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President's Message

The only thing constant is change.
May you live in interesting times.
No matter where you go… there you are!

These are banal expressions we've all used and hear often – too often. But, oh, how true they are. Our community of space professionals is experiencing change, and the changes are very interesting, indeed. As we enter the summer of 2005, the National Aeronautics and Space Administration (NASA) has a new administrator and, while he is clearly in pursuit of the very same vision for space exploration as his predecessor, the path of the pursuit is clearly changing. As Dr. Mike Griffin said in his recent testimony to a Senate committee, "the vision hasn't changed. It's only the ways and means to accomplish it that we're talking about." Returning the shuttle to flight and completing the International Space Station are indeed still our first steps, but in NASA today, the steps are quickening toward delivering a Crew Exploration Vehicle as soon as possible and beginning in earnest our push back to the Moon and on to Mars.

The Defense Department is in a state of change as well, and this change has been taking shape for the past few years. In the 1990s our armed forces and the space assets supporting them were evolving away from focusing on the East-West conflict of superpowers that had prevailed during the Cold War. The country was looking inward, more or less at peace with the world – a world which was changing all around us. Then, on September 11, 2001, our country's focus changed again when the lightning bolt of horror illuminated a frightening landscape. Space systems are now supporting our global reach in the war on terrorism, guided by the mantra of "net centricity." We are evolving our information technology strategies for warfighter support from "smart push" to "smart pull." Evolved space systems are allowing our forces on the far side of the world to get the support they need, when they need it.

It's supposedly an ancient curse to wish that someone "live in interesting times," but if there's one thing our community likes it's a challenge, and what is interesting is also usually challenging. The AAS and our membership of corporations, organizations, universities, and of course individual professional members will continue our collective roles in rising to the challenge. In the past year, we have held excellent meetings and symposia, spoken out in public policy statements, and provided opportunities for the community to engage in dialogue about the challenges we face, both technologically and politically. We have joined the Coalition for Space Exploration and are actively participating in advocacy for the vision. In the past couple of months, we have welcomed some new corporate members, and we are delighted because our voice is being heard, and there is so much to talk about…and to do.

So, as we go along as participants in change, there we are! The AAS is in its fifty-first year as a professional society dedicated to "Advancing All Space." And that's a good – and important – place to be.

Jon Malay

ON THE COVER

NASA's new administrator, Dr. Michael Griffin, talks with employees at NASA headquarters following his swearing-in ceremony on April 14. Griffin left his post as the head of the space department at the Johns Hopkins University Applied Physics Laboratory to take the position. He previously served as chief engineer at NASA and executive vice president and chief technical officer of Orbital Sciences Corporation. (Source: NASA/Renee Bouchard)

Lunar Land Claims Recognition: Designing the Ultimate Incentive for Space Infrastructure Development

Space business is being impeded by the lack of necessary big-ticket space infrastructure. To jumpstart space development, an economic incentive is needed to motivate private industry to finance and build this infrastructure.

by Douglas O. Jobes

While the National Aeronautics and Space Administration (NASA) often interfaces with private sector, the government cannot – and should not – be expected to bear the entire burden for developing space. NASA's primary focus is exploration and discovery. That means a comprehensive approach to space development depends on finding ways to make space profitable for private industry – if possible, convincing corporations, institutions, wealthy individuals, and venture capitalists to invest billions of dollars in space.

Consider the satellite industry, once the sole province of government but now a private sector success story. In 2003 the commercial satellite industry grossed over $90 billion, according to the Satellite Industry Association. Revenue has been increasing year after year in this industry because the profits to be made outweigh the expenses of doing business.

But for more ambitious ventures – such as businesses based on the Moon and in Earth-Moon space – the financial hurdles of getting from the drawing board to profitability are much greater.

No Rest Stops in Space

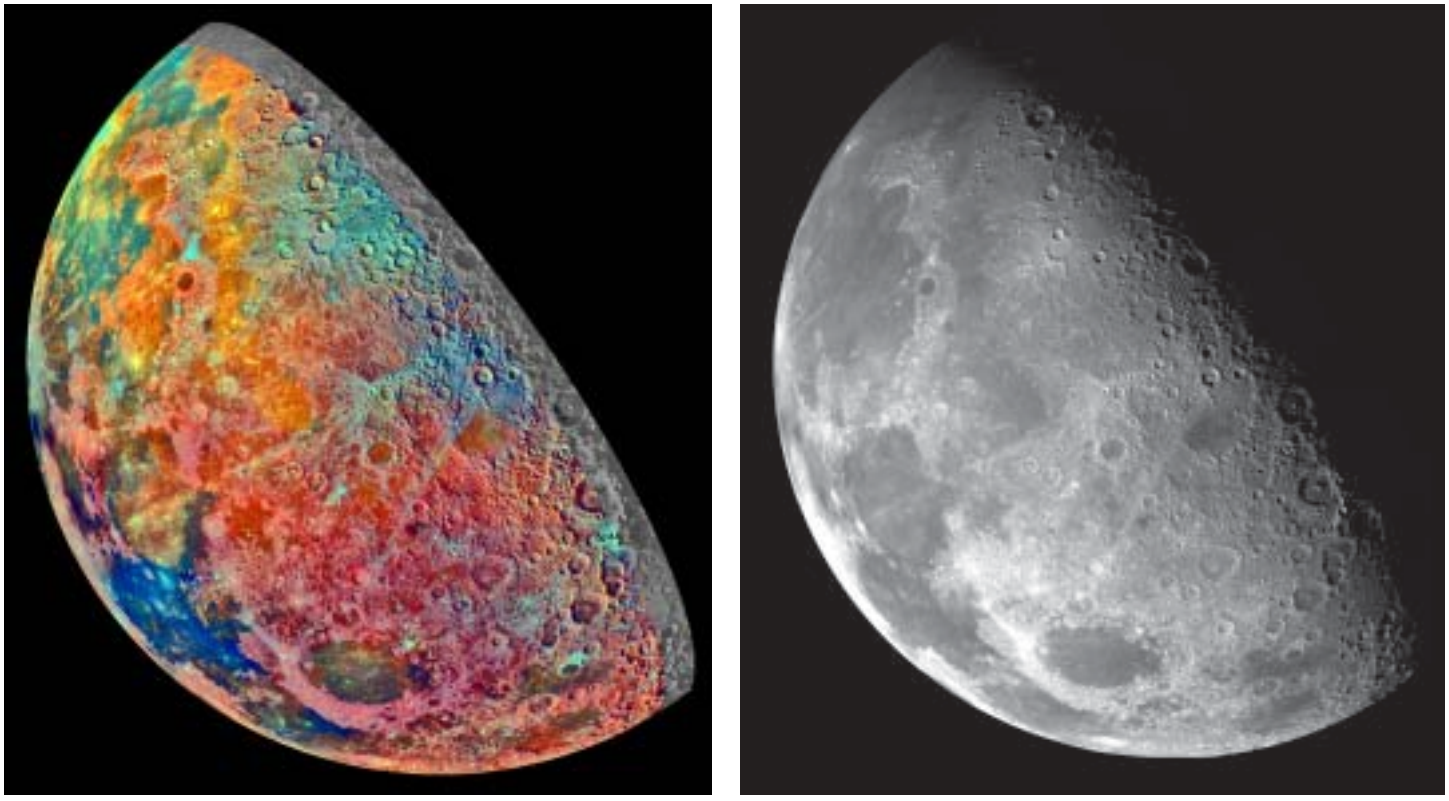
Besides the much-discussed issue of high launch costs, there is another big obstacle to overcome on the way to opening space to entrepreneurialism: the lack of basic space infrastructure. The launch vehicles, cargo transporters, orbital facilities, refueling stations, lunar surface facilities, and so forth on which businesses will depend are the missing pieces of the puzzle. There are business models that potentially would be very profitable if only the space infrastructure was there to support them.

As one example, consider a business plan proposed by Dr. Michael Duke and associates at the Colorado School of Mines. This plan involves processing lunar soil, or regolith, into rocket propellant for use by the commercial satellite launch industry. As it turns out, a big expense for most satellite launches is the cost of boosting the satellite from low Earth orbit (320-800 kilometers above Earth) to its final geosynchronous orbit (about 35,000 kilometers up).

These researchers recognized that lunar regolith from certain regions of the Moon is relatively abundant in hydrogen and oxygen, which can be extracted by known processes and converted into liquid rocket fuel. Instead of inefficiently lifting large quantities of propellant from Earth's gravity well to take spacecraft from low Earth orbit to geosynchronous orbit, as is done today, the propellant could be manufactured on the Moon's surface then shipped to a waiting orbital transfer vehicle based at Lagrange point L1 between Earth and the Moon. The orbital transfer vehicle would transport the fuel from L1 to low Earth orbit and rendezvous with the satellite there. The transfer vehicle, laden with the fuel produced on the Moon, would then carry the satellite to its geosynchronous destination, the transfer vehicle afterward returning to its L1 home base to await the next load of propellant.

Analysis of the proposal showed this business model would be economically competitive, generating significant savings for the satellite industry. The problem is that the model is only profit-

An early part of space infrastructure development will be finding out what lunar resources can be efficiently harvested and utilized. A small robotic rover takes samples of lunar material for testing in this artist rendering. (Source: NASA)



LEFT: This false color image captured in 1992 by the Galileo probe shows the Moon's expansive compositional variation. Such images will be closely analyzed by lunar businesses involved in mining operations, propellant manufacture, and other possible lunar development industries. RIGHT: The same hemisphere of the Moon is shown in a more familiar light. (Source: NASA/Jet Propulsion Laboratory-Caltech)

able if the existence of basic space infrastructure is assumed.

Businesses need considerable infrastructure to have a foothold for operations: space facilities in low Earth orbit that can act as cargo transfer and rendezvous points; trans-lunar and lunar landing vehicles to carry cargo and personnel; surface facilities on the Moon that can accommodate lunar launches as well as landings; and lunar surface facilities for housing personnel, maintaining equipment, and performing business activities.

One of the more intriguing efforts to evaluate space infrastructure requirements is the research being done by the organizers of the International Space Settlement Design Competition. These annual competitions are open to student teams from any high school anywhere in the world. In the United States, competitions are held at the Johnson Space Center, the White Sands Test Facility, and the Jet Propulsion Laboratory, involving hundreds of participants. To help define realistic criteria for the competitions, the founders have for several years been investigating the space infrastructure that space-based businesses might require, including businesses based in orbit around Earth or the Moon, on the surface of the Moon or Mars, and even in the asteroid belt between Mars and Jupiter.

Anita Gale, a co-founder of the competition and a senior project engineer at The Boeing Company, notes that a space-based business further out than geosynchronous orbit starts with nothing. Outside Earth's atmosphere, she says, "there is vacuum, a variety of environmental hazards, unrealized access to extraterrestrial resources, and solar energy – nothing more. There is currently no scheduled transportation service, no port to pull into for supplies or repairs, no grocery store, no refueling station, no building supply store, no dirt to grow food in, no water."

The Problem: Who Will Pay for Space Infrastructure?

Private investment is needed to create much of the space infrastructure needed for doing business, but without the space infrastructure to allow the establishment of profitable businesses, the private investment is unlikely to happen. This is the catch-22 of space development in today's current political and economic environment. A catalyst needs to be found to motivate the private sector to invest not just millions or tens of millions but billions of dollars to build the necessary structures in space.

Private industry is motivated by the potential for profit, so a considerable return on investment is needed. Some have proposed government cash prizes and even huge tax breaks for companies that help to develop space. Both of those concepts involve an obvious deal-killer: they both would drain the U.S. Treasury at a time when budget deficits have reached record levels. It is very unlikely that Congress would approve multi-billion-dollar, government-funded space incentives.

There is, however, one possible incentive that would not cost taxpayers anything but could generate an incentive of billions of dollars for construction of space

Before businesses can begin industrial development on the Moon, a reliable and inexpensive vehicle will need to be developed to transport materials and people to the lunar surface. Here, an artist's rendering shows a concept vehicle landing on the Moon. (Source: NASA)

infrastructure: rewarding anyone who establishes a privately funded, permanent lunar base – along with a regular Earth-Moon space transportation service open to all paying individuals – with the right to claim ownership of a large tract of land on the Moon surrounding the base. A large section of raw land on the Moon could have a potential value billions of dollars to investors, venture capitalists, and speculators. The key to translating this potential value into actual value is a concept known as "lunar land claims recognition." The basic principle underlying lunar land claims recognition is that Congress would pass legislation recognizing private claims of land on the Moon – but only claims based on the tangible achievement of establishing a permanently inhabited facility. This is, in effect, a prize concept – a "Space Settlement Prize," if you will.

To enable lunar land claims recognition, Congress would need to pass legislation outlining the specific conditions under which a private lunar land claim would, following the establishment of a privately funded lunar base, be recognized. The U.S. government itself would not claim any land, but would instead recognize the right of the private group, consortia, or business that finances and builds a permanent base to make a claim.

Lunar land cannot be bought and sold today because there is no legal basis for ownership or exchange, but that could be changed by a land claims recognition law. A lunar land claims recognition law would use property rights as an incentive to motivate private individuals and companies to do something of great value for all of society.

The legislation could easily be structured to include participation by the international community – and in fact *should* be so to make it clear the plan is not an American attempt at a land grab on the Moon. It would, of course, be desirable if other nations were to pass similar laws, although initially that would not be necessary. Because the United States represents such a large fraction of the world's economy and often leads the way on economic matters, the United States's recognition of a private lunar land claim would be a sufficient start.

To head off objections that other nations might have to the United States passing such a law, it could be written into the law itself that the private groups who construct the permanent lunar base be international consortia – even to the extent of requiring inclusion of citizens from at least one developing country as investors or providers of an equatorial launch site.

With a prize of billions of dollars' worth of lunar real estate, as well as the potential to operate profitable businesses once the infrastructure is in place, consortia of companies, wealthy individuals, and other private entities should be willing to begin making plans and investing funds to develop the lunar base and space transportation service. To build a permanent base and regular space line will require investing in not only the technology to make it feasible but also the construction of the structures.

Once human and cargo transit vehicles and orbital and lunar surface facilities are developed, these structures and the technology behind them could be used by many types of space-based businesses. The same reasoning applies to the construction of better spacesuits, robotic tools, crew support infrastructure, and so on. In the process, innovations that would result in lowering launch costs might come about.

The Value of Lunar Land

Right now, the value of an acre of land on the Moon is not zero. In fact, the value is actually null – that is, absent or non-existent. Land cannot have value where land sale transactions have no basis. If land cannot be owned and exchanged, then it truly isn't worth anything in the sense that a commodity or investment has value.

Land claims recognition legislation would turn land on certain areas of the Moon into a legally tradable commodity without invoking government sovereignty. Lunar real estate will acquire enormous value after the establishment of a permanent base or settlement, regular commercial access, and a system of property rights.

So how does the legality of lunar land claims recognition stack up in the eyes of space lawyers? Currently space law contains a number of gray areas. Humanity simply hasn't had enough experience in space to develop laws for every scenario, so there are those who would argue for and against it.

But consider the evaluation of Declan J. O'Donnell, a tax, securities, and space law attorney in private practice in Denver, Colorado. O'Donnell is publisher of the *Space Governance Journal*, president of the World Space Bar Association, and a recipient of the Indira Gandhi Award of India for International Space Law. He says the legal basis used for lunar land claims recognition is "a valid approach to real property rights in space resources. In fact, compared to most of the proposals out there, the basic assumptions are not radical at all."

The legal aspects will be considered in more detail shortly. But first, more about the profitability of land in a lunar land claim. Under lunar land claims legislation, plots of lunar land would be offered for sale by the prize winner (the private entity that financed and built the lunar base) following months of worldwide press coverage produced by the race to establish a permanent settlement on the Moon. There will be those with specific business purposes for buying and using the land, but there will be a much bigger speculative and investment market. Many people who will never leave Earth will buy lunar land.

The dollar value of a lunar land claim will only become high enough to be extremely profitable when people can actually go there, and speculators and investors know this. Therefore, under the legislation, the lunar land deeds recognized by the United States would be offered for sale by the private claimants who established the permanent base only after the land is actually accessible – that is, when there is a transport system going back and forth often enough to support a permanent base.

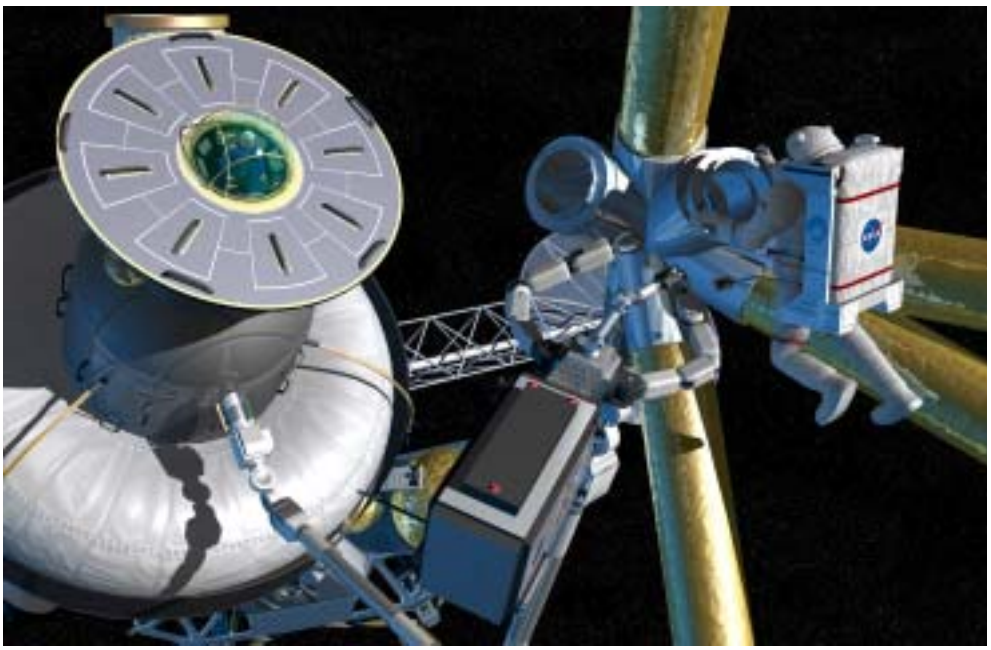
It isn't necessary to guess what the rock-bottom value for lunar land would be, either. Over the last twenty-five years, an entrepreneur named Dennis Hope unwittingly conducted an experiment that indicates the potential market for lunar deeds.

In 1980, Hope "claimed" the Moon and started a business selling lunar land "deeds." Thanks to Hope, the average value of lunar land, even on the most remote regions of the Moon's surface, is clearly no less than about $20 per acre – even with the land undeveloped, completely inaccessible, and barren and airless.

Because Hope's claim is not recognized by any court, he is in effect selling the deeds as novelty items. As startling as it may be, Hope has sold over two million of these deeds since 1980, according to his website (www.lunarembassy.com), with the base price for lunar land currently $19.99 an acre.

A nationally recognized real estate expert, Dr. Jeffrey D. Fisher, believes Hope's sales of novelty deeds represent a fair comparison with the real lunar deeds that may one day exist. As the director of the Center for Real Estate Studies at the Indiana University School of Business and professor of real estate, Fisher is an expert in the science of property valuation, having authored such books as *Real Estate Finance and Investments* (2005), *Income Property Appraisal* (2004), and *Income Property Valuation* (2003). He notes, "One way appraisers estimate value is the comparable sales approach. That Mr. Hope has been able to sell novelty deeds for lunar land at this price may be an indication of the actual novelty value per acre. If an entity were selling land sanctioned by the U.S. government, which would make the ownership rights more official, then I can see the value being even greater."

Of course, an officially recognized lunar land deed would have some novelty value, but more importantly it would be a tradable commodity with intrinsic value like the deed to any other undeveloped land. How large a claim the United States should recognize would be up to Congress to decide. Logically the claim should be large enough to create a very compelling incentive for taking the financial risk. For example, the U.S. government might decide to recognize a claim of no more than 4 percent of the Moon's surface – about 1.5 million square kilometers, or the size of



This artist's rendering shows people and robots performing construction in space. The development of space infrastructure will require a variety of space stations that may act as fuel depots or large vehicle assembly facilities. (Source: NASA)

Alaska. A claim this size would be worth $8 billion at $19.99 per acre, while at $100 per acre the value is nearly $40 billion.

Once its claim was legally recognized, the organization could immediately start mortgaging or selling plots on its claim to investors, real estate speculators, and members of the general public.

Private Ownership and International Law

Land claims in space are addressed by the 1967 Outer Space Treaty and the 1979 Moon Treaty. The United States and most other spacefaring nations are signatories of the Outer Space Treaty. In article two, this treaty sets restrictions on national ownership of property, as follows: "Outer space, including the Moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means."

During the decade before the treaty was written, when the need for the treaty was being discussed, no one was much worried about a private company launching a rocket to the Moon. What Americans were worried about was the Soviet Union landing on the Moon and claiming the ultimate high ground – and the Soviets were worried about the United States doing the same.

On September 15, 1959, *The New York Times* reported: "[United Nations] Secretary General Dag Hammarskjold, in the introduction to his annual report last year, urged 'agreement on a basic rule that outer space and the celestial bodies therein are not considered as capable of appropriation to any state.'"

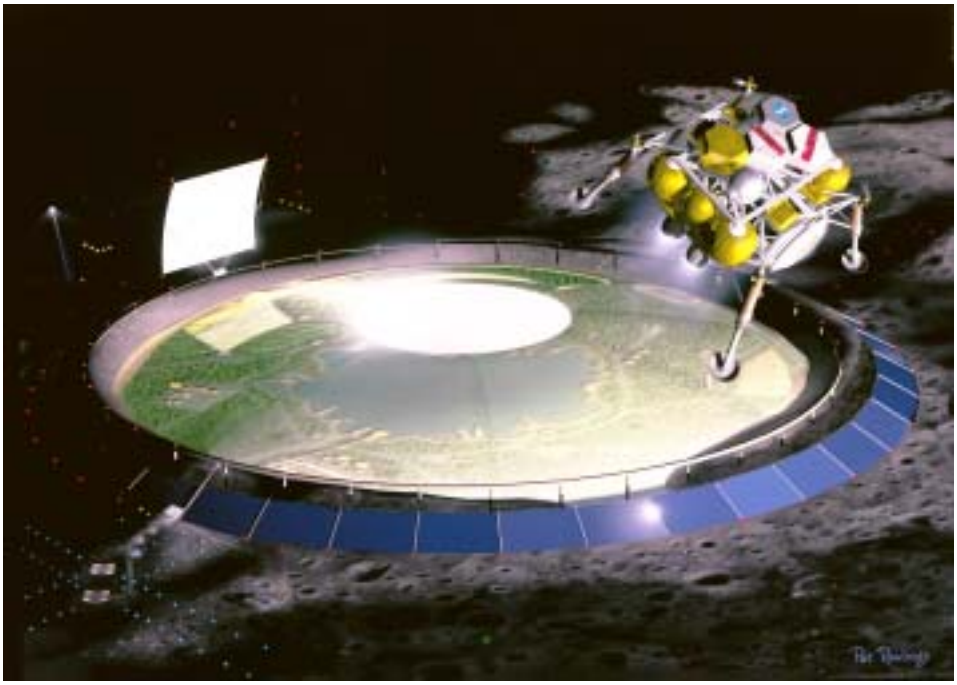
The Moon Treaty, on the other hand, very clearly attempts to ban private ownership of land in space. The very existence of the 1979 Moon Treaty is a clear indication that the 1967 Outer Space Treaty does not ban private ownership of land in space and that lawmakers and diplomats recognized that to be the case. The Moon Treaty, however, was an abysmal failure: of the 191 member nations of the United Nations, only five nations, none of them spacefaring, have ratified the treaty.

The Moon Treaty is widely regarded as a dead letter, and because the United States never ratified it, the Moon Treaty is not binding on this country or its citizens. That the United States refused to sign the Moon Treaty strongly indicates that Congress never intended property rights to be placed in jeopardy by either treaty.

The Outer Space Treaty specifies that outer space should be considered the "province of all mankind," but such a provision does not imply private property ownership in space should be banned. To ensure that people of all nations would have access to a lunar base, it could easily be written into the land claims recognition law that any land claimed must necessarily be open to other nations. In other words, the owners of the land claim would be required to provide reasonable accommodations for visits to the areas of the claims and could not bar access under normal circumstances. Restrictions would only be allowed in cases where such access might create a physical hazard, such as preventing access to areas of the lunar base under expansion or construction, where safety issues might be involved.

In addition, article six of the Outer Space Treaty mentions that the activities of non-governmental entities require authorization and constant supervision by the appropriate government bodies. Compliance with article six requires private consortia that would attempt to build permanent facilities on the Moon to adhere to the requirement of governmental supervision of their activities (perhaps as overseen by the United Nations); however, article six says nothing about the validity of private ownership of property in space and does not imply that private claims would be based on sovereignty. It quite clearly states that a system of registration and monitoring would need to be implemented, not that a nation could own land, or that a private entity could not own land.

The bottom line: in an era when government-run space programs were the



Developing lunar infrastructure may require the extraction of resources from the lunar regolith. Perpetually shadowed craters at the Moon's south pole may contain ice, which, if made into water, could be very useful for sustaining life and could aid in power generation. This artist's rendering depicts a solar-powered colony near the Moon's south pole. (Source: NASA)

only game in town, the last thing on the minds of legislators when the United States ratified the Outer Space Treaty was a concern that the private sector might someday finance a mission to the Moon and establish a claim.

Legal Framework for Land Claims

So if private property rights in space cannot be derived from a "gift of the sovereign," how can private land rights be derived? The appropriate legal framework for private land claims in space is the "use and occupation" standard from civil law. "Use and occupation" means the claimants, by establishing a permanent presence on the land, have mixed their labor with the soil and created property rights that are independent of government.

In civil law countries like France, property rights have never been based on sovereignty as they have in the United States (which inherited the common law standard from England). Even in the United States the line is not black and white between common and civil law; derivatives of civil law are used by states such as California, New York, and Louisiana.

"Use and occupation" must be the standard for any land claims regimen in space because the common law standard cannot be applied on the Moon, where sovereignty is barred by international treaty. Congress will have to decree that, because there can be no government on the Moon, a permanent base or settlement can give itself title just as though it were a government. Property deeds for land under its control will be recognized by U.S. courts of law, subject to specified limitations – just as titles issued by France, China, and even Iran are recognized by U.S. courts.

Needed: A Few Good Congressmen

Creating an incentive for private industry to finance the construction of expensive space infrastructure without imposing a huge burden on American taxpayers could be achieved if Congress were to pass a lunar land claims recognition law. The Space Settlement Institute has developed a draft of such a law, called "The Space Settlement Prize Act" (www.spacesettlement.org/law), which could be a starting point for Congressional debate.

Governments are often seen as major supporters of new ideas for space development. Proponents of a "space elevator," shown in this artist's concept, are hoping the U.S. government, through NASA's Centennial Challenges Program, will help to incentivize the development of a strong yet lightweight tether to support the elevator. (Source: NASA/Marshall Space Flight Center)

As proposed by the Space Settlement Institute, the law would give the first private entity to establish a privately-funded, permanent lunar base and space line the right to legal recognition by the United States of the entity's claim to a piece of lunar territory about the size of Alaska, approximately 4 percent of the lunar surface. Each successive lunar base and space line established by other, subsequent private groups could receive recognition of a claim of 15 percent less land than the previous one (to place a premium on being the first to succeed in establishing a base). Such a law would ensure that, if all its conditions are met, U.S. courts will accept private entities' claims and allow private groups to recoup their investments and make profits by selling deeds to parcels of its lunar land to American citizens, and everyone else, back on Earth.

It would be very desirable if as many other nations as possible joined in granting recognition. Therefore, the draft legislation strongly encourages reciprocal arrangements with other nations. Among the conditions that would have to be met to comply with international space law would be the requirement that the space line and lunar base be open to all peaceful, fare-paying passengers, regardless of nationality. U.S. recognition of land claims would be an open proposition, equally, to consortia from any nation, and, in fact, it is very likely that some lunar bases would be established by multi-national consortia

and launched from non-American spaceports.

Without something like the land claims recognition law, it may be a very long time before the space infrastructure that space businesses will need is financed and constructed.

On February 10, Congressmen Ken Calvert, the newly appointed chairman of the Space and Aeronautics Subcommittee of the House Science Committee, spoke before the Federal Aviation Administration's annual commercial space transportation conference. Calvert stated, "In 2010, the shuttle will be retired, so there is right now a need to move people into space quickly, safely, and reliably. I believe that need could be met in large part by the private sector.... The job of Congress is to pass legislation and exercise its oversight functions in such a way that will enable this industry to succeed."

In June 2004, the President's Commission on Implementation of United States Space Exploration Policy (also known as the Aldridge Commission) specifically recommended prizes, tax incentives, regulatory relief, and the assurance of "appropriate property rights for those who seek to develop space resources and infrastructure." It's hard to imagine a more effective way to help the private space industry succeed than by passing legislation creating a financial incentive worth billions of dollars to research, design, develop, and build vital components of the infrastructure in space.

And what would motivate Congress to pass a lunar land claims recognition law? Unlocking billions of dollars in private investment for the development of the space industry and space infrastructure would create an economic boom for this country in the aerospace and technology sectors. Untold new technology jobs would be created. More young people in this country would become interested in pursuing science as a career, inspired by a private industry race to the Moon in which they could possibly participate, just as the young generation was inspired during the Apollo era. An intensive effort on the part of the private sector to develop space infrastructure will have many economic and societal benefits.

A catalyst like that which a lunar land claims recognition law would provide is needed now to jumpstart the development of space infrastructure. As Anita Gale points out, "The effect of adding space infrastructure will be like building a freeway in Southern California. After the first elements of infrastructure are in place, gas stations and restaurants are built at the exits, then hotels, and finally entire towns. After the first big spaceport or settlement is established, there will be a space construction boom."

We can only close our eyes and imagine – and then open them and get to work to make it happen. ■

Douglas O. Jobes **is president of the Space Settlement Institute, a think tank dedicated to finding ways to make space settlement happen in our lifetimes (www.space-settlement-institute.org).**

What Vision for the Future?

The United States needs not choose between space exploration and the pursuit of Earth-focused space applications. It can do both.

by Brian Stone

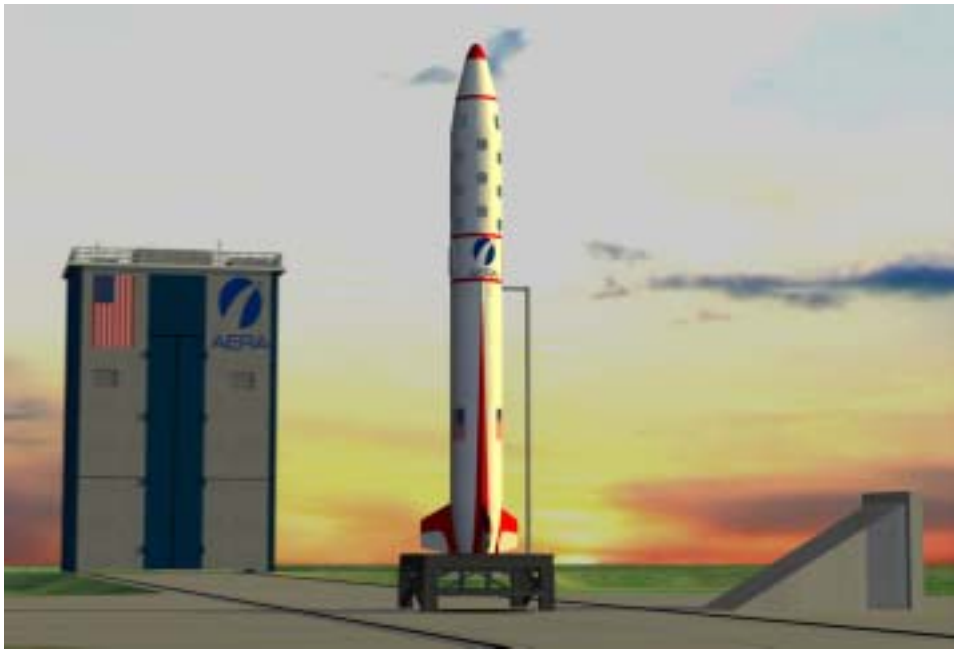
John Logsdon, director of the Space Policy Institute at The George Washington University, and Rick Fleeter, chief executive officer of AeroAstro, have offered two alternative views of our potential future in space. Logsdon suggests that the U.S. government should pursue the broad program of exploration laid out by President Bush in January 2004 to establish a U.S. presence on the Moon and Mars. Fleeter suggests that large-scale government exploration programs are "burdensome baggage of an aristocratic calling" and that pursuing space exploration will prevent commercial interests from pursuing space activities with direct benefits to society and humankind. Both futures are intended to further U.S. scientific, security, and economic concerns, but are an "exploration-driven" vision and an "applications-driven" vision mutually exclusive or compatible? I believe the two visions *are* compatible and that the right course for the United States will be to pursue a balance of exploration and applications-driven activities in space.

Public and Private Roles

The United States must "think big" with regard to space exploration. America wants to have a human presence in space beyond low Earth orbit. It is generally felt that the cost of access to space is the major barrier to increased commercial and scientific exploitation of space, and the long-term goal of both the government and the private sector is to develop technologies to place higher payloads into space at lower costs. Space exploration critics such as Fleeter suggest that by agreeing to pay large sums of money for access to space, the government is the problem and not the solution to this part of the issue. The government needs to pursue more cost-efficient approaches to space access, but we have not yet reached the point where the commercial sector can effectively step in and produce a future that will derive the maximum benefit for American – and international – society.

While it will always be popular to rail against the government and insist that the private sector can do things better, the federal government is best placed to support exploration efforts. Governments are the only entities with large enough financial reserves to bear the costs and risks of potential failures to be encountered along the way. In a certain sense the government is the ultimate source of venture capital; by design the government is supposed to take the risks that make private and commercial development possible down the road.

Despite any altruistic intentions contained in corporate vision statements, commercial companies are for-profit entities established to make money. Whether privately held or publicly owned, the goal is to provide a return on investment that is generally in keeping with the amount of financial risk involved. Space ventures are highly financially risky, and therefore the expected long-term payback is high and can be tolerated only by a relatively small group of investors. The long-term strategy for the U.S. government should be to bring down the level of risk involved, providing cheaper access to capital and stimulating investment, thereby driving the commercial space sector and



After decades of technology development leading to many successful missions, wealthy governments are no longer the sole participants in human space exploration. The engineering expertise generated by large government efforts now allows new commercial enterprises like Aera to venture into the human space exploration business. Aera plans to execute the first commercial U.S. human passenger space flight vehicle with its Alteris vehicle, shown here, in late 2006. (Source: Aera Corporation)

Space-related efforts are often financially supported by government agencies that have much to gain from such activities, which contribute to the study of urban development, natural disasters, and pollution control. This image of the 2002 Mt. Etna eruption in Sicily was captured by the Moderate Resolution Imaging Spectroradiometer (MODIS) instrument aboard NASA's Terra spacecraft. (Source: Jacques Descloitres, MODIS Rapid Response Team at NASA Goddard Space Flight Center)

providing the maximum benefit to Earth from a scientific and investment point of view.

If the government steps in and bears the majority of the risks in the space sector by pursuing a far-reaching exploration policy, then the private sector will be able to look for profit-making opportunities along the way. This is an established historical pattern: the government takes the risks, and the private sector figures out which elements will be profitable. For example, the U.S. government spent millions of dollars developing ARPANET, a computer network which was the pathfinder effort for the now-ubiquitous internet. Would the commercial sector have invested the money to develop computer networking to the point needed to successfully commercialize the technology? Certainly not without some guarantees of profit down the road.

At the same time, the government needs to ensure that access to space remains a level playing field and that it does not become commercially viable for only those companies currently participating in the aerospace industry. When a commercial entity takes a financial risk to develop technology, it needs to protect its ability to provide a return on investment through patents and intellectual property rights. In the early 1960s the Kennedy administration was approached by AT&T with a proposal to develop a satellite communications capability in exchange for an agreement from the U.S. government to provide launch capabilities. Satellite communication was seen as a major foreign policy tool by Kennedy, and the proposal was rejected by the administration on the basis that it would provide an unfair monopoly on space communications to AT&T. In fact, the Kennedy administration adopted an entirely opposite approach and took on commercial satellite development itself through the National Aeronautics and Space Administration (NASA) on the basis that such valuable capabilities needed to be available to a wider commercial audience for the greater public good. Although it is hard now to imagine that the technology for space access might someday become as ubiquitous as the internet, it is important for the government to ensure that the building blocks of access to space remain publicly funded to ensure today's early space pioneers don't become the robber-barons of the future.

Weighing the Benefits

The fundamental goal of the exploration-driven vision set out by President Bush in January 2004 is "to advance U.S. scientific, security, and economic interests through a robust space exploration program." To support this goal the United States intends to:

- "Implement a sustained and affordable human and robotic program to explore the solar system and beyond;
- Extend human presence across the solar system, starting with a human return to the Moon by the year 2020, in preparation for human exploration of Mars and other destinations;
- Develop the innovative technologies, knowledge, and infrastructures both to explore and to support decisions about the destinations for human exploration; and
- Promote international and commercial participation in exploration to further U.S. scientific, security, and economic interests."

The "applications-driven" vision is quite different. The best example of this vi-

sion is found in the European Commission's 2003 white paper, "Space: A New European Frontier for an Expanding Union," which lays out the European Union's long-range space policy vision. In contrast to the outward-looking policy of the United States, the EU space plan is very much Earth-focused. The white paper discusses such things as the development of "space tools" for use in conducting Earth observations to monitor compliance with international treaties, observe the weather, and facilitate the assessment of agricultural activities. A significant element of the EU policy is the development of the Galileo navigation system to provide Europe with a satellite-based navigation system independent of the U.S.-operated Global Positioning System. The policy also talks about using space resources to "bridge the digital divide" to bring internet connectivity to remote and underserved regions of the European Union. Only a very small mention is made of space exploration; the priority is clearly on Earth-focused applications of space technology.

Originally developed for the U.S. military, the Global Positioning System satellite network has grown to incorporate a variety of commercial uses including private motor vehicle navigation. The evolution of space satellite technology supported by the U.S. government generated a multi-billion-dollar commercial satellite industry that now includes satellite television, satellite radio, and many other forms of telecommunications. (Source: The Boeing Company)

By setting the goal as the Moon and eventually Mars, the U.S. exploration vision will be broad enough to potentially include any space-related activities necessary to achieve these far-reaching goals. The notable distinction of the vision is that it assumes that the economic and societal benefits will be derived later, as part of the journey. That is, the government is taking the risk of potential success or failure of the vision. Through the process of federally supported exploration, the U.S. scientific and business community will be enriched by a series of technological and logistical challenges.

What the new vision does not assume is that the process of exploration will be cost-effective, market-driven, or guaranteed to have a specific set of "payoffs" for the American taxpayer who will provide the funds to support the vision. It does, however, provide the most potential benefit of the two visions.

Although it is impossible to name all of the specific future benefits to humankind from pursuing the exploration vision, it is possible to make some inferences from the broad goals outlined in the policy about research areas that will reap dividends. For example, in order to develop a sustainable robotic exploration program it will be necessary to develop intelligent robotic systems capable of conducting *in situ* analysis. The distances from Earth are too great to effectively control rovers in real time remotely, which means that they must have the capability to operate and "think" on their own. In addition to being able to use artificial intelligence, the robotic systems will need highly miniaturized, on-board analytical laboratories to conduct research in the field. Communications bandwidth will be limited and the cost of sample return will be so great that the research paradigm will shift toward sending only reduced data back to Earth. This work in robotic exploration has the potential to promote development in computer networking, nanotechnology, and autonomous robotic systems.

Another element of the exploration vision with strong applications on Earth will be the technologies developed to protect and sustain human physiology during extended space missions. Although we have gained considerable experience with the effects of extended weightlessness on human physiology, extended long-range travel presents a new series of challenges. New systems will need to be developed to protect astronauts from the effects of long-term radiation exposure during extended flights to Mars, and research will need to be conducted to prevent physical atrophy in flight. These human factors studies will contribute to our knowledge of the human body and may have applications for medicine that have not yet been conceived.

Fleeter stated in a recent opinion piece: "What counts to us in life – our safety, security, health, education, career, and family – are [*sic*] where society will

invest its resources, not in a long-range quest for a putative greater destiny, promulgated by of all things, a government bureaucracy populated mainly by engineers (i.e., NASA), a destiny we are told we will only find among planetary bodies and stars far from Earth, not in our own backyards, universities, companies and national research facilities."

What Fleeter is missing is the fact that NASA is not the only agency funding space-related activities. The Departments of Commerce and Defense and non-mission agencies such as the National Science Foundation will all continue to put money into the applications-related activities that can be supported in space. It is not a zero-sum choice for exploration over all other things. Much of the applications-driven research that uses space resources is done by researchers outside the "government bureaucracy" – at universities and federally-funded research and development centers throughout the United States. For example, three U.S. government agencies support the National Polar-orbiting Operational Environmental Satellite System (NPOESS), a $7-billion program to establish a network of polar-orbiting satellites to conduct atmospheric and oceanic observations to improve weather and sea-state forecasting across the globe. Although the funding for NPOESS is not completely secure, this project is not currently competing with the new vision for space exploration and is making headway toward becoming a tremendous application for improving the lives of people on Earth.

The primary advantage the broad exploration vision has over the applications-driven vision is the fact that it does not constrain the potential long-term benefits to only those applications which are currently known. By including only the pursuit of technologies and applications with known benefits to society or with known profit-making potential, an applications-focused policy's potential benefits would be limited to those that rely on current technology. In the applications-driven vision, entire classes of research would be excluded, such as the human physiology research mentioned earlier.

In addition, by adopting the broad exploration vision, the government leaves open the possibility that the commercial sector can leverage new technologies developed along the way, including those in areas of research not yet known or even conceived. Adopting the applications-driven vision would place constraints on the activities pursued and would limit the potential net benefits of the overall initiative, even though it may cost less in the short term.

Another major concern that could be addressed through a major program of space exploration is the issue of America's declining science and engineering (S&E) workforce. In a 2001 report, the National Science Board reported that the future of the U.S. S&E workforce is facing two long-term trends of major concern: (1) "global competition for S&E talent is intensifying" and (2) "the number of native-born S&E graduates entering the workforce is likely to decline unless the nation intervenes to improve success in educating S&E students."

Although the United States is currently a world leader in the development of technology, the nation is increasingly reliant on non-native labor to fill S&E positions in the U.S. workforce. The National Science Board called for "national-level action" to ensure U.S. competitiveness in the future. A flagship activity such as a major space exploration initiative has tremendous potential to inspire and motivate individuals to pursue careers in science and technology.

Technological advances in intelligent robotics are an important step toward the in situ *analytic capabilities on the surface of solar system bodies far from Earth. Developing robots, such as the "Nanorover" seen here, improves both government and commercial research efforts in the fields of nanotechnology and autonomous microrobotics. (Source: NASA/Jet Propulsion Laboratory-Caltech)*

Striking the Right Balance

In 1971, Caspar Weinberger, then deputy director of the Office of Management and Budget, wrote a memorandum to President Richard Nixon in which he gave his thoughts on NASA budget development, and in particular the proposal to cancel Apollos 16 and 17, the remaining two lunar missions. Weinberger wrote: "It would be confirming, in some re-

spects, a belief that I fear is gaining credence at home and abroad: [t]hat our best years are behind us, that we are turning inward, reducing our defense commitments, and voluntarily starting to give up our super power status, and our desire to maintain our world superiority. America should be able to afford something besides increased welfare, programs to repair our cities, or Appalachian relief and the like."

What Weinberger recognized then is that a broad vision for space activities provides what he called a "moral lift" for the American people. By exploring the unknown and undertaking these major technological achievements, the government provides people with answers to questions that would not otherwise be answered and conducts activities they can be proud of as Americans. I agree with Weinberger that we should be able to afford more; if we do not set our sights high enough, we will reduce the potential long-term payoffs to be gained along the way.

Unlike the failed 1989 Space Exploration Initiative, a key feature of the new vision for exploration is that it is to be done within existing budgetary constraints. There is no unrealistic expectation that the NASA budget will double in a single year as it did early on in the Apollo era. The goal is to redistribute the funding within NASA by making politically tough choices such as eliminating the space shuttle and developing new and more cost-effective means of accessing space. The three imperatives for implementation of the new vision, as stated in the *Report of the President's Commission on Implementation of United States Space Exploration Policy*, are that the program must be sustainable over many decades, affordable with available resources, and credible in the stewardship of taxpayer dollars.

In the end the United States will likely pursue a future that includes both applications-driven and exploration activities. Because it will take many years to develop the new technologies needed for extended human space flight, there will need to be some short-term successes to justify sustaining the overall program. I believe that the balance will arise through the need to balance long-term and short-term expenditures – and to ensure that the program is providing tangible benefits to the American people. The exploration program must have relevance from "K to gray," meaning that the broader impacts must be applicable to both the young and old.

A national program as large as NASA's new vision for space exploration is likely to help revitalize an interest in science and engineering among young students. In an attempt to help keep youngsters excited about space and science in school, NASA has developed education programs such as NASA Explorer Schools. The astronaut shown here answers space-related questions from students at an Explorer School. (Source: NASA)

I believe that the United States can conduct a robust program of space exploration that allows us to push the boundaries of our knowledge while remaining relevant to activities here on Earth. To use Fleeter's words, what is "bankrupt both ideologically and financially" is the notion that all space activity must be conducted and coordinated by the government, with NASA being the sole supplier of space-related products and services. As it should and where possible, the government is moving out of the portions of the space sector that have become commercially viable such as certain aspects of remote sensing, communications, and launch services. The "big government" Apollo-style space program is not the model to be followed for the future, nor is it applicable to the current situation. We are not in a space race or under pressure to put humans on the Moon in a mere ten years.

As Logsdon asks, the question is whether or not we have the political will to fully implement the vision by phasing out the space shuttle and the other activities that are currently limiting the ability to redistribute funds to exploration and by making the other tough choices that may raise concern in Congress. If the political outcry over NASA's proposal to eliminate the Hubble Space Telescope was an indicator of the path ahead, then imagine the discussion that will take place over the phase-out of the shuttle.

I think the time is right for the people of America to have a moral lift, and I think exploring space is a good way to provide it. ■

***Brian Stone* is pursuing his Master of Business Administration degree at The George Washington University.**

Goddard Memorial Symposium Attendees "Explore the Possibilities"

The forty-third Robert H. Goddard Memorial Symposium was held March 29 and 30, 2005, at the Greenbelt Marriott in Greenbelt, Maryland. Ed Weiler, director of the National Aeronautics and Space Administration's (NASA) Goddard Space Flight Center kicked off the first day by welcoming attendees and introducing a very enthusiastic Jim Garvin, NASA's chief scientist. Garvin captivated the audience with his discussion on the importance of NASA's plans to use the Moon as a test bed for future missions to the Mars and beyond. He ended his presentation with the admonition that "exploration without science is tourism."

Guest speaker Conrad C. Lautenbacher, administrator of the National Oceanic and Atmospheric Administration (NOAA), provided opening remarks on day two. Lautenbacher stressed the need for all nations to improve understanding of how the Earth works. "Space is the foundation for global Earth observing," said Lautenbacher. "I'm a cup-half-full observer. We can figure out how to sustain the Earth if we just put on our thinking caps." The administrator said that although there are tens of thousands of sensors around the world today, there is really little integration. He said that this important issue and others were recently discussed at length at the third Earth Observation Summit in Brussels. "It was gratifying to see worldwide participation that got attention at the political level." Following his remarks, Lautenbacher was presented the AAS 2005 Award for the Advancement of International Cooperation for his outstanding leadership in launching the ad-hoc intergovernmental Group on Earth Observations and the development of a ten-year plan for the Global Earth Observation System of Systems.

Five technical sessions and one student session were included in the two-day event. Day one of the symposium focused on topics including NASA's strategic management and education initiatives, lunar exploration, Mars exploration, the Cassini and Huygens missions, detector and sensor technologies, supercomputing technologies, optical systems and communications, and sensor webs.

Maryland Congressman Steny Hoyer addressed the lunch attendees on day one, touting his endorsement of NASA and the vision for space exploration and his belief that America needs to reduce its fiscal deficit to ensure success of the vision.

Sessions on day two covered the Earth-Sun system, climate change, NASA/NOAA programs, the Hubble and James Webb Space Telescopes, precipitation from space, astroplanetology, the Beyond Einstein program, and space interferometers.

Wednesday's lunch speaker, E.C. "Pete" Aldridge, Jr., shared with attend-

LEFT: La Vida Cooper discusses her experiences in working for NASA. (Source: NASA/Goddard Space Flight Center) RIGHT: Conrad Lautenbacher discusses Earth observation challenges. (Source: NASA/Goddard Space Flight Center)

ees his endorsement of the vision for space exploration and provided background on how the commission he chaired on implementing the new vision reached its conclusions. Aldridge told the audience, "We'll get there from here with clear messages, sustainability, and credibility. We know from past experience the value of exploration and the benefits to Americans. Ask the children: they want to go into space and visit other worlds."

AAS President Jon Malay bestowed Aldridge with the AAS Lifetime Achievement Award for leading the President's Commission on the Implementation of United States Space Exploration Policy and for serving more than forty-two years in aerospace leadership positions, eighteen years of which were in the Department of Defense. The AAS also presented the 2004 Space Flight Award to Harold W. "Hal" Gehman, Jr., for his outstanding contributions as chairman of the Columbia Accident Investigation Board.

NASA Goddard Space Flight Center coordinated a student session and career fair for high school, undergraduate, and graduate students on day two of the symposium. About fifty students from more than a dozen high schools and universities participated, some as far away as Illinois. Two Goddard electronic engineers, a Goddard astrophysicist, and the chief of staff of NASA's space shuttle program office provided the students information about NASA careers and conducted a recruiting session. During the second day lunch, five students gave one-minute presentations on what inspired them to pursue curricula in math, science, and engineering and careers in the space program.

Jon Malay (left) presents E.C. "Pete" Aldridge with the AAS Lifetime Achievement Award. (Source: NASA/Goddard Space Flight Center)

More than 250 people attended this year's Robert H. Goddard Memorial Symposium, including Michael Goddard, a descendant of Dr. Goddard. ■

NOTE: Many presentations from the Goddard Memorial Symposium can be accessed and downloaded from the AAS web site at: www.astronautical.org.

OBITUARY

Saunders B. Kramer, Sr.

Saunders Kramer's passion was space exploration. "Sandy," as he was known by family, friends, and colleagues, wanted to be the first man on Mars and dreamed of the possibilities of life in space. Born on October 30, 1920, he died May 30, 2005, as he recovered from heart surgery.

He established his position in the space community very early in the space age at Lockheed Missiles & Space Division. There he served as the director/manager of the first detailed study of a crewed space station (1958) followed by station designs for the U.S. Air Force. He was also responsible for the concept and design of the first crewed space tug as well as early space shuttle concepts (1958-1960). While at Lockheed and until the time of his death, he collected, analyzed and interpreted data on all satellite/spacecraft launchings. This evolved into an extensive database that focused on Soviet/Commonwealth of Independent States/ Russian activities.

Following his interval at Lockheed, Sandy joined the U.S. Department of Energy in 1971 and conducted research and development activity in new automotive engines directed toward reducing exhaust pollution and improving engine efficiency. He retired from the federal government in 1992.

Sandy authored more than two dozen papers, and co-authored another dozen. In 2003, he authored and published *The Hundred Billion New-Ruble Trip: A Russian Landing on Mars* (highlighted in the July/August 2004 issue of *Space Times*) and was a contributing editor for *Air & Space Magazine*. He was a founding member and fellow of the American Astronautical Society (AAS), a fellow of the British Interplanetary Society, a charter member of The Planetary Society, and a life member of the National Space Society.

Sandy was an active and valued member of AAS, and he will be greatly missed. His family has requested that contributions in his memory be made to AAS, NSS, or The Planetary Society.

NASA Welcomes a New Administrator

Michael D. Griffin was confirmed by the U.S. Senate to become the National Aeronautics and Space Administration's (NASA) eleventh administrator on April 13.

"I have great confidence in the team that will carry out our nation's exciting, outward-focused, destination-oriented program," said Griffin, who committed to spending much of his first several weeks at his new post reviewing progress toward returning the space shuttle safely to flight. "I share with the agency a great sense of privilege that we have been given the wonderful opportunity to extend humanity's reach throughout the solar system."

During his confirmation hearing before the Senate, Griffin stated his priorities, which are consistent with President Bush's vision for space exploration:

- Fly the space shuttle as safely as possible until its retirement, no later than 2010;
- Bring a new Crew Exploration Vehicle into service as soon as possible after the space shuttle is retired;
- Develop a balanced overall program of science, exploration, and aeronautics at NASA;
- Complete the International Space Station in a manner consistent with our international partner commitments and the needs of human exploration;
- Encourage the pursuit of appropriate partnerships with the emerging commercial space sector; and
- Establish a lunar return program that will lay the groundwork for later missions to Mars and other destinations.

President George W. Bush nominated Griffin as NASA administrator in March. At the time, Griffin was serving as the space department head at Johns Hopkins University's Applied Physics Laboratory in Laurel, Maryland.

Griffin was president and chief operating officer of In-Q-Tel, Inc., before joining Johns Hopkins in April 2004. He also worked within Orbital Sciences Corporation of Dulles, Virginia, and served as chief executive officer of Magellan Systems, Inc.

Earlier in his career, Administrator Griffin served as chief engineer at NASA and as deputy for technology at the Strategic Defense Initiative Organization. He also has served as an adjunct professor at the University of Maryland, Johns Hopkins University, and The George Washington University. He taught courses in spacecraft design, applied mathematics, guidance and navigation, compressible flow, computational fluid dynamics, spacecraft attitude control, astrodynamics, and introductory aerospace engineering.

Griffin is the lead author of more than two dozen technical papers, as well as the textbook *Space Vehicle Design* published by the American Institute of Aeronautics and Astronautics (AIAA) and now in its second edition.

A registered professional engineer in Maryland and California, the administrator is a fellow of AAS and AIAA. He is a recipient of the NASA Exceptional Achievement Medal, the AIAA Space Systems Medal, and the Department of Defense Distinguished Public Service Medal. He is a certified flight instructor with instrument and multi-engine ratings.

Griffin received a bachelor's degree in physics from Johns Hopkins University; a master's degree in aerospace science from Catholic University of America; a Ph.D. in aerospace engineering from the University of Maryland; a master's degree in electrical engineering from the University of Southern California; a master's degree in applied physics from Johns Hopkins University; a master's degree in business administration from Loyola College; and a master's degree in civil engineering from The George Washington University. ■

NASA Administrator Michael D. Griffin. (Source: NASA/Renee Bouchard)

Lunar Exploration: Human Pioneers and Robotic Surveyors

Reviewed by Mark Williamson

Lunar Exploration: Human Pioneers and Robotic Surveyors, Paolo Ulivi with David M. Harland. Heidelberg: Springer Praxis, 2004. 363 pages. ISBN: 1-8523-3746-X. $39.95 (paperback).

There have been so many books on lunar exploration that one wonders, when another one is published, what drove the author to write it and whether buying it can be justified. In his foreword to *Lunar Exploration: Human Pioneers and Robotic Surveyors*, David Harland addresses this issue head-on, noting that a great deal of information is now freely available on the internet. The problem, as he rightly points out, is "to sort the wheat from the chaff."

Paolo Ulivi has chosen to concentrate in this book on the scientific results of lunar exploration missions, including "an insight into the politics and management of the various space programs," as opposed to what he calls "the human side of lunar exploration." Nevertheless, there is still a fair bit of coverage of the Apollo missions and the proposed, but ultimately cancelled, Soviet counterparts. And because the book's cover features that famous boot print in the lunar soil, we must assume that the human element retains its importance, not least in terms of marketing.

But what about the bulk of the book? Its seven chapters cover the early lunar missions, including the Luna, Ranger and Surveyor series, then move on to the race to place a man on the Moon. Later chapters deal with the return to the Moon of the 1990s, featuring the Clementine and Lunar Prospector spacecraft, and a look toward the missions of the future.

Although the cover blurb makes much of how the author draws on recently declassified information to describe "Chinese lunar exploration projects and how lunar nuclear weapons were developed by the superpowers in the 1950s," there is very little on these topics in the book. China's plans read like an afterthought in the final chapter, there is only a short subsection on the superpowers' military ambitions in the first chapter, and neither "nuclear" nor "weapon" occurs in the index.

At the other extreme, it seems the author has succumbed to the glut of information available on the Apollo program and included too much on the nuts and bolts of the Saturn rockets and other related hardware. What the author includes in his book is, of course, his own business, but there are arguably other books which cover the technology better. Having said that, for those who don't have access to those books, this one offers useful, if not original, coverage of the field.

This book is unashamedly technical, and its text is replete with rocket engine designations, weights, dimensions, and payload characteristics. It is, however, readable and interesting, the technicalities being interspersed with historical context and observations. The book is illustrated with about a hundred black-and-white photos and line drawings – chosen largely for their technical content rather than simply to break up the text – and also includes an appendix on Soviet launcher nomenclature, a glossary, a bibliography, and a chronology of lunar exploration, followed by an eleven-page index. It is only unfortunate that, considering the book has much in common with an academic history text, there are no numbered references, which means that serious students have no way to follow up the author's claims directly.

All in all, Ulivi's book is a useful and accessible package available at a reasonable price. ■

Mark Williamson **is an independent space technology consultant and author.**

11th International Space Conference of Pacific-basin Societies (ISCOPS)

The 11th International Space Conference of Pacific-basin Societies (ISCOPS) is scheduled to be held in China in 2007. This conference is sponsored by the AAS, Chinese Society of Astronautics (CSA), and Japanese Rocket Society (JRS). It was last held in Tokyo in 2003. The ISCOPS provides a forum for space decision-makers, experts, engineers, and technicians to exchange ideas and experiences in space technology and the future of space development and its applications, mainly in the Pacific Basin.

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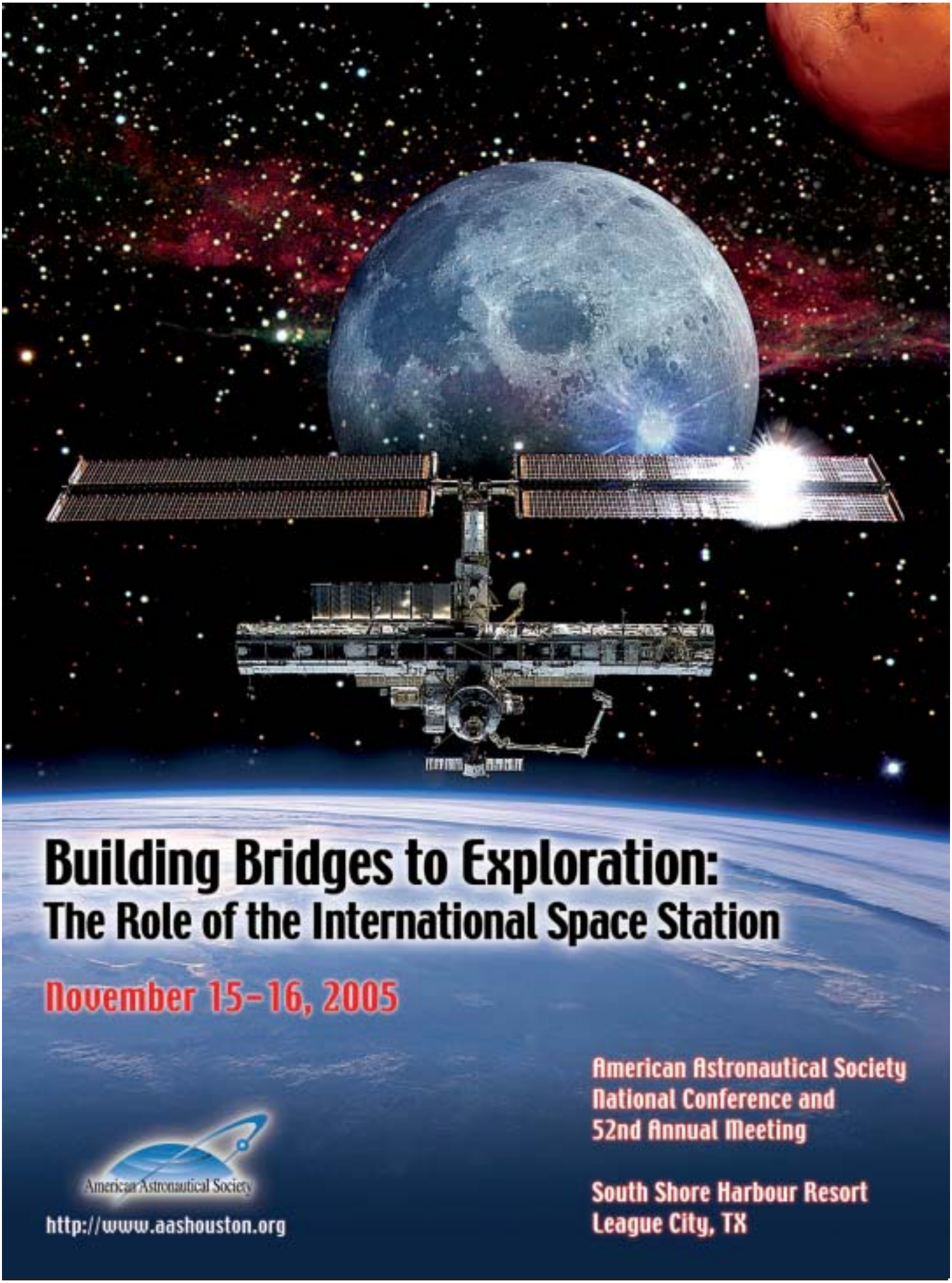
Building Bridges to Exploration:
The Role of the International Space Station
November 15–16, 2005
American Astronautical Society
National Conference and
52nd Annual Meeting
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AAS National Conference and 52nd Annual Meeting

Building Bridges to Exploration: The Role of the International Space Station

November 15-16, 2005
South Shore Harbour Resort, Houston, Texas

Program Outline

DAY 1
Keynote Speaker: 2005 Carl Sagan Memorial Award Recipient
Session 1: Realizing the Promise of the International Space Station
Luncheon
Session 2: Focus on International Space Station Research
Session 3: International Space Station Challenges Enabling Exploration Risk Reductions
Session 4: Roundtable on Integration Challenges of Large-scale Programs
Reception & Awards Banquet

DAY 2
Keynote Address
Session 5: Common Challenges: Human and Robotic Exploration
Luncheon
Session 6: International Space Station as a Mars Mission Testbed
Closing Reception

Charitable Giving and the AAS

A popular way to donate to an organization is to make a gift by means of a will, i.e., make a bequest. You may wish to consider either a general bequest to AAS or a bequest targeted to an existing or new AAS scholarship or award fund. Such bequests are deductible against estate and inheritance taxes. Of course, there are also tax advantages to making charitable donations to AAS while you're living. Such gifts could give tribute to the memory of someone who has passed away or be in honor of a person still living. Special occasions offer other opportunities for gifts to be directed to the Society. As a final note, although AAS can provide suggestions for charitable giving, such actions should always be reviewed by your financial or legal advisor.

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Where Have You Gone, Joe DiMaggio?

We need another Carl Sagan.

by Dwayne A. Day

Carl Sagan died in December 1996, and the world has been a sadder place without him. No matter what you thought about his politics, you have to admit that Sagan was the closest thing the space community has had to a philosopher poet. We could sure use his help right now.

Space exploration – true space exploration, defined as going new places and learning new things – has been on a spectacular roll lately. The two Mars rovers are creaky but still crawling across the surface of the red planet. Cassini is dodging the rings and moons of Saturn and revisiting Titan, where the Huygens probe revealed a bizarre environment of hydrocarbon rain eroding frozen ice mountains. A spacecraft known by the inventive acronym MESSENGER is flying to Mercury. And that's not to mention the several orbiters, American and European, currently circling Mars or destined to arrive there soon.

Unfortunately, the human space flight projects are in worse shape. The shuttle is still grounded, the International Space Station is still years away from completion, and the bold new space exploration "vision" is mired in the drudgery of budget politics. But wondrous things are happening way out there in the deep cold black of outer space, and we do not have anybody to turn the science into poetry.

You can see this on the television talk shows. A few astronauts and scientists have appeared on late night talk shows over the years, but they have never been asked back. The hottest late night "news" entertainment program, Jon Stewart's *The Daily Show*, has been decidedly negative about space. When the Mars rovers discovered evidence of water on Mars—a fundamental prerequisite for life as we know it—Stewart's response was to ask why we had spent hundreds of millions of dollars to discover something that we can get in the bathroom sink. More recently, when scientists reported the results from Cassini's study of Saturn's beautiful and mysterious rings, Stewart was equally dismissive: "Three billion dollars and they discovered dirt?"

The Mars rover program has Steve Squyres, the Cornell University scientist whose geeky exuberance is a welcome change from the typically dull, somewhat bureaucratic demeanor of most NASA principal investigators. But Squyres's delivery is reminiscent of the enthusiastic high school science teacher trying to convince bored students that science really is neat, honest. His greatest appeal is to people who are already convinced.

Another person in the space community who regularly plays the spokesman role to the general public is Robert Zubrin. But Zubrin is a little, well, hard-edged. His enthusiasm translates into zealotry, and he often comes across like a southern fundamentalist preacher who the choir loves but who scares away people at the church door. If you engage him in conversation, you get the vague feeling that he is about to go for your neck. He appears to have softened his message and his delivery somewhat over the past few years, but he still makes space enthusiasm seem somewhat off-putting to outsiders, like being at a Trekkie convention where people will spontaneously break into song. In Klingon.

Probably the best overall spokesperson is Neil deGrasse Tyson, the director of the Hayden Planetarium in New York City. Tyson has charisma and credentials and the necessary sense of wonder (although you have to worry about a man who seriously considered downgrading Pluto from planetary status). But despite his eloquence, Tyson still has not captured the public the way we in the space community need.

What we need is another Carl Sagan, someone who doesn't talk down to the general (and often ignorant) public but instead wants to bring humanity along for the ride through this wondrous and mysterious universe. Perhaps Sagan's greatest coup was that he captured the imagination of one of America's media icons, the late Johnny Carson. Sagan used to appear regularly on Carson's *The Tonight Show*, talking about the Voyager missions to the outer planets or the latest dis-

Neil Tyson dazzles an auditorium full of people with his animated yet eloquent lectures about the mysteries of the universe. (Source: Delvinhair Productions)

coveries in astronomy as if he was telling a story about something that had happened to him last week. One of the keys to his success was, ironically, that he became a bit of a caricature. People made fun of his delivery at times – "*billions and billions…*" – but they respected and understood him because he had a way of taking the extraordinary and making it seem understandable, yet still extraordinary. When he explained how the basic matter that makes up every human being was generated in the cores of exploding stars he coined a memorable shorthand explanation: "We are starstuff," he said, and it tapped into a basic human desire for spirituality.

How do we get that back? Perhaps it just isn't possible anymore. There are too many media outlets, and there is too much cynicism, and maybe no single spokesperson, no matter how elegant, can rise above the noise. But we're going to need it. NASA leaders think that billions of hits to the Mars rover website is great news, but that is somehow empty and unfulfilling, a statistic. The internet is no substitute for storytelling. We need something more. We need someone who can explain why this space stuff is important so that, well, so that we can do more of it.

Maybe we should send the current group of space scientists to charm school. Get them a Hollywood publicist who can train them and massage their image. It is probably easier to turn a scientist into a poet than it is to turn an actor into an astrophysicist. Maybe we can get the scientific community working on this. Can somebody genetically engineer charm and charisma and all those things that Carl Sagan had, then put it in a bottle so we can feed it to a few people?

Carl Sagan was a man who, more than any other, portrayed the beauty of the universe in a way that was both inspiring and humbling. Read these words that Sagan wrote in *Pale Blue Dot*. Read them and weep:

> "Look again at that dot. That's here. That's home. That's us. On it everyone you love, everyone you know, everyone you ever heard of, every human being who ever was, lived out their lives. The aggregate of our joy and suffering, thousands of confident religions, ideologies, and economic doctrines, every hunter and forager, every hero and coward, every creator and destroyer of civilization, every king and peasant, every young couple in love, every mother and father, hopeful child, inventor and explorer, every teacher of morals, every corrupt politician, every superstar, every 'supreme leader,' every saint and sinner in the history of our species lived—on a mote of dust suspended in a sunbeam."

Carl Sagan, we need you, buddy. ■

Carl Sagan managed to positively engage and inform the public about space achievements by garnishing his explainations with wild excitement and easily understandable language. Few public space advocates have become as popular or as enchanting as Sagan. (Source: Michael Okoniewski, ©1994)

Dwayne A. Day **works for the Space Studies Board of the National Research Council. Although an admitted space-geek and recovering Trekkie, he does not sing in Klingon.**

Attention All AAS Members!

Call for 2005 Nominations

FELLOWS: To qualify as an AAS fellow, a candidate must be a current active member with significant scientific, engineering, academic, and/or management contributions to astronautics and space. In addition, contributions to AAS are considered. Selection procedures and a complete list of fellows elected since 1954 can be viewed on the AAS web site. Nominations may be submitted by any AAS member and must be received by the AAS business office by July 18, 2005. The fellows committee will review all submissions, and their recommended candidates will be sent to the officers, directors, and active fellows for vote.

AWARDS: Each year AAS presents awards to recognize the excellence and professional service of our own membership and members of the space community. All AAS members are invited and strongly encouraged to nominate worthwhile candidates for this year's awards. Award descriptions, previous recipients, and nomination procedures can be viewed on the web site. Nominations will be accepted by the AAS business office through July 22, at which time the awards committee will review all submissions and forward names of recommended candidates to the officers and directors for vote. Recipients (and newly elected fellows) will be invited to accept their awards at the annual AAS banquet on November 15, 2005, at the South Shore Harbour Resort in Houston. Note: If you are interested in serving on the awards committee this year, contact the AAS office immediately.

OFFICERS AND DIRECTORS: 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 AAS membership. Are you interested in serving in an elected position, or would you like to nominate a qualified individual? If so, contact the AAS office.

UPCOMING EVENTS

AAS Meeting Schedule

August 7–11, 2005
***AAS/AIAA Astrodynamics Specialist Conference**
Embassy Suites Resort
Lake Tahoe, California
www.space-flight.org

November 15–16, 2005
AAS National Conference and 52nd Annual Meeting
South Shore Harbour Resort
Houston, Texas
www.astronautical.org
See pages 21 for details!

January 22-26, 2006
***AAS/AIAA Space Flight Mechanics Winter Meeting**
Westin Innsbruck Golf Resort
Tampa, Florida
www.space-flight.org

February 4-8, 2006
29th Rocky Mountain Guidance and Control Conference
Beaver Run Resort
Breckenridge, Colorado
www.aas-rocky-mountain-section.org

March 14-15, 2006
44th Robert H. Goddard Memorial Symposium
Greenbelt Mariott Hotel
Greenbelt, Maryland
www.astronautical.org

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