the late Carl Sagan, and spiritual self-help guru Wayne Dyer.

Jon's story grew out of his own experiences as a naval officer and Washington staff officer, plus his interfaces through the years with NASA astronauts and both human and robotic space systems. He says that the idea for the story came to him while sitting on a barstool in Cocoa Beach after viewing a successful shuttle launch in 1991. The idea rattled around in his head and was only captured in a rough, hand-written outline that he kept until 2000, when he began to actually write the book in hotel rooms on the evenings of business trips. The first complete draft came together at the end of a silent retreat at a monastery in Northern Virginia two years later. After reading several books



on how to market a novel, Jon began launching letters to prospective publishers and agents and validated the well-understood statistics for publishing first novels: very low probability at best, and near impossibility for a story that doesn't conform to the most popular and commercial genres. *Seraphim Sky* was well outside of this norm, and Jon's collection of rejection letters grew.

Jon then investigated "print-on-demand" technology, which led him to the self-publishing company iUniverse (www.iuniverse.com). A Navy friend who chronicled his experiences as a cancer survivor used this company to publish his own book. Jon was able to conduct the entire publishing process by email and found the approximate $1000 outlay to be reasonable due to the quality of the product, the helpfulness of his account manager, and the placement of the book on web sites such as Amazon.com and Barnes & Noble online. At very minimal cost, he set up two identical web sites: www.jonmalay.com and www.seraphimsky.com, both of which link to "buy now" pages for his book at the online booksellers and publisher. Jon claims he has no illusions of selling thousands of copies but is confident that by carefully exposing key people in the space business, entertainment industry, and government to the book, he will eventually be referred to a prospective agent or publisher and then a mainstream publishing effort will begin. He's continuing to write in his off-duty hours, just now completing co-authorship of the soon-to-be published *National Geographic Encyclopedia of Space*. He says that his job at Lockheed Martin makes him a better writer, and being a writer makes him better at his job.

Space fiction has become all the richer as a result of the fascinating stories that these two authors have created. It's a great satisfaction for each of them to have his book "out there," but it would be better yet if the members of the space community read the new novels. ■

Jim Kirkpatrick **is the AAS executive director.**

Human and Robotic Space Exploration: Conflicted or Complimentary?

The best option for achieving space exploration goals isn't a humans-only or a robots-only program; rather, it's one that merges the best qualities of each.

by Yoji Kondo

Since the days of the Apollo missions to place American astronauts on the Moon, there have been active debates among various professionals, politicians, and others concerning the relative merits of human space exploration and scientific research in space using robotic or automated instruments. These debates have sometimes gotten so heated that they have become acrimonious from time to time.

> The desire to understand nature through scientific quests and the spirit to explore what's beyond the mountain range and the ocean are entirely compatible since they are the two sides of the same survival trait that has thus far made an evolutionary success of the human race.

During the early years of the space age, those working in the human space program maintained that human presence in space was critical to exploring the final frontier. Much of the public appeared to share that same sense of enthusiasm about humankind's future in space. Neil Armstrong's remark as he became the first man to walk on the Moon, "That's one small step for man, one giant leap for mankind," was an inspiration to millions of people that the golden age of space exploration had arrived—and that people, not robots, were going to lead humanity on the adventure.

At the same time, there were people who maintained that we should spend most, if not all, of our resources on "pure" scientific research projects in space using robotic and automated instruments, such as orbiting astronomical observatories and geophysical satellites. These people believed that robotic envoys were virtuous on their own merits and would provide a far greater scientific return for the investment than human explorers would. (Still others did not much like the idea of spending funds on a space program of any sort. Some astronomers, for example, insisted that ten five-meter telescopes would cost as much as launching one orbiting astronomical observatory.)

Are human exploration of space and robotic probes in space necessarily diametrically opposite? Of course, the federal government will always have to make decisions about how to allocate the available funds for the space program between human and robotic programs; such discussions are a necessary part of the process for rational distributions of funds among various programs in our system of government. But it is worth examining the validity of arguments that we should only send robotic missions to the Moon or to Mars, and not human missions, because the latter are more costly and are a risk to human lives.

I should like to submit to the reader of this article that, contrary to such beliefs, our quest of scientific knowledge and

As have other missions before them, NASA's Mars rovers have proven through their revolutionary scientific findings the value of continuing to build and launch robotic spacecraft. (Source: NASA/JPL/Cornell)

Astronaut F. Story Musgrave, anchored on the end of the Remote Manipulator System arm, prepares to be elevated to the top of the Hubble Space Telescope to install protective covers on the magnetometers. Humans and robots have provided mutual support to one another in space exploration pursuits—and will continue to do so. (Source: NASA)

our desire to explore the unknown come from the same basic drive that is present in all successful human groups that have survived the ordeals of nature: namely, the desire to understand the wide world in which we live—islands, valleys, mountain ranges, savannas, continents, planets, solar systems, and galaxies alike. The desire to understand nature through scientific quests and the spirit to explore what's beyond the mountain range and the ocean are entirely compatible since they are the two sides of the same survival trait that has thus far made an evolutionary success of the human race.

There can be no question that both humans and robots are valuable in space exploration pursuits. Robots have proven their ability to revolutionize scientific understanding of the universe while keeping humans out of harm's way and minimizing mission costs. Moreover, as Ranger and Surveyor did for Apollo, robotic spacecraft make excellent scouts for future human missions into the solar system. Concomitantly, humans can be integral to maintaining spacecraft health, as shuttle astronauts have done several times for the Hubble Space Telescope. And in the future it may be the cognition skills that only human space explorers possess that will answer the questions of where, when, and how much water once existed on Mars.

I believe that a society that would want to send astronauts or cosmonauts into space would be one that would willingly support "pure" research in space as well. And indeed, this has been the case in the United States. Quite understandably, the voting public finds it easier to identify with astronauts and cosmonauts and their great adventures in space. On the other hand, they are thrilled at the photographs returned from space, sometimes with unanticipated consequences. Take, for example, the Apollo 8 photograph of the blue and fragile-looking Earth hanging over the lunar horizon: while taken by astronauts, it was expressly this photograph and the sense it conveyed of a delicate spaceship Earth that gave a major impetus to the environmental movement.

Too often, human space exploration and robotic space exploration proponents argue for their programs at the expense of the other. The "space pie" is too small to be divided by such differences.

The political sphere has been equally—and rightly—attentive to both human and robotic space exploration. During the peak of the Apollo missions, a great deal of money became available for building orbiting astronomical observatories and other space probes, too, although

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these spacecraft generally had little to do with the success of the Apollo missions. Today, the space shuttle, International Space Station, Mars rovers, and an assortment of astronomical and Earth observing spacecraft all are supported within NASA's budget.

Indeed, human missions and robotic instruments soon will be working with each other to fulfill humankind's destiny of expanding our domain throughout the solar system and someday to domains beyond—even to distant solar systems. Earlier this year, President Bush put forth a vision for the U.S. civil space program in which this very idea would be made reality. Within this vision, robotic explorers would conduct reconnaissance of the Moon, Mars, and beyond, to be followed by human visitors when the time was right. But even during human expeditions to locales throughout the solar system, robots would accompany people to support the missions as necessary.

Human-robotic cooperation will take a multitude of forms, some of which we are not yet even aware. Perhaps after establishing a considerable human presence and permanent base on the Moon, we could launch robotic and even human interplanetary missions—an endeavor that on Earth is now scientifically worthwhile but rather expensive. We could also use the Moon as a stable optical bench in space tens of kilometers across to conduct such important astronomical observations as broad baseline interferometry.

Too often, human space exploration and robotic space exploration proponents argue for their programs at the expense of each other. The "space pie" is too small to be divided by such differences. Both human and robotic space missions in space ought to be supported together. They are complimentary to each other, technically and culturally. In an age, in which both undertakings are not only feasible but also pragmatic, neither would likely do well without the other—technically, scientifically, financially, or politically. ■

Once human explorers reach the Moon, they could use it for launching robotic and human interplanetary missions as shown in this artist's conception. (Source: Alessandro Gattuso, www.alessandrogattuso.com)

Yoji Kondo **is an astrophysicist at NASA's Goddard Space Flight Center.**

AAS's Response to the Aldridge Commission Report

Continued from page 4

to have a role in the early stages of defining cooperative elements. Further consideration of the U.S. position on collaboration is in order to create a partnership environment that is enticing to the world's top space expertise. The AAS urges establishment of a forum with potential partners—sooner rather than later—to discuss international collaboration in the implementation of the vision, including models of cooperation beyond the two identified by the Commission.

- **Education and public engagement.** Energizing these activities is critical to the viability and sustainability of the exploration effort. A focused education and public engagement effort beyond what NASA did in the 1960s is needed today, supplemented by similar actions throughout the space community. As the report states, a new model for public engagement is needed "to infuse space exploration into our culture as never before." The importance of the Commission's two recommendations on this subject should not be underestimated.

Great opportunities are on the horizon, but so is a great deal of work. The AAS extends its appreciation to the Aldridge Commission for taking the first step on this long journey. We intend to be there for all the steps that follow. ■

UPCOMING EVENTS

AAS Meeting Schedule

August 16–19, 2004
***AIAA/AAS Astrodynamics Specialist Conference and Exhibit**
Rhode Island Convention Center
Providence, Rhode Island
www.aiaa.org

November 16–17, 2004
AAS National Conference and 51st Annual Meeting
Pasadena Hilton
Pasadena, CA
www.astronautical.org

See page 13 for details

January 23–27, 2005
***AAS/AIAA Space Flight Mechanics Winter Meeting**
Copper Mountain Resort
Copper Mountain, Colorado
www.space-flight.org

February 5–9, 2005
28th Rocky Mountain Guidance and Control Conference
Beaver Run Resort and Conference Center
Breckenridge, Colorado
www.aas-rocky-mountain-section.org

New Conference Dates

March 29–30, 2005
43rd Goddard Memorial Symposium
Greenbelt Marriott Hotel
Greenbelt, Maryland
www.astronautical.org

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