

# Space Lifestyle

M A G A Z I N E Fall 2007

X-Prize Cup Air Extraordinaire

New Cosmological Theory Proposed

Getting Far Out with  
Artist Belbruno

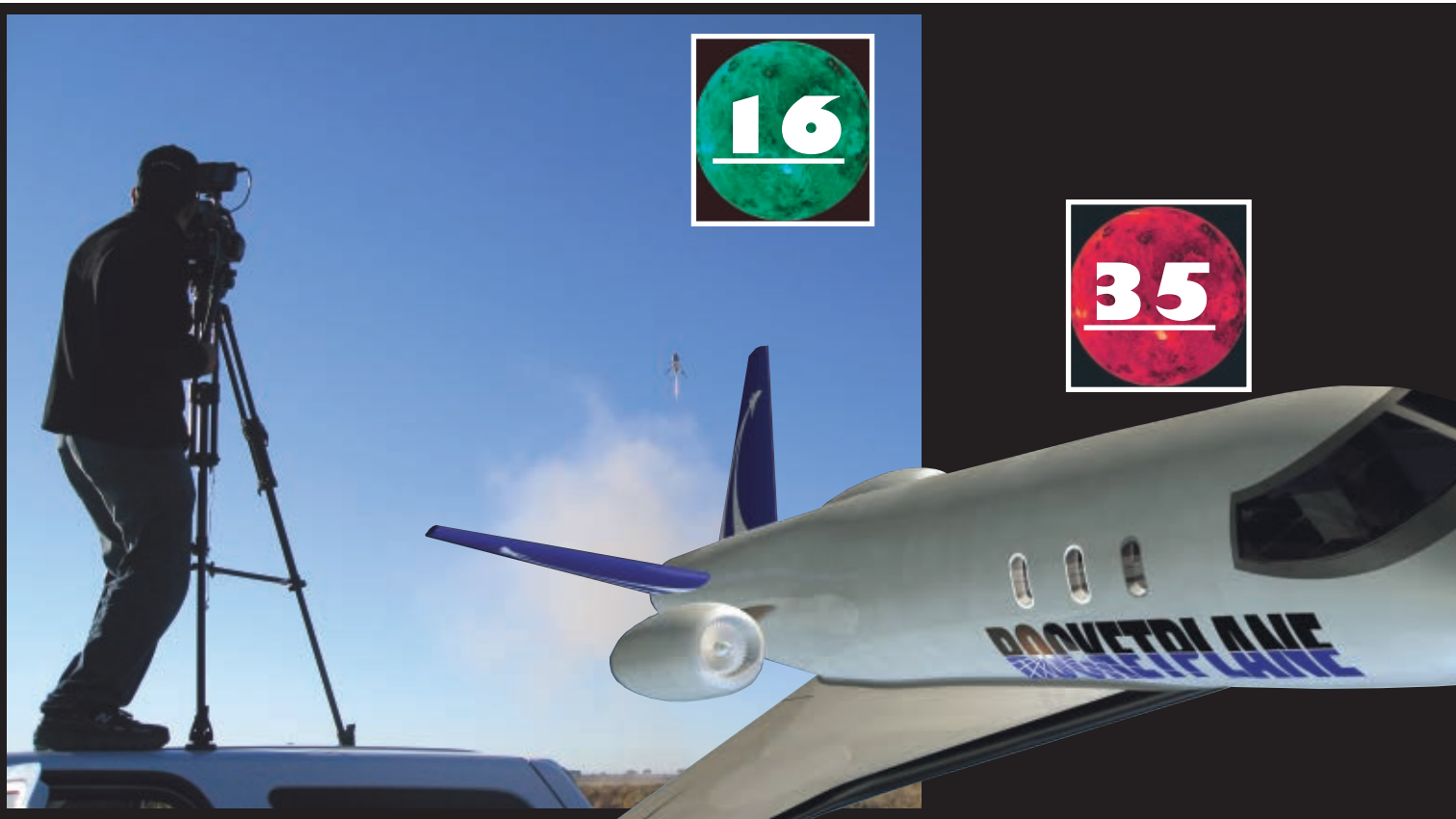
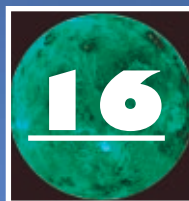
Biosphere Revisited

*Special Report:*  
John Herrington and Rocketplane



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M A G A Z I N E



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## About the Cover

Taken May 20, 2007 by Sanath Kumar with a Canon EOS DIGITAL REBEL XT, this picture is of the Moon and Venus. Kumar stood outside the University of North Dakota's Clifford Hall, in Grand Forks, North Dakota, to capture this rare planetary event. The brightly reflecting objects appear larger than usual because of their close proximity to each other against the night sky, much like the Moon alone seems larger when it appears off the horizon.



## editor's letter

***This Editor's Letter was written in Las Cruces, after the International Symposium on Personal Spaceflight.***

**A**fter only attending half the conference, I did manage to get a chance to ask several astronauts, both from government and private spaceflights, a question. They were speaking to a group of space entrepreneurs and future business hopefuls, and I asked them, "If you had the opportunity to go to space again, would you go again, or would you stay grounded and help others go into space, here on Earth?" I take it almost all of them enjoyed their trip, because they all said, yes, they would go again to space.

But what it reminded me of was the huge disconnect the space community has with the public. Lori Garver, one of the most prominent space advocates in Washington, D.C., even described it in a white paper, recently, entitled "When Perception Becomes Reality: Evolving the American Public's View of NASA." Many in the space community, and even those outside, should read it. As much as the space community tries to create a community amongst themselves, sometimes its from embracing the very thing they love the most, there is always a disconnect with the public.

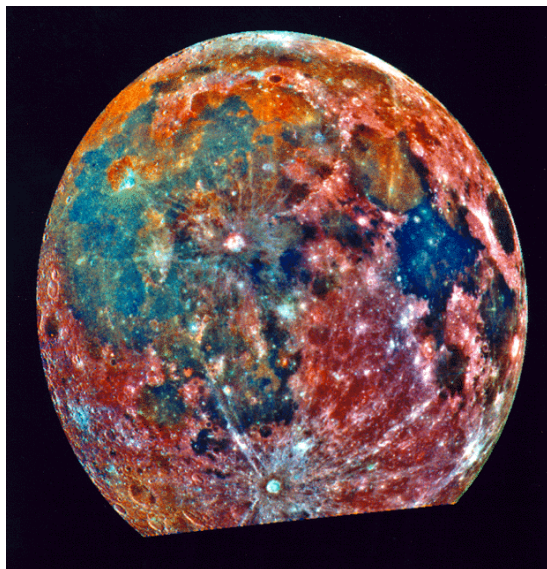
Whether we choose to go into space or not, be it suborbital, or a trip around Saturn, or a permanent stay on the Moon, some of us *will* go. But some of us will choose to *stay* here on Earth, for whatever reason. That's a very real part of space that even if understood, shouldn't divide us as a people.

Richard Branson had the right idea when he was in Las Vegas, last October. He actually jumped off a skyscraper, pulled a parachute and then let hundreds of Virgin Airways tickets fall to the public below. He announced that space will be a reality in the next few years, after he had landed. Branson's reaction gave everyone a chance to be a part of space, at that moment—whether they were going to go one day or not. He found the middle ground with airline tickets and had the chance to support his corporation, as a whole. For a complex world, with diverging space views, it made space even more real.

But for now, here is another issue of *Space Lifestyle Magazine*, written and edited for you and your interests, for wherever your dreams may take you.

Sincerely,

David Bullock  
Editor-in-Chief  
Space Lifestyle Magazine



## Space Lifestyle MAGAZINE

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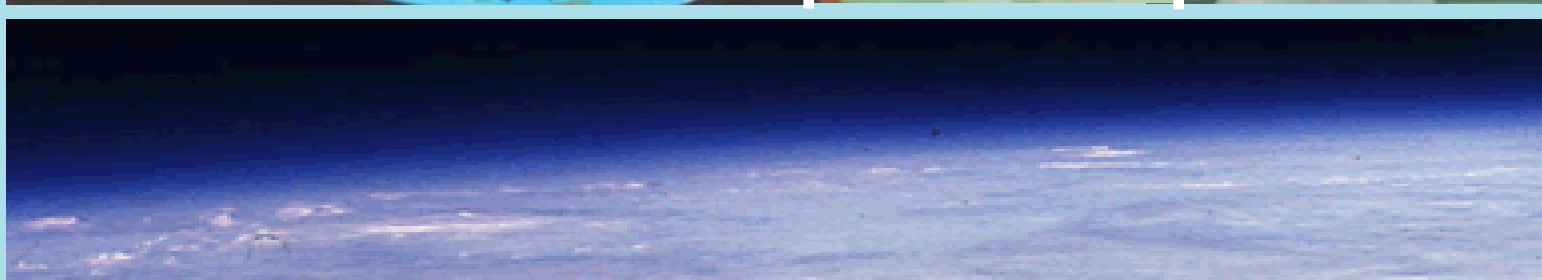
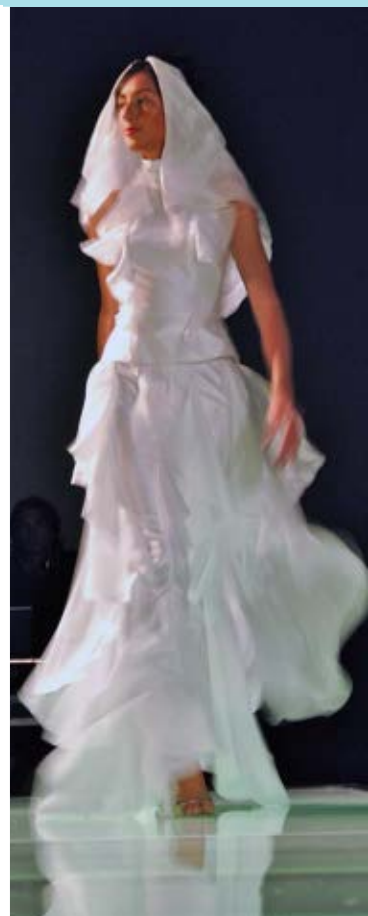




## CSA Kicks Off Space Style 2007

**R**andall Echevarria, California Space Authority, Karyl Newman, Principal and Founder of Chandler and Menouche, and Randa Milliron, CEO and co-founder of Interorbital Systems brought Space Style 2007: a giant leap for couture to the LAX Sheraton on November 6, 2007. Here is a picture of Space Style 2007 and two pictures of a wedding dress entry in the Misuzu Onuki space fashion design competition by Eri Matsui that was at the show. More information about the show can be found at: <http://www.myspace.com/agiantleapforcouture>

Photo Credit: From CSA Public Relations



# Students Launch Rocket Project

The North Dakota Student Rocket Initiative Project (NDSTRIPE) is one of several educational rocket incentives throughout the United States. Sponsored by NASA and the National Space Grant and College Fellowship Program, the North Dakota team launched the pictured rocket on Oct 1, 2007. For more information go to and to see video of NDSTRIPE's launches go to: <http://rocket.und.edu>

Photo Credit: David Bullock







Image Credit: UND Space Studies

## UND SPACE STUDIES ENJOYS 20 GOOD YEARS

The multi-disciplinary Space Studies Program celebrated both 50 years of space exploration and 20 years of their existence as a department at the University of North Dakota. The on-campus and distance learning academic program offers an accredited Masters of Science degree with an overview of the space sector. Courses include space politics, engineering, astronomy, remote sensing and history. More information on their program can be found at: <http://www.space.edu>



# New Lunar Site Launched

**T**o find out more on future and past lunar science and missions, check out the Lunar Planetary Institute's Lunar Science and Exploration site at: <http://www.lpi.usra.edu/lunar/> Whether you're going for the Google X-Prize, studying our celestial companion, or visiting the site for leisure, the LPI site is a good source for information, some of which wasn't available until someone landed on the lunar surface.

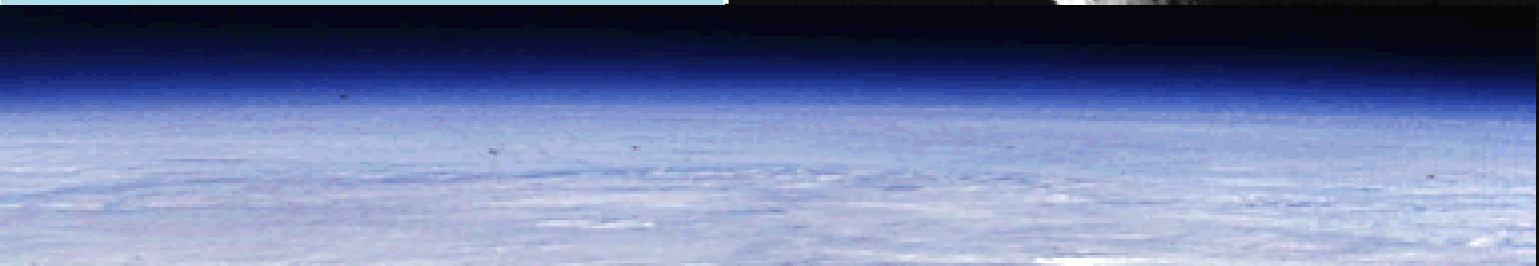
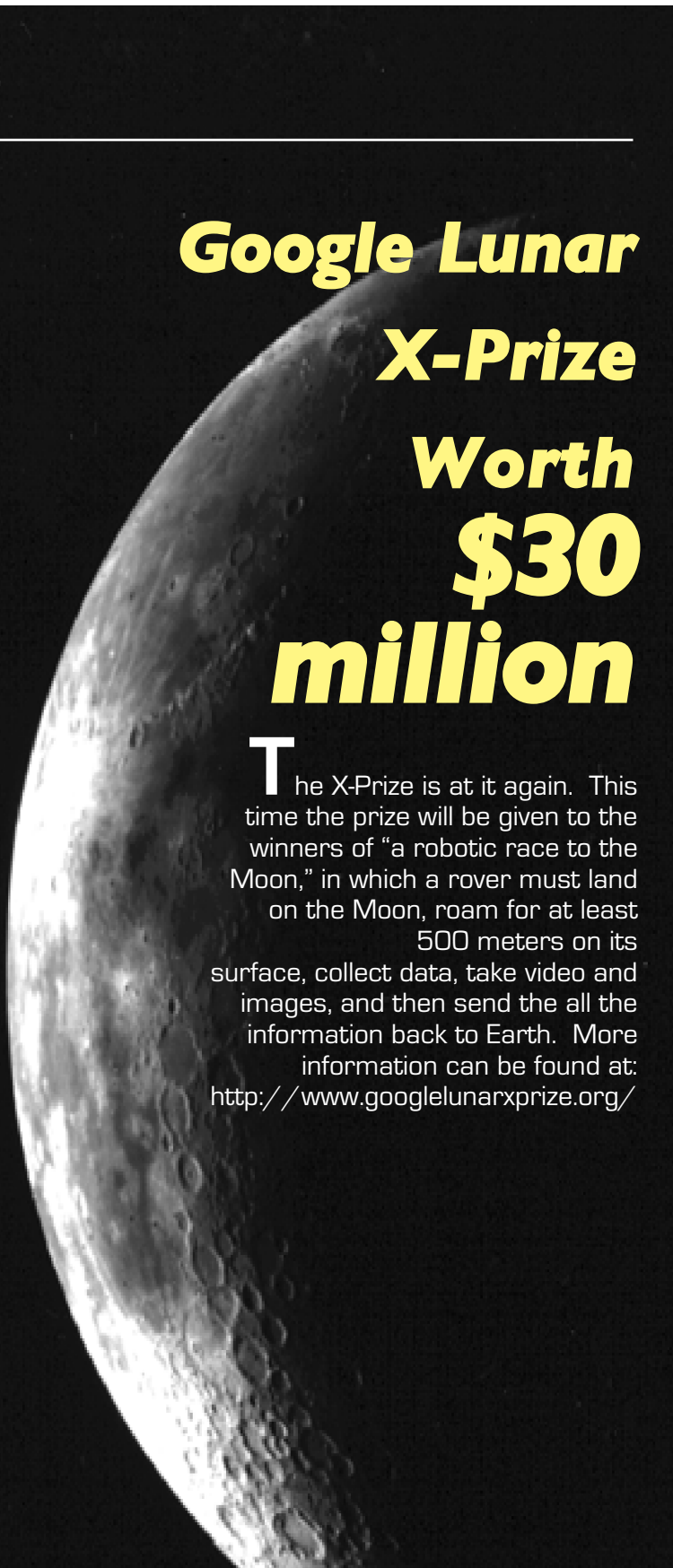


**LUNAR AND  
PLANETARY  
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## Google Lunar X-Prize Worth \$30 million

**T**he X-Prize is at it again. This time the prize will be given to the winners of "a robotic race to the Moon," in which a rover must land on the Moon, roam for at least 500 meters on its surface, collect data, take video and images, and then send the all the information back to Earth. More information can be found at: <http://www.googlelunarxprize.org/>



## Dr. David Livingston, Host of the Space Show

### Interviewed by Ryan Olson

**T**o Dr. David Livingston, space is not only about sensible business. There is a passion behind what he does, and he has an understanding that space is key to the future of humanity. SLM got the chance to speak to Livingston, radio host of The Space Show ([www.TheSpaceShow.com](http://www.TheSpaceShow.com)), who, by facilitating detailed and diverse space dialog brings together perspectives, one listener at a time.

Livingston is the founder of The Space Show, a no-nonsense talk radio show that is devoted to increasing space commerce, developing space tourism, and facilitating our move towards a space-faring economy and culture. With a program archive that reaches back to 2001, Dr. Livingston has interviewed hundreds of key people within the space industry. Livingston's background includes business consulting, financial advising, and strategic planning. He currently specializes in solving business problems for start-ups and entrepreneurial operations. He is also an adjunct professor at the University of North Dakota, Graduate School of Space Studies, specializing in space commerce, space economics, ethics, and management. With this type of background, Livingston brings a much-needed dose of business-reality into a complex space industry that is often romanticized and under-considered.

#### What lead you to formulate The Space Show?

**I**t was by accident. I had given a talk at the Cato Institute as part of a commercial space one day workshop, and a radio station in Phoenix heard about the talk. They asked if I wanted to do a business consulting talk show given my advanced degrees were in business. I thought it would be good experience to try it out for 3 months and to improve my public speaking. I started interviewing authors of business books and other leading business people but it was a bit boring for me. One day for the show I decided I would do one of my space business themes so I invited Dr. Patrick Collins to do the show with me on space tourism. Patrick was in Japan so I set it up with him and he was the first guest on the program for space, which back then was called Business Beyond Without Boundaries. I totally enjoyed the show and got good feedback. After that, almost all shows have been space related. I changed the name of the program about a year later to The Space Show when I moved from the Phoenix station to KKNW in Seattle in August 2001.

#### How do you distinguish or separate viable space businesses from the crackpots?

**C**ritical thinking. Discernment. Look at the management teams, see what they have done in the past. Is any of it related to what they are doing now? Look at their claims, their rhetoric? Does it make sense? Does it match known engineering and physics? Do they have money? Do they have a plausible and quality business plan with a marketing and financial plan, plus a good executive summary and quality pro formas with identified assumptions. Is everything a secret? That is a known giveaway for using caution. How out of the box are they? For example, are they going orbital in a year? Are they going to Mars in a few years, maybe Venus, maybe a setting a lunar business? Can they get to the job site? I normally just apply common business sense and questions to what people say about their business. The rest is easy. But you have to be willing to go with the evidence and facts, not stay with your agenda or belief system.

Depending on whose report you read, the U.S. will have spent upwards of \$200 billion on the Space Shuttle program by the time it is put to rest. Do you think the cost/benefit has been worth it?



**P**robably. We have learned a lot. The question is, were we to have never had the shuttle, would we have learned as much, the same things, more, nothing, what would our opportunity cost on knowledge have been? But, we have the shuttle: that is the fact. So let's move forward with our scientific, technical, human factors knowledge base and make the best for our future given our set of experiences. Focusing back on "what if" seems a big waste of time unless you want to write academic papers. It would also be helpful if we learned lessons from the past, that is let's look at the problems re the Shuttle and make sure we don't repeat them in what we do next. There are always

benefits and hits that one takes but I think overall the Shuttle has been a terrific tool. Not as good across the board as it could have been but none the less a very good tool. I just hope those working the next generation of vehicles for the Moon and beyond do learn from the past.

#### After Apollo many people lost interest in space. What would you recommend to spark or rekindle the general public's excitement and interest in space?

**T**ell the space story differently. Do what the OECD does and I speak about their Space 2030 reports on The Space Show frequently. In fact, I am finally doing an OECD Space Show program on July 13 and I urge people to listen. Space is the path to solving many of our problems right now on Earth. Space is the only domain where humans have worked together to be their best, even when fighting with one another back here on the ground. We need to tell the story differently, let people know how space development can transform their life, bring power to them, provide quality jobs for their children, etc. It's a field of hope and growth, not a view of hunkering down, dealing with rationing, limitations, rules and prohibitions. What do you want for your life and for the life of your kids and grandkids? You want a future? Or do you want to live in a world where everything is rationed, controlled and you face limitations daily and people telling you that this or that can't be done. To me, the answer is clear and easy. Space. Understand. Use it.

#### What's in the future, or what's next for The Space Show?

**T**he Space Show is now part of the non profit One Giant Leap Foundation (OGLF) and is seeking educational grant funding. With proper funding, there are some program expansion plans coming up, I want to produce written volumes for all the years of The Space Show and much more. As things progress and objectives are met, I will share them on air with listeners and with those that correspond with me on a regular basis. My goal is to make sure The Space Show and its message and way of delivery its message is out there in the general public and reaching new people all the time. Kids and seniors and everyone in-between. Space is for us and our lives, I know the story is there to tell and I know the story is so valid, it can't help but be accepted. The Space Show plans on playing a major part in story telling and changing our world. One can check out the OGLF website which is up and running with its initial version, subject to change and further development.

The Space Show can be listened to in archives and at times LIVE at: ([www.TheSpaceShow.com](http://www.TheSpaceShow.com)) The Space Show is broadcast multiple times per week on radio, Internet, and on satellite uplink feeds.

*Ryan Olson is a space enthusiast, and a former student of Dr. Livingston. He is currently the Assistant 911 Program Manager for the State of Montana, specializing in wireless E911.*





A photograph of an astronaut in a white spacesuit standing on the lunar surface. To the left, an American flag is planted in the ground. The background shows the dark, cratered landscape of the moon under a black sky.

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# The Canvas of Reality

## Edward Belbruno's Parallel lives

By Lois Elfman

When Dr. Edward Belbruno was around 7 years old, he painted a picture of Saturn from the perspective of its moon Titan. This was around 1960, before any photos existed, but his intuitive vision, somehow, is an uncanny match for images that we see today. As he grew up, Belbruno would find two decidedly separate ways of exploring space and he has excelled at both.

Today he is a mathematician whose research spans celestial mechanics, dynamical systems and chaos theory. He is the founder and president of Innovative Orbital Design, Inc. and holder of many patents on routes in space. As an artist he has explored different types of work from realism to abstract expressionism.

"Science and space in particular have been a deep love of mine, but art has been more my real talent," says Belbruno, 54, who has been based at Princeton University for the past nine years. "When I have been lucky enough to make discoveries in the way things move in space—in particular getting space ships to the [Earth's] Moon, which I've done several times—it's really hard work. It's nothing which comes naturally. Whereas art is easy. I just sit in front of a canvas and the painting comes out naturally. That's the real talent."

Belbruno's advanced education began at Mitchell College in New London, Conn., where he studied math, science and art. He completed his bachelor's degree at New York University with a double major in chemistry and mathematics. His love of space drew him to NYU's Courant

Institute, where he came under the tutelage of Juergen Moser, one of the great mathematicians of the 20th century. Belbruno completed first a master's degree and then a PhD, abandoning his painting during that period because there was simply no time.

After earning his doctorate, he accepted a position as an assistant professor of math at Boston University and also immediately resumed painting. He yearned to get into the space world, but wasn't sure how. Then out of the blue he received a call from the Jet Propulsion Lab in Pasadena, Calif., a NASA lab that deals with robotic missions to the planets. He was hired in 1985 to find ways to refine the means of getting a mission to Jupiter. He learned aerospace engineering for the first time and eventually began doing research on how to get to the Moon with almost no fuel. After being terminated from his job in 1990, he was rehired to do research on a failed Japanese robotic lunar mission.

"They wanted desperately to salvage their mission using an accompanying space craft that was a relay for the one that never made it. They wanted to get to the Moon with no fuel," he says. "I found this brand new way to the Moon, which is now a very important discovery. It represents a whole new way of space travel. It actually was used to get the second Japanese spacecraft to the Moon, even though it was never designed to go there. When that happened that was the first demonstration ever of using chaos theory for space travel." Chaos is a field of mathematics that





Hellfire of Creation - Microwave 5 (Part of  
'Microwave Radiation of the Universe Series') -  
30 x 30 inches October 2006

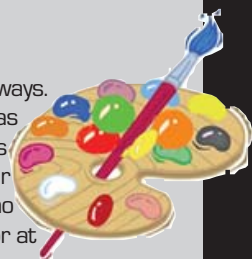
deals with processes that move in random kinds of ways.

Despite his love of space, he bluntly says he has no desire to actually go there. "I have several friends who are astronauts, so I'm very familiar with their descriptions of what it's like to go up there," Belbruno says. "I'm afraid of heights. For me, taking an elevator at the Empire State Building is a big deal. I really can't imagine sitting on top of a rocket where they light that thing and it goes up in the atmosphere. Also, I have an uneasy stomach."

"Seeing the stars must be spectacular when you're up there, but down here you can get a good view too. I paint star fields all the time, so I have a good feeling what that's about. As far as walking on the Moon or on Mars, I wouldn't mind doing that, but it's not something I'm driven to do."

Art is his vehicle for examination of the universe. His work has been shown professionally since 1991, and he's had several one-man shows. Through impressionist paintings, largely done in oils, he expresses his vision of the universe, just as van Gogh put his inner reality on canvas.

"For me, the thought processes that go into doing works of math or



Pyramid at Dawn  
- 30 x 40  
inches oil on canvas 1984



Ringed Planet - 30 x 30  
inches oil on canvas 1983

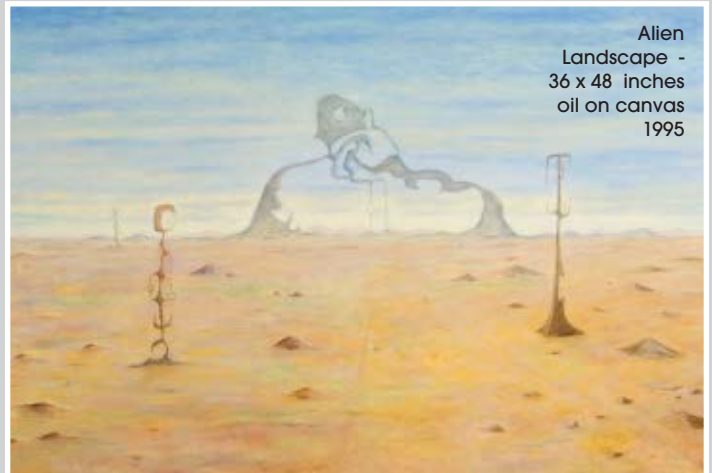
space research using deductive reasoning are entirely different from the kind of activity that goes into doing a painting," Belbruno explains. "I found if I'm doing a painting and I think anything analytic or deductive reasoning-wise, it ruins the painting. If I do a math project and try to make it artistic, it's a disaster.

"With art, you're working on a very intuitive level. When you're creating a really good work of art, you're truly creating from moment to moment. When I'm in that mode, eight hours can feel like five minutes. Every moment you're in that mode you're creating something new from this very special location in your mind, wherever that is. With math, you can make an insight into a mathematical problem or scientific problem and that insight uses creativity for a second. Then the next year of your life is writing it up."

Belbruno does not teach at Princeton, but he chose to base there for his NASA research. He frequently travels and lectures. He's written two books for Princeton University Press; the first was a theoretical math book published in 2004 titled *Capture Dynamics and Chaotic Motion in Celestial Mechanics*. His new book, *Fly Me to the Moon*, with one of his paintings on the cover, is written for a general audience.

He is also currently renting an old barn near Princeton to paint canvases depicting the microwave background radiation of the Big Bang of the universe. Some may be as large as 6' x 10'. A satellite scanned the universe for a number of years to document the Big Bang and documented a pattern that shows the distribution of microwaves. Color-coding showed a range from red for the hottest spots to blue for the coolest. "You end up getting these incredible patterns of what the universe looked like 14 billion years ago when it exploded, called a microwave background radiation," Belbruno notes.

Where the paintings will lead, he doesn't yet know. "We'll see," he says. "I think it will look so cool when I'm done with these things, especially the large canvases. Where they'll be shown will be natural. It will just happen."



Alien  
Landscape -  
36 x 48 inches  
oil on canvas  
1995



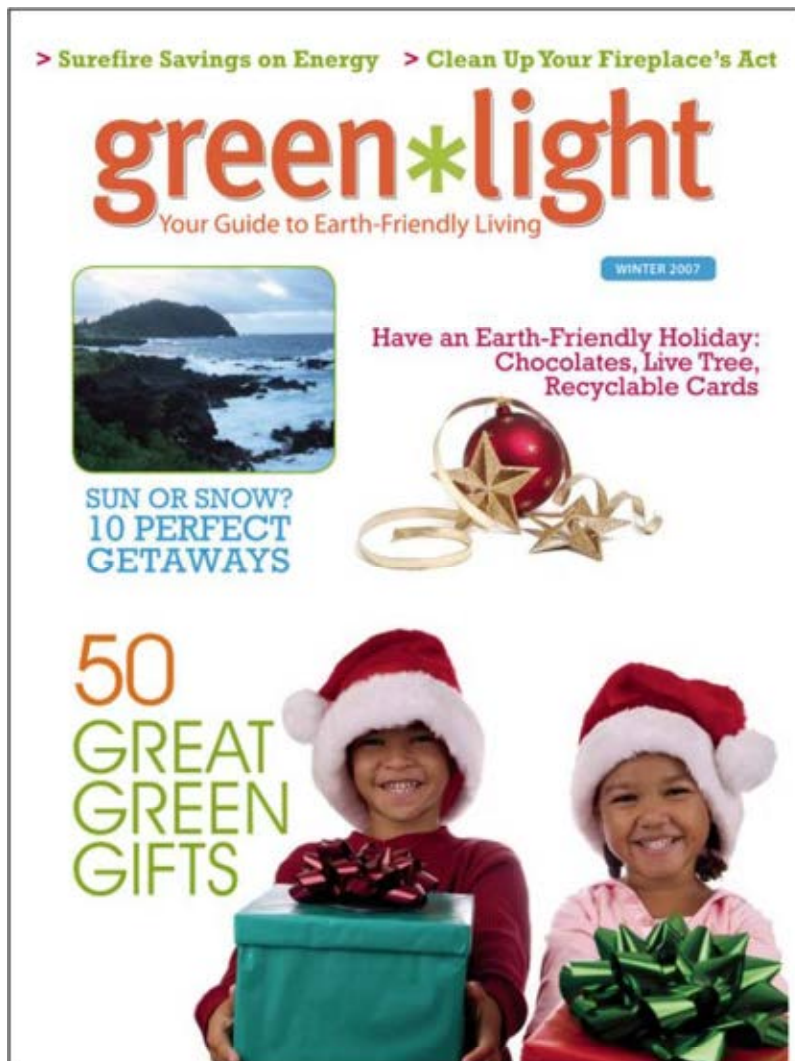
Waterscape  
at Night  
- 30 x 40  
inches oil on canvas 2000  
(A black night with stars over the water)



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# When Just Showing Up Is...

# A Prize in Itself

Armadillo Aerospace's craft launches for a successful first attempt. Photo: X-Price Cup

**Below:** SpeedUp's owner Bob Steinke (center) and company volunteers Tim Read and Jason Shankle stand in front of their demonstration Lunar Launch Vehicle *The Laramie Rose*. Photo: David Bullock

**By David Bullock**



After quiet moments of anticipation, the sonic booms from the US Air Force's F-22 Raptor exploded for the crowds attending the 2007 X-Prize Cup and Holloman Air and Space Expo. The sound was so loud that many children would try to match the noise from the passing aircraft with their own strained, high-pitched long raws. Much excitement started the lively free Air and Space event that came to Holloman Air Force Base this year.

Full of a mix of wandering locals, military personnel, and the curious, an estimated 85,000 people came to see the event, located in the vicinity of the future home of Spaceport America and Las Cruces, New Mexico. Many at the show believe this area is where personal spaceflight will find its commercial beginnings. A combination of military aircraft, stunt planes and space technologies entertained the crowds throughout much of Saturday and on into Sunday, October 27<sup>th</sup> and 28<sup>th</sup>.

Everyone involved put their best foot forward. Holloman Air Force Base's General David Goldfein, Commander of the 49<sup>th</sup> Test Squadron, welcomed the crowd, along with X-Prize founder Peter Diamandis. All the space-related promotional booths, for students, organizations and various military aircraft, greeted the oncoming public energetically and enthusiastically. Much work had been taken on, by both employees and volunteers of the organizations represented at the show.

While space wasn't the only focus of the event, the main out-of-this-world attraction that rocketed the crowd off the ground was the Northrop Grumman Lunar Lander Challenge. Nine contestant organizations competed this year. Masten Space Systems,



SpeedUp, Mirco-Space and Unreasonable Rocket had manned booths, but all of these companies had not completed their launch vehicles. Armadillo Aerospace had the largest presence and was the only entry launched this year. Armadillo, an experienced X-Prize contender, also entered in the very first X-Prize competition won by Scaled Composites and SpaceShipOne.

Armadillo had been showcased with launches sporadically throughout the show. After a scrub of the first launch due to technical difficulties, attributed to transporting their launch vehicle from Dallas, Texas, the small company with a shelled mammal as a logo finally began their first launch, a success, Saturday afternoon.

John Carmack, the leader of Armadillo and founder of id software, credited the success of the first flight to the accuracy of the GPS system. Carmack directed the flight operations for each of the launches.

The Challenge has two levels required for each entrant. The prizes total \$2 million, with each prize awarded by the X-Prize Foundation. For the first level, a launch vehicle must launch vertically 50 meters from a flat concrete pad, move across in the air horizontally 100 meters, and then land vertically for a total flight time of 90 seconds. The second level is the same distances as the first, but is performed on a simulated lunar surface instead of a concrete

interviewed members of the public refused to comment on the lack of a third flight. The space community tents had attendees that were even a bit angry.

Unreasonable Rocket, the father-son Lunar Lander Challenge contestant, was one of the eight other competing companies that still had a chance for all four prizes. Both the father and son share the same first and last name, Paul Breed, but are distinguished by their middle names, "Paul T.," for the father and "Paul A." for the son.

When approached, Paul T. described how he made the journey as a space competitor from his hometown of San Diego. "I've always been a builder of things," Paul T. said, "I've always have liked working with my hands and building things. I've built race boats, model airplanes, solar powered airplanes, rebuilt cars—built all sorts of stuff. I started doing some work the San Diego State Rocket Group. They're building rockets but don't know enough about electronics, which is my specialty. So, I put in some telemetry and some video, and I realized that this is really good stuff. By the time I was looking for a project to do, the X-Prize Lunar Lander Challenge came to be."

Paul T. explained how working with on the project was a dream-come-true. "Not so many fathers can spend their time working



**Carol Pilon from the Canadian Third Strike Wingwalkers stands atop of a 1940 Stearman as it soars, spins and loops through the sky.  
Photo: David Bullock**

pad and must remain in the air 180 seconds.

The prize money is divided by first and second place in two levels. First place for Level One is worth a total of \$350,000. Second place for Level One gets \$150,000. Then, the prizes go up significantly. Level Two first place will win \$1 million. Second place for Level Two claims a half a million dollars.

Unfortunately, the two launches made afterwards by Armadillo for a repeat level one attempt of the Challenge would fail. "The igniter was clogged again," Carmack told the press after the team's first failed Level One attempt, "so out there in field we were trying to fix it and all we were able to do was file down a paper clip, and jammed it in there and ground it in and around the igniter orifice. But we were [also] afraid that anytime you mess with the igniter, something will go wrong on start-up." And it did. Even after some help from Unreasonable Rocket, who gave a filter from one of their solenoids that was on their incomplete vehicle, problems continued for that second launch. The third attempt didn't even end up with a launch, but a small fire.

After the third launch the mood was so depressing that the

hand in hand with their 20 year-old son." He continued explaining why he did the Lunar Lander Challenge, "I want to get the message out that a small group of creative people can do amazing things. I hope to inspire people that way."

Despite Armadillo's failure, the Cup itself wasn't over, and the show went on. For both days, a medley of announcers guided the crowds into watching the aircraft and spacecraft take to the skies. Those announcing included Miles O'Brien from CNN, John Herrington, former NASA shuttle astronaut and member of the NewSpace company Rocketplane, Rick Preston, Chief Announcer from the US Air Force, and Larry Lowe from Air and Space Smithsonian Magazine.

A slew of events were described to the crowds peering at the skies. Many in the crowd would try to capture the air performers and crafts with their cameras, as each performer flew by. The Third Strike Wingwalking air stunt performing group had one of their female performers ride the wings of their deep red propeller plane. It would soar across the azure sky and then, loop through the blue open canvas. Ultimate Airshows followed the wingwalkers



Crowds wander in front of the variety of military aircraft on display throughout the X-Prize Cup air show. Photo: David Bullock

## The Northrop Grumman Lunar Lander Challenge – The Competitors

**Armadillo Aerospace ([armadilloaerospace.com](http://armadilloaerospace.com))** – Competitor for both the Anasari X-Prize and last year's Lunar Lander Challenge, Armadillo is led by John Carmack. Carmack founded id Software, and created such titles as *Quake* and *Doom*.

**Masten Space Systems ([masten-space.com](http://masten-space.com))** – Long time competitor for the NewSpace race. They could not compete this year "because a supplier was behind schedule," according to David Masten, the company's President. Masten is from the Bay Area, with a team of business professionals and engineers seeking to launch tethered flights. Currently, they are selling SodaSats, which allows customers to have the launch and recovery of very small payloads for a price of \$99.

**Micro-Space ([micro-space.com](http://micro-space.com))** – Like Armadillo, this is the only other company in the Northrop Grumman Lunar Lander Challenge that had competed for the Anasari X-Prize. Many of the company's components have flown on other high-powered rockets.

**SpeedUp ([speedupworld.com](http://speedupworld.com))**– Led by Bob Steinke of Wyoming. The company, which works with Frontier Astronautics, created the launch vehicle "The Laramie Rose" with the goal "to build the simplest possible rocket to win the Challenge," according to Steinke. SpeedUp seeks the most cost effective plan for an unmanned mission, like the Lunar Lander Challenge. They want a balance between the cost of adding redundancy vs. the cost of being more efficient.

**Unreasonable Rocket ([unreasonablerocket.blogspot.com](http://unreasonablerocket.blogspot.com))** – A father and son team from outside of San Diego, a city recently struck by large brushfires. Despite their troubles, the father, Paul T. Breed and son, Paul A. Breed, gave one of their parts to Armadillo, when a replacement was needed. The two are building rockets in their garage for under \$200,000.

The competitors Acuity Technologies, Bon Nova, Paragon Labs, and a confidential ninth competitor were either unavailable for comment or did not have a manned presence at the X-Prize Cup this year.

with several of their planes performing a series of aerobatic flight tricks. And towards the end of the Cup's day, hang glider Dan Buchanan, who is confined to a wheel chair when grounded, sailed in front of the crowds with fire-works trailing behind.

The upcoming Rocket Racing League also put on a presentation at a booth. The League is an air-based competition intended to find the fastest pilot and aircraft combo for each event's race track. Competing pilots follow the invisible track through a Virtual Reality camera, which directs them where to go. People at home can compete along with the drivers in a simulated game. The race schedule is planned to be completed sometime in 2008.

There are currently six pilots scheduled to compete in the upcoming races. Paul Novacek from the Santa Fe Rocket Racing League explained how he got involved in the competition and said, "Saw what was going on, knew I got to get involved with this... looked like a hell of a lot of fun." He sees the Racing League as "all part of the big picture and to make it achievable." Fellow competitor Todd White of Rocket Star Racing agreed, "Rocket Racing is a great opportunity to fly. I wanted to fly in a small private space endeavor. This is an area that is a really neat piece to it."

Robert Zigmon, a forty year-old from Alamogordo, New Mexico, took his family to the X-Prize Cup this year, which included his son, Kenneth, age 15. He took time from working on Aviator-10, which is

actually the name of a movie theater being built in Alamogordo New Mexico, symbolically designed for the city's flight history. Zigmon said the Cup was, "Awesome. It gives you a good feeling in this country." He continued speaking for himself and his family, "We watch it because it is an important part of our country and our state."

Several dozen X-Prize booths were located within the gated area, and a VIP tent had a presence. Besides the booths of the Lunar Lander Challenge contestants, other booths were manned by Northrop Grumman, X-COR, Starchaser Industries, and the Rocket Racing League. Inspiration and a sense of adventure were on the minds of most of the company's represented there. At the media day held before the actual Cup, Bob Davis from Northrop Grumman, the company that sponsored the Lunar Lander Challenge, said of the contestants, "We admire the people and that they try to go into space for tomorrow."

Many of the people that attended thought the Air & Space Show was a success. Becky Ramsey, Director of Communications, Space Prizes, for the Cup, reveled in the enthusiasm of the two days. "Everyone seems to be having fun," she said, "People are having a good time."





**Students Betty Ann Fish, Alan Fisher, Caleb Rawson, Gabriel Fish and Jacob Verburg demonstrate Gyroscopes at the International Student Science Fair Exhibitions at the X-Prize Cup.**  
Photo: David Bullock



**Alexandra Landon and Christo Magri from Morton Ranch High School in Katy, Texas stand in front of their science fair project, PenguinED. The two proposed a space education program for humans, who are about as flightless as penguins, until an education is received.**  
Photo: David Bullock

**International Science Fair Entrant Joe Bussenger from Perkasee, Pennsylvania holds up his tiny ElectroX Rocket Motor System, which seeks to solve shock vibration on solid fuel rocket motors.**  
Photo: David Bullock



**An F-22 Raptor lands after several successful flybys for the public.**  
Photo: David Bullock





## Before the Cup- International Symposium on Personal Spaceflight

**T**alks for the ISPS Conference focused on many aspect of Personal Spaceflight. Discussion panels included those on spaceports in general, astronauts, investing in space, and the local issues and concerns related to Spaceport America in New Mexico. The audience consisted mostly of space advocates, entrepreneurs and other members of the space community.

Many of the major spaceports were represented in a discussion panel. Olle Worberg of Spaceport Sweden told the crowd he represents a spaceport that has been active for forty years, and looks forward to including launches for Personal Spaceflight. They should be ready for those operations by 2012. He expressed that as infrastructure issues of engineering and architecture become concerns, Spaceport Sweden is trying to be a place that is both unique in style and location, but maintains similar standards.

Jacaques Braton of Arianespace talked of the European spaceport he runs in South America. Because of the prime location near the equator, which is preferable to best deploying launch satellites in orbit, Arianespace has been a strong leader in satellite launches and came looking to enter the arena of Personal Spaceflight.

Besides representation from Spaceport America, two other US spaceports were represented. Space Florida, which represents the spaceport of that state, had Steve Kohler represented that organization. Kohler said Space Florida has the experience and know-how to expand their market from the US Space Shuttle launches to those of Personal Spaceflight.

Virginia Spaceport representative, Billie M. Reed also talk of his launch facilities experience. The facility has been licensed by the FAA for the past ten years. He also spoke of the Spaceport Liability Act of Virginia, which interestingly, is the only state law, which will not take loss of life issues in Virginia's Commonwealth.

In a later panel, a young Rebecca Armstrong addressed the crowd. She is a Physics major and an ISPS intern. Her work took her to see many spaceports around the country. Like many in the space community she began with a theme often heard, "I want to go to space." She took part in writing a handbook for her internship, and said much about the hardwork it can take to break the atmosphere and go.

But, one of the most inspiring discussions was given by Patty Grace Smith of the United States Federal Aviation Administration (FAA). "Space has its own uniqueness," she began, "People see private human spaceflight will be the next great leap in transportation." She continued to say to say that commercial space is in the economic interest of this country. People from all over have been providing input to the FAA, she claimed. She stated also that "The FAA licensing process is thorough."

What was most interesting was that Smith added that businesses should always be questioning themselves, and told the audience that if it takes more time for the space community to get what they expect, "then it will give us more time to get it right." Reiterating a long time space adage that space is slow.

Embry-Riddle students Jacklyn Duff and Curtis Edwards stand in front of their exhibit on the Icarus Sounding Rocket. The rocket exhibit was one of several small exhibits, which included the Science Fair, the military and many NewSpace companies.  
Photo: David Bullock



Another launch attempt made by Armadillo Aerospace at the Holloman Air Force Base.  
Photo: X-Prize Cup

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## Space on Earth

### *Saving Our World by Seeking Others*

By Charles S. Cockell, Macmillan Publishing, London / New York, 2007

Reviewed by Michael Riccardi

**T**his book is, to some degree, a polemic," writes Cockell, "It expresses a point of view as much as it is a description of science and technology." The "polemic" in *Space on Earth* is the presumed ideological divide between environmentalism and space exploration. The reader may already be familiar with the often made criticism of space exploration and habitation (i.e., its massive cost) by those who feel our money is better spent improving conditions and restoring habitat here on Earth first. But the book is more a 'dialectic' in that it seeks (as its major theme) a broader synthesis of these seemingly opposed purposes. In simple, elegant prose, the author shows that "an environmentally aware society and a space-faring society are not an 'either/or' choice for humanity."

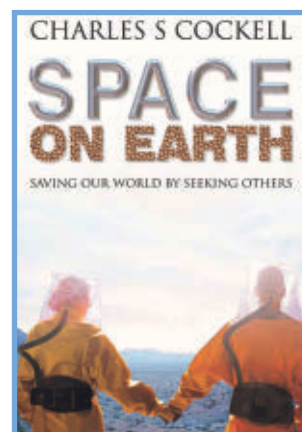
*Space on Earth* contains no diagrams, graphs, charts or photos. Rather, in its 175 pages and nine chapters, the book offers a literary and intellectual journey from 'Earthrise' to a future 'habitable world'. Throughout, the author pursues an integrative vision of the *eco* and the *astro*—arguing for a 'systemic link' between environmentalism and space exploration, one that forges itself at the most basic technical and social levels.

There is a subtle, but persistent sense of utopianism in these pages. But Cockell is not in any way naïve when he lays out his vision of the imminent and distant future; he readily acknowl-

edges that the exploitation of (virtually endless) resources from space (such as asteroid-derived metals) could easily engender a new and calamitous cycle of mass consumption here on Earth. It is for reasons such as this that *Space on Earth* calls for a convergence of these two 'cultures'.

Cockell's book reads often like a manifesto. Each chapter's title is underscored with a single, theorem-like assertion, such as: *The settlement of space and the environmental stewarding of the Earth are one and the same challenge*, and, *The arguments for the care of the Earth's environment and its creatures get stronger the further from Earth we go and the more we realize the startling uniqueness of life on Earth*.

Though it finds the possibility of finding life on other worlds to be exciting, *Space on Earth* is not really concerned with this issue; the exploration of space will improve life on earth, and merging environmentalism with space exploration will improve our endeavors in space. Cockell reveals a positive, reciprocal influence between the two.



## Rocketeers: How a Visionary Band of Business Leaders, Engineers, and Pilots is Boldly Privatizing Space

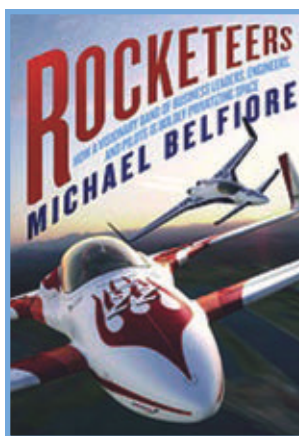
By Michael Belfiore

Reviewed by Nancy Atkinson

**M**ichael Belfiore has spent a majority of his life trying to make it as a science fiction writer. That is, until he discovered the X-Prize. "Competing for the prize were real people, engineers at small companies as well as amateurs, building honest-to-God spaceships, just as in *Rocket Ship Galileo* [by Robert Heinlein]," writes Belfiore. "Turns out a lot of other people who had been inspired by the science fiction of old had gotten tired of waiting for government programs to give their rides to space."

In "Rocketeers" Belfiore provides an in-depth, behind the scenes look at the emerging New Space industry. He introduces readers to the players in the personal spaceflight arena; how each got started in the business of spaceflight, with their motivations, their passions, and their dreams. Belfiore moves seamlessly between chapters and topics, providing all the details necessary for a comprehensive overview, but at the same time, without an overload of excessive information.

In a smooth, easy style, akin to a discussion between friends, Belfiore shares the experiences of Brain Binnie's dramatic X-Prize winning flight, reveals the impetus behind Peter Diamandis' development of the X-Prize, introduces the very private hotel tycoon Robert



Bigelow and more. The author captures the personalities who are taking incredible risks and putting up big bucks to realize their own dreams, as well as helping others to achieve what some say can't be done. Belfiore becomes part of the action himself when he helps one entrepreneur pick up spaceship-building supplies at a Home Depot. He also details how NASA is even trying to "hitch a ride" and benefit from the developments of the NewSpace sector. Included are the successes, as well as the failures that have marked the beginnings of this "second space age."

The final chapter includes some speculative fiction as Belfiore ponders what the state of spaceflight might be in 2034, taking the opportunity to get some digs in at NASA.

The book is very well documented with an extensive note section at the end. "Rocketeers" also includes many exclusive photos, many snapped by the author.

This book is a must-read for anyone interested in spaceflight. "Rocketeers" is one of the few books out there that provides genuine optimism that the future of spaceflight is us.





# WHEN 'BRANES' COLLIDE

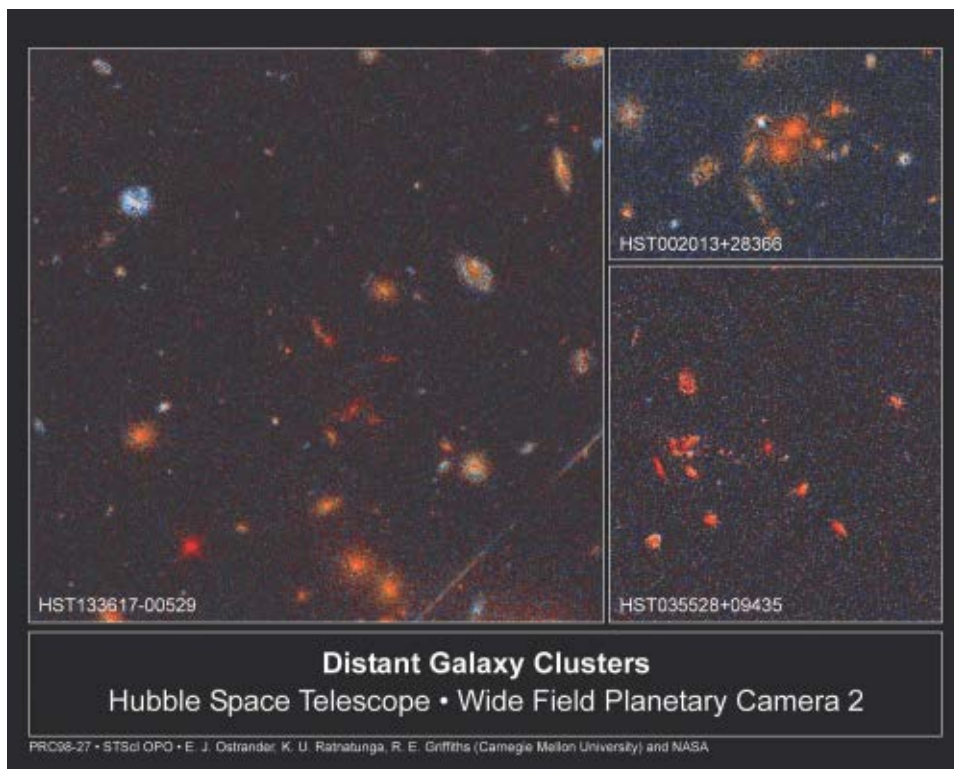
Two Cosmologists  
Explain a Universe Birth  
and Rebirth Cyclically

By Michael Anthony Ricciardi

At the peak of ancient Hellenic Culture, many schools of philosophy rose to prominence. One such school—the Stoic School—posited a creation theory known as 'ekpyrosis', which means 'fire' or 'conflagration' in Greek. This is the notion that the Universe was born from a great fire—and by such means, it would also come to an end. But soon after this fire, the Universe would be reborn again.

Some ancient eastern beliefs—such as in Sikhism—also hold to a 'cyclic' model of the Universe. In the Sikh cosmogony, the Universe passes through an infinite series of 22,000 years cycles, at the end of which the universe is annihilated, then it too would be reborn.

Time shifting to the early 20<sup>th</sup> century, physicists have put forth a theory of cos-



mogenesis that would come to stand as the central model of cosmology: The Big Bang. The theory held that the Universe was born from a 'singularity' which suddenly expanded in a massive explosion—giving us the energetic matter that would come to constitute the objects in the observable Universe. Once Einstein's two theories of Relativity (Special and General) appeared on the scene, attempts were made to synthesize these with cosmology theory—with the result being a newer version of a cyclic universe. In these early models, the basic idea was that our three dimensional Universe (with time as the fourth) undergoes repeating cycles of expansion and contraction—a 'Big Bang' followed by a 'Big Crunch'...over and over again.

In a sense, this early 20<sup>th</sup> century model was not so different a notion from those ancient conceptions. The idea of a *cyclical* nature to creation, and to time, seems to be a perennially appealing notion.

### Will the Big Bang Go Bust?

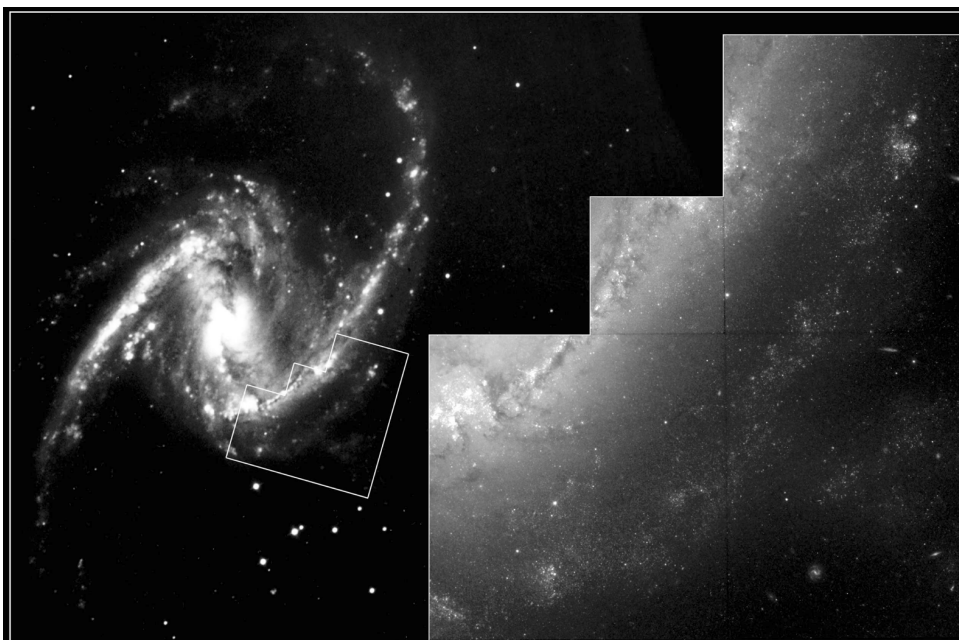
Our classic Big Bang theory has held for some time—seeping solidly into the popular consciousness—even though it requires a few counter-intuitive (yet factual) notions. One of these is an 'infinitely dense' point of matter (*the singularity*) which also must possess infinite temperature (or *energy potential*). Also, one of the consequences of our classic Big Bang Model is a non-isotropic or inhomogeneous cosmos (a universe that is 'lumpy' and filled with varying densities and motions of celestial objects). Another consequence of our classical model is the appearance of magnetic 'monopoles'—bizarre one-dimensional objects—scattered throughout the space-time fabric.

The problem with our current model is that these predicted consequences do not jibe with observations (such as the apparent 'flatness' of the cosmos) and calculations (such as the necessary age required

for galaxy formation). In the decades afterwards, and as more data came in, cosmologists have attempted to refine this model to explain the contradictory observations (such as the fact that the Universe looks the same in every direction that we point our telescopes). In the early 1980's, a new theory was put forth—known as the Inflationary Model—which posited a period of uniform, 'hyper-expansion' from an earlier, much smaller universe of much higher temperature and density. Two divergent views emerged from this theory: one – that the universe would continue to expand indefinitely, and, two – that expansion would eventually slow down and begin to contract or 'crunch'. Alan Guth, from MIT, Andre Linde, of Stanford University, Andreas Albrecht, from UC Davis, and Paul Steinhardt, of Princeton University developed this newer theory. The new theory was designed to resolve the many problems with models cosmologist found at the time. The cause of this inflationary epoch has been theorized to be some instability or 'collapsing' of a higher dimensional universe, leading to the uniform expansion and distribution of matter that we now observe.

### Why the Cosmological Constant Means so Much

In 1998, convincing evidence was obtained from observations of distant galaxies that the Universe was not simply expanding, but *accelerating*; the galaxies observed were flying away from each other at increasing speed. And in the fall of 2006, researchers using the powerful Hubble Space Telescope were able to see back in time and observe ancient supernova evi-



**Galaxy NGC 1365**  
Hubble Space Telescope • Wide Field Planetary Camera 2  
PRC96-21a • ST ScI OPO • May 9, 1996 • W. Freedman (Carnegie Institution of Washington) and NASA



## Four problems with the traditional Big Bang Model vs. Steinhardt/Turok's Cyclical Answers

To cause the expansion to stop, and then reverse to contraction, the model assumed that the mass density of the universe exceeds the critical density (the value at which point gravity is overcome by 'anti-gravity'). Today, we know that the mass density is only about one fourth of the critical density (and therefore, not enough to cause a collapse).

"First, it is important to understand what is cycling in our picture: the distance between branes is opening and closing at regular intervals, creating hot matter and radiation each time they hit one another. This causes the temperature and the density of matter and radiation to keep being reset to the value they had a cycle ago. The cause is the force between branes – nothing to do with how much matter and radiation is created."

The model predicts the expansion is decelerating whereas we know the expansion is accelerating.

This key aspect of the theory addresses the first stated problem concerning the fact that the mass density does not exceed the critical density. But, what about the apparent 'flatness' and homogeneity of the universe? Does the recently observed 'jolt' to the vacuum energy density impact this?

"In order to make sure that the branes are smooth and uniform before they hit (so that the universe is smooth and uniform after the bang), we actually want a period of accelerated expansion to stretch the branes, smoothing them out and spreading out all the matter and radiation produced in the earlier bounce. So, the observed acceleration (see problem to the left) is a plus for us, not a minus."

The model runs afoul of the Second Law of Thermodynamics; with each cycle, more entropy (used energy; disorder) is created and then "reconcentrated" near the crunch, and with more concentrated entropy at the crunch, the next bounce is actually bigger than the one before – hence, the interval between cycles does not remain the same and, extrapolating back in time, their duration shrinks to zero after just a few bounces.

How is the 'accumulation of entropy' problem solved at the moment of the Big Crunch?

"In our picture, the usual three dimensions expand but never contract – only the extra dimension goes through regular expansion and contraction. So, we produce entropy during each cycle that is dispersed during the period of dark energy domination, but it is NOT reconcentrated before the big crunch. So, there is not the reconcentrated entropy problem and there is no problem with the cycles continuing forever (see problem to the left)."

Consequently, the age of the universe (since the last bang) is predicted to be too short, or young.

And finally, what about the predicted age of the Universe?

"Having dark energy instead of extra matter changes the prediction for the age of the universe, so the age in our model is in line with what we know and there is no problem (see problem to the left)."

dence, which indicated a sudden 'speeding up' of cosmic expansion at around five billion years ATB ('after the bang.'). Somehow, a sudden 'instability' must have emerged within the 'cosmic bubble'—giving our so-called 'bubble' a good swift kick in its cosmic pants.

This sudden 'jolt' would come to verify, tentatively, the existence of a mysterious form of energy called 'dark energy'—a repulsive or 'anti-gravity' force feeding expansion and acceleration. Dark energy is possible because so called 'empty space' (the vacuum) is not so empty; it actually has miniscule mounts of energy, and as the energy's density increases, even to very small degrees, it contributes to expansion. The value of this energy density is referred to as the *cosmological constant* (or *lambda*).

All this mysterious dark energy activity works in opposition to the also recently verified 'dark matter', which dominated the celestial scene in the early days ATB, allowing for the formation of galaxies, and eventually, *us*. Dark matter was originally posited to account for the 'missing' matter necessary to keep things together long enough to form stars. In recent years, new data has revealed a far more complex cosmos than was previously theorized. It is as if the early Universe were engaged in a 'push me, pull you' contest—between the *pulling* force of dark matter and the *pushing* force of dark energy—with the eventual 'dominance' of the dark energy that we seem to observe today.

### Don't You Love it When A Scientist Says 'Eureka'

In a May, 2006 paper published in SCIENCE Magazine, Neil Turok and Paul J. Steinhardt put forth, in remarkable detail, a new theory that explains virtually every observable phenomenon and resolves all of the problems inherent in the current model. The theory involves the cyclical collision, or 'bouncing', of *branes* (short for *membranes*)—vast, flat, empty planes of 3-dimensional space — connected via a 'spring-like' extra dimension. Owing to gravity, these branes are periodically, over trillions of years, forced together (like two sheets of paper, arranged above/below). The energy from this motion (the *kinetic* energy) spills into our brane, filling it with a massive, pervasive burst of energetic particles and radiation. As energy is released into our brane, the spring-like extra dimension "relaxes", the branes separate once more, and the newest cycle of expansions proceeds. The visible matter of our universe appears uniformly distributed because the 'Big Bang' did not result from a singularity—an emergence from a single point in space-time—but from the collision of branes which occurs nearly simultaneously (and uniformly) throughout the cosmos.

SLM interviewed Professor Steinhardt and asked him to explain the key concerns with his theory. Viewed as a whole, as a true *Universe*, this cyclic model seems to be self-sustaining. Some critics have suggested that the ekpyrotic model is akin to a 'perpetual motion machine'—a famously flawed, pseudo-scientific fantasy. Flawed, because at first glance, there doesn't seem to be an external energy

flow 'driving' the periodic bouncing of branes. Steinhardt explained what exactly is causing the cyclic collision in his model:

"This idea of 'perpetual motion' has been suggested by many people, including Lenny Susskind, so we analyzed and discussed this in quite a bit of detail. There is no perpetual motion or violation of thermodynamic laws. It seems that we might have perpetual motion because the branes seem to be drawn together by the springy force alone that joins them together, and it seems that the spring should wind down if you produce matter and radiation each bounce. But this is not the case. The secret is that we are not relying on the springy force alone. We are actually drawing energy from the gravitational field during each cycle and converting this into brane kinetic energy, and then into matter, to start the cycle again."

The use of the gravitational field as an inexhaustible energy source is a key idea that also relates to the inflationary phenomenon; there is a finite energy density, yet, in order for the cosmos to inflate (increase its volume), the total vacuum energy must increase. And, where does this extra energy come from? Once again, the answer is *gravity*. "And, since you know there *is* such a thing as eternal inflation," Steinhardt continued, "you know there is no limit to how much energy can be drawn from a gravitational field. So, eternal inflation is not a perpetual motion machine, and neither is the cyclic model. They are just both taking advantage of the peculiar feature of gravity that it can be infinite energy source."

If this sounds both remarkable and extremely convenient, then you are perhaps getting a good idea of the nature of theoretical cosmology. For, while cosmologists draw upon observable data (like the type 1a supernovas), they are ultimately dealing with something that cannot—perhaps can never be—observed directly: the extra dimension connecting our cosmic brane to another hidden one. And there may be more dimensions 'out there', and more 'branes' as well.

One might wonder how physicists come up with such ideas in the first place—what must their creative thought process 'look' like...

Steinhardt told the following to SLM: "It is hard to describe. It is mostly subconscious and non-linear thinking. For us, it began with the idea from string theory that there are branes separated by an extra dimension based on a talk we both heard from Burt Ovrut. Neil and I, who were in the audience, suddenly and simultaneously realized that a collision between branes would have the same effect as a big bang by suddenly heating up the universe and filling the universe with matter and radiation, but it would not be the beginning of time. Something would happen beforehand – since a collision has a "before" as well as an "after." So, here was a chance to resolve the famous cosmic singularity problem.

"We both converged on Burt after his talk to see if this was possible. He thought it was. That was the first step.

"But, if we were going to consider this, why not revise all of cosmic history? To do this, we needed to reproduce all the successful predictions of the big bang/inflationary picture. This began a series of investigations and a series of surprises and "aha!" moments to see how far we could get or to see if we ran into some disastrous trouble. So far, we have not run into disaster. I think this is the best I can offer."

In considering such theoretical models, one is unavoidably confronted with the awesome mystery that engulfs us. One can only wonder too at the idea of a 'beginning' and an 'end' to the cosmos—whether such notions have any meaning here. For, the most astounding thing about Steinhardt and Turok's model is its implication of a universe of unimaginable ancientness.

In conclusion, SLM asked Professor Steinhardt what his thoughts/feelings were when he realized the implication of his theory.

"Shock and surprise. We thought there were all sorts of theorems that showed this is impossible. We surprised ourselves when we discovered a way that seems to evade all the known rules. I should add – our model does not *require* an infinite number of cycles. The universe *might* have a beginning and might settle into [finite] cycling. But the surprise is that, so far as we know, there is nothing preventing infinite cycling."



Flash File of Cyclical Universe. Credit: Paul Steinhardt

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M A G A Z I N E







**John Herrington before the start of his first spacewalk in November 2002 and the new design for the Rocketplane XP. Photo: NASA Image: Rocketplane**

or John Herrington, going to space is easy. It's coming back to Earth that's hard. 60% of space travelers experience Space Adaptation Syndrome – commonly known as space sickness, which includes nausea, dizziness, and headaches – but, Herrington made the transition from Earthling to astronaut without so much as a hiccup.

As part of the STS-113 crew aboard space shuttle Endeavour in November of 2002, Herrington performed three successful spacewalks to help build the International Space Station, all the while improvising new procedures, diagnosing and fixing problems on the fly, and executing tricky installation tasks one-handed (the other hand was busy making sure Herrington didn't float away from the station.)

In what would certainly cause vertigo for most people, Herrington's favorite part of his second EVA was climbing atop the station's P-1 truss, looking out at nothing but empty space, in front of him, and at Earth whizzing by down below. Seemingly, Herrington acclimated effortlessly to the hostile environment of space, and photos from the mission show him with a smile he could never quite suppress.



# ROCKETPLANE'S JOHN HERRINGTON

A NewSpace VP and Former Astronaut  
Talks about Reorganization, Redesign and COTS



But back on the ground at wheel stop on the runway of the Shuttle Landing Facility at Kennedy Space Center, Herrington slumped over, feeling terrible. "I never felt so heavy in my life," Herrington said. "I really wanted to walk around and look at the shuttle, but I knew I would have just fallen down in a heap." He experienced nausea and dizziness for only a couple of hours, but it was a surprising and unexpected welcome home.

Herrington wants to go back to space, now more than ever. Perhaps the weightless environment to which he had so readily adapted to makes him yearn to experience it again. However, his goal is to return to space on a regular, if not frequent basis. But this time, he wants to bring some of the rest of us with him. In 2005, he left NASA and now is the Vice President and Director of Flight Operations at Rocketplane Global, one of the emerging commercial or "NewSpace" companies.

But of course, going to space isn't easy at all, a fact that Herrington has been exposed to every day at both NASA and Rocketplane. STS-113 was the last successful shuttle mission before the Columbia accident in February 2003. Herrington led the air operations for helicopters involved in the search and recovery effort of Columbia's debris. That job, Herrington said, was one of the toughest things he's ever done.

Herrington will pilot the suborbital spaceplane that Rocketplane is building to provide paying passengers the opportunity to have the astronaut experience: weightlessness and incredible views of the Earth and space. Herrington expects to perform approximately 50 test flights before bringing any customers aboard, and with the vehicle not yet completed, the journey to space could be long and complex. 2010 is the target date for the company to bring their first clientele to space.

Rocketplane CEO and President George French has said of their company's endeavor, "This is rocket science, and it's not easy." But currently, the challenges facing Rocketplane are more financial than technical, and they reveal the pressing issues that independent new space companies must deal with in today's economy and in the emerging market for commercial spaceflight.



**By Nancy Atkinson**

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Rocketplane's company structure consists of the parent corporation Rocketplane Limited, under which are two separate entities: Rocketplane Kistler, which is developing a reusable two-stage orbital unmanned spacecraft called the K-1, and Rocketplane Global, which is building the suborbital, passenger-carrying vehicle known as the XP.

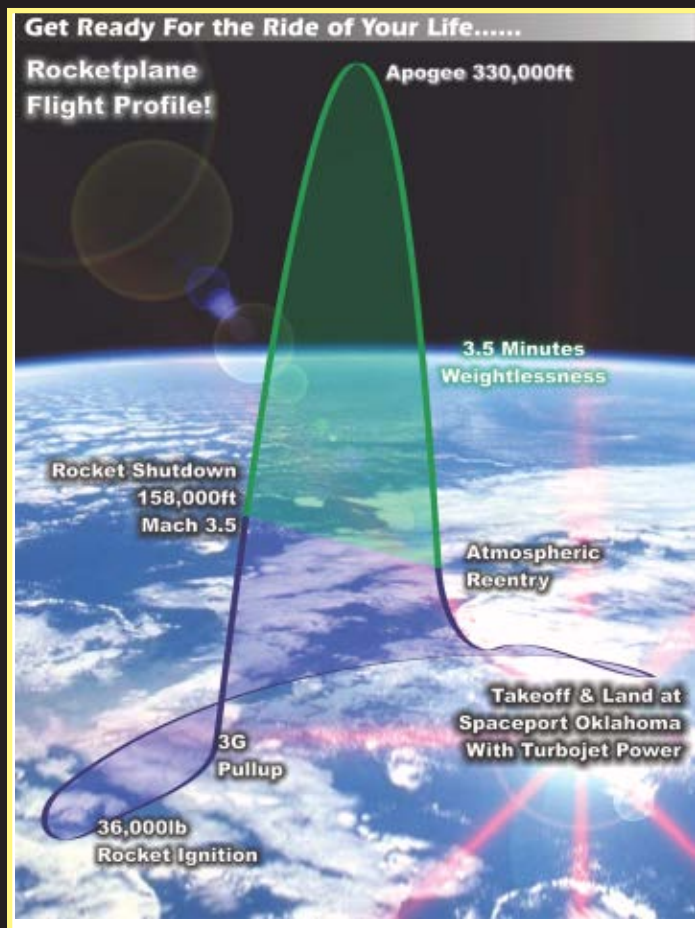
In August 2006 Rocketplane Kistler (RpK) won a potential \$207 million contract with NASA for the COTS (Commercial Orbital Transportation Services) program, to bring cargo and eventually crew to the ISS. Work on the XP was slowed, and there were layoffs of both management and staff at Rocketplane Global to allow resources to focus on the K-1.

But in October of 2007, NASA terminated its agreement with RpK, citing the company's failure to meet financial and design review milestones per the agreement. Randy Brinkley, who at the time was President of RpK, sent a letter of protest to NASA.

When Herrington summarized the reasons for the protest, he said that it was that NASA instigated changes in the way COTS would operate and other actions by NASA downplayed the significance of the COTS program. "Those things had a big impact on our investors," he said. "I don't think it was something that NASA set out to do, but it's what happened. I think those things had an effect on Wall Street and the way the market reacted to it, caused our investors to say, unfortunately, that this wasn't a good investment for them."

**Right: The XP's mission profile includes takeoff and landing from the same location at the Oklahoma Spaceport. During the 1-hour flight, passengers would experience 3-4 minutes of weightlessness at apogee. Rocketplane hopes to provide flights every 3-5 days.**  
Image: Rocketplane

**Below: Herrington outside the International Space Station during his second EVA of the STS-113 shuttle mission. Photo: NASA**



# stupid cancer

**Wow!**

So much progress since 1977.

**Death rates are falling.**

More people survive.

**Sounds great, right?**

Sure. If you're 65... or 7.

**For young adults (15-39),  
survival rates have not  
improved in 30 years.\***

**This is not ok.**

Welcome to the  
**I'm Too Young For This!**  
Cancer Foundation.

We are the only national  
cancer research and advocacy  
organization serving the unique  
needs of survivors and their  
caregivers under the age of 40.

**Stupid cancer. Survivors rule.**

**Laura Higgins**

Singer/Songwriter

LauraHiggins.com

Survivor: Hodgkins Lymphoma

Diagnosed: 1997

Status: Rocking on.



**ImTooYoungForThis.org**

a place for young adults affected by **cancer**

\*national cancer institute report, Closing The Gap, 2006



## Shortly after submitting the letter to NASA, Brinkley resigned from Rpk.

Then, if there wasn't enough bad news for Rocketplane, the company recently got word that the luxury travel company Abercrombie and Kent is suing Rocketplane for \$3.4 million, alleging that the company breached a contract by not reaching a series of benchmarks in preparing for their first sub-orbital flight which Abercrombie and Kent has been

So, even though the termination of the COTS agreement only affects the Kistler side of Rocketplane, Herrington observed, "It certainly hurts all of us. On a personal level, you want to do well, and you want every part of the company to succeed. It takes people's attention away from where it should be focused. It's hard to concentrate when there's so many things being said in the media and there are a lot of people out there who don't know what the issues are. They hear Rocketplane Kistler and they think Rocketplane total, but that's not the case."

Was going after COTS a mistake for Rocketplane? Author Michael Belfiore thinks perhaps it was. Belfiore has been covering the commercial space industry for several years and is the author of "Rocketeers: How a Visionary Band of Business Leaders, Engineers and Pilots is Boldly Privatizing Space." (The book is reviewed in this issue of SLM.)

"I know that was probably too big a prize to pass up, but it did hurt their suborbital spaceplane program, setting it back for many months," Belfiore said. "Hopefully now that the COTS distraction has been removed, the team can go back to work on the project that was their reason for being."

Chris Bergin, Managing Editor of NASASpaceflight.com, who has written extensively about Rocketplane, holds a different view. "Viable space tourism is still a fair few years away, and it certainly was not a mistake to go after the NASA cash now with K-1 and COTS," he said. However, Bergin added that while losing any contract is a blow, COTS is not a guaranteed pot of gold. "The only certainty about the contract is the retirement of the shuttle fleet in 2010," he said. "NASA needs COTS, that's for sure, but the ISS isn't going to be around forever. Viability of a business plan via another approach will be telling on how much of a blow losing their initial COTS contract was to them."

Herrington feels that pursuing COTS was the right decision. "I think we did the right thing," he said. "I think George [French] made a business decision that at the time was appropriate. I personally thought it was a phenomenal opportunity to keep resupplying the space station and have a commercial stake in the game. It's clearly evident that we can't rely on sources outside the US for that. I still believe that COTS is a good thing, and I hope there is some way we can go forward with that. But I'm not in control of it."

If there is a positive aspect to the COTS quandary, Herrington said the delays forced on the XP program gave the engineers at Rocketplane Global time to contemplate the spaceplane's design. "It gave a chance for the engineers that were dedicated to the XP to sit back and look at what we had, look at our business case, look at the performance of the

vehicle and make some very intelligent decisions," he said. "They've done an incredible job in the year and a half of focusing on those specific things."

The result was an almost complete redesign of the XP. Rocketplane revealed the new layout of the suborbital spacecraft at the 2007 X Prize Cup in New Mexico on October 26. Originally, the



A design of Rocketplane XP in flight.

Image credit:  
Rocket Plane

promoting.

Herrington and Rocketplane business development associate George French III said they couldn't comment on any of these issues as all are currently in negotiation. But French III wanted to make it clear that "Rocketplane Kistler and Rocketplane Global act as two separate companies," he said. "They do not directly affect each other. If one dies the other will keep going."

# Exploratorium Celebrates International Polar Year with Webcasts

**A**ntarctica is a great place to do science on both the environment and space.

The continent's clear skies, relatively isolated marine ecosystems, and large ice sheets allow for many different types of scientists to study environmental changes. The current changes in landscape, the response to global warming by the continent's animals, and the past global climate conditions recorded in the Antarctic environment are all different aspects in which geologists, biologists and glaciologists learn more about Antarctica and our world in general. The South Pole also allows scientists to find more information about universe outside our planet home. Antarctica is a location where cosmologists can look at some of the darkest, unobstructed views into deep space.

The Exploratorium brings the public a series of live Webcasts with Antarctic scientists, who will talk about their work on the environment and even aspects of an astronomical nature. Mary K. Miller,



Photo: Jeff McMahon, University of Chicago

Exploratorium Project Director and a Host and Producer of the museum's webcast series "Ice Stories," is excited to return to Antarctica to see life through the eyes of scientists.

"The poles provide a unique vantage point for studying climate change and the impacts it will have on global environmental health," Miller explains, "That is why it is one of the major scientific themes for the International Polar Year. Since we cannot travel to all the places where scientific work will be conducted, we thought that the scientists themselves could help introduce the public to the unique field locations and the ways in which they meet the daily challenges of working on the ice. Our goal with these webcasts is to highlight research during IPY through the viewpoints and experiences of scientists who understand how important the poles are to global environmental health and our understanding of our own planet and the universe beyond."

entists who understand how important the poles are to global environmental health and our understanding of our own planet and the universe beyond."

Webcasts will be available at  
<http://www.exploratorium.edu/poles>:



Photo: Mary Miller, Exploratorium

## Ice Stories Webcasts Winter 2007/2008

<http://www.exploratorium.edu/poles>

All times are listed in P.S.T.

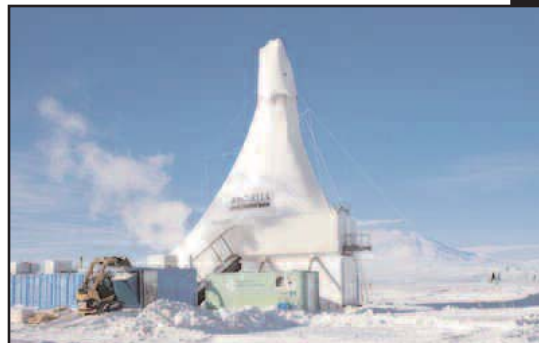


Photo: Christina Riesselman, Stanford University

**Wednesday, November 28th, 1 p.m.**

**Friday, November 30th, 1 p.m.**

**Sunday, December 2nd, 2 p.m.**

**Sunday, December 9th, 2 p.m.**

**(The ANDRILL Project)**

Learn about the ANDRILL (ANTarctic geological DRILLing) project, a multinational collaboration of more than 200 scientists, students, and educators which will reconstruct the history of the paleoenvironmental Antarctic region by recovering sediment cores under the Antarctic ice and seas.

**Fridays, December 7th, 11 a.m.**

**Friday, December 21st, 10 a.m.**

**Friday, January 18th, 8 a.m.**

**(South Pole Telescope)**

The new South Pole Telescope, its brief history, first discoveries, and the scientists working on this project will be brought to you through live webcasts on these dates.

**Saturday, December 8th, 2 p.m.**

**Wednesday, December 19th, 2 p.m.**

**Thursday, December 20th, 2 p.m.**

Exploratorium Senior Scientist Paul Doherty shows hands-on demos related to science going on in Antarctica.

**Friday, December 14th, 1 p.m.**

**(date and time subject to change)**

A team studying ice sheet dynamics shares their adventures on the West Antarctic Ice Sheet.

**Saturday or Sunday, December 15th or 16th, 2 p.m.**

**Friday, January 25th 1 p.m.**

Learn about penguin colonies and how they've responded to environmental and climate change over time.

**Friday, December 28th, 8 a.m.**

**Saturday, January 12th, 8 a.m.**

Connect with scientists working on Ice Cube, a telescope currently being constructed deep under the ice. The telescope will take up a cubic kilometer of the ice sheet and consist of dozens of strings each containing 60 detectors suspended in crystal clear ice more than 1,500 meters below the surface.

**Friday, January 4th, 1 p.m.**

From one of the most rapidly warming places on earth, Palmer Research Station in the Western Antarctic Peninsula, the Exploratorium brings you the Long Term Ecological Research (LTER) Project.

**Friday, January 11th, 1 p.m.**

NASA scientists talk about balloon research in the stratosphere over Antarctica that will collect data about cosmic rays.

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**Space Lifestyle**  
MAGAZINE





**X-Prize's William Pomerantz introduces Herrington to unveil the new design for the Rocketplane XP on Media Day X-Prize Cup 2007.**  
Photo: David Bullock

XP used a Learjet fuselage as the starting point for building the vehicle. But now the fuselage will be built from scratch. It will be larger, allowing for five passengers instead of three, as well as more room for microgravity payloads during science missions. Several other notable changes include a T-tail instead of V-shaped, beefed-up landing gear, and J-85 afterburning engines.

Herrington said he's excited about the vehicle being larger and feels the new afterburning engines, which will supply up to 50 percent more thrust, will enhance takeoff performance. "It's a much better performing engine that gets us to a higher altitude and gets us there quicker," he said.

The XP will take off from a runway at the Oklahoma Spaceport just like an airplane and quickly climb to 62 miles altitude (100 kilometers). Passengers onboard would have several minutes of weightlessness as well the breathtaking views of Earth and space before returning to the spaceport. The total flight time: 45 minutes. Cost per seat, \$200,000. And the experience, as the saying now goes, is priceless. Rocketplane offers high adventure in the truest sense.

As the name Rocketplane Global indicates, the company hopes to have locations around the world to provide their service, and views to particular parts of the world, to more people.

But this enterprise is entirely based on finding investors who believe in Rocketplane's vision. "We're going out and doing our very best to show people what we're doing," Herrington said. "I firmly believe in the technical approach these guys are taking. They are great engineers in respect to that. The financial part is difficult in a new market when you're trying to convince investors that this is the direction to go and that there will be a return on their investment. I think that's the long pole in the tent."

While Herrington declined to offer specifics on what kind of funding the company has already secured, Bergin believes Rocketplane Global's business plan is sound. "Reports of any 'funding woes' for Rocketplane appear to be specific to the money they needed to complete milestones with the K-1/COTS contract," he said. "The XP side of their business

appears to be a different beast - so one could assume that was protected and separate from their published problems with COTS via investment. There's no reason that I can see for them to fail with the XP."

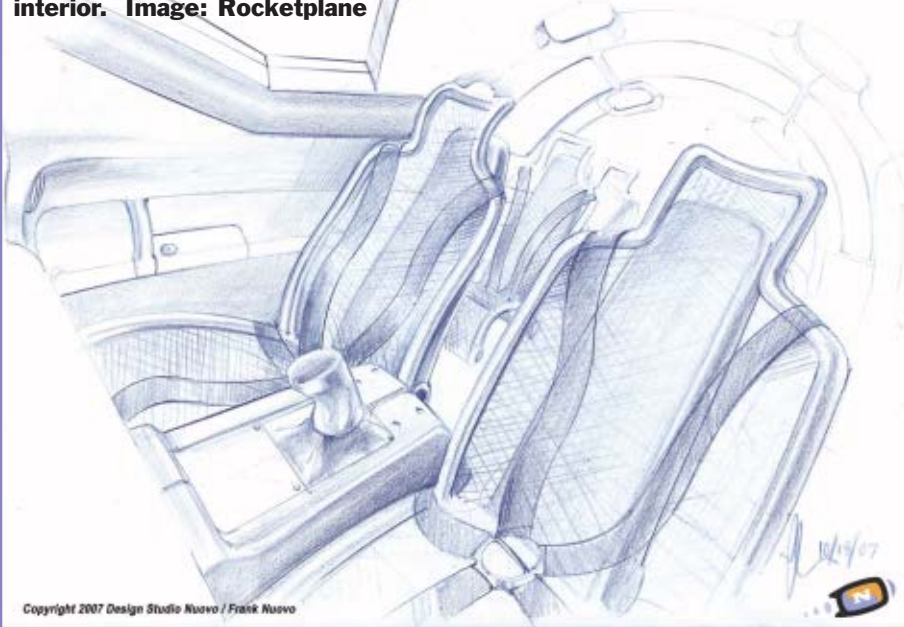
Despite the recent difficulties Rocketplane has endured, Herrington is excited to be part of Rocketplane and is enjoying the challenges of his NewSpace career. Equally, Rocketplane feels fortunate to have Herrington on board.

"John is a NASA astronaut, however, it is his many spectacular talents and abilities that make him valuable to the Rocketplane team," said President George French. "He is a military test pilot, knows flight avionics and astronautics, and knows the environment of space. To us, John is an asset in that he brings education, knowledge, experience, and skills to finish and test our spaceplane, which will regularly take civilian astronauts

into space."

Herrington says he's often asked why none of the competing private space companies have yet followed in SpaceShipOne's wake to actually fly someone into space. "I think in this country we have the expectation that it's going to happen tomorrow," he said, "but the reality is it takes smart

**In addition to the engineering changes to the XP, Rocketplane hired designer Frank Nuovo to provide an innovative new plan for the cabin interior. Image: Rocketplane**



Copyright 2007 Design Studio Nuovo / Frank Nuovo

people doing a lot of hard work to make something happen and it doesn't happen overnight. It's hard to build something that's this unique and that's not been done before."

And Herrington believes that how a person, or a company, overcomes difficulties along the way is what can set them apart. "Humans can improvise, and there's no better mechanism in the world than the human brain to solve a problem and then make it happen." Herrington paused, perhaps recalling his spacewalking experiences, then added, "And that's what human and personal spaceflight is all the about—the human part."

## ***New Design***



Rocketplane revealed a new design for their XP spaceplane - A vehicle that may bring paying customers to the edge of space -- at the 2007 XPrize Cup. Below is the design of the original Rocketplane spaceplane. Photo and Image: Rocketplane

## ***Old Design***





Taber MacCallum, Mark Nelson, Sally Silverstone, Jane Poynter, Linda Leigh, Abigail Alling, Roy Walford, Mark Van Thillo



Photo Credit: Gill Kenny

## Biophere 2 Revisited:

# A Present Day Look at the Project's Participants

Compiled by John George and  
Deborah Parrish Snyder

A little over 16 years ago, an eclectic group of scientists, engineers, ecologists, doctors and researchers embarked on an endeavor that stirred the imaginations of those fortunate enough to have been aware of the project—a project that provoked a peculiar and extraordinary amount of controversy. The experiment was called Biosphere 2, a deferential and appropriate name because biosphere 1, actually, is the Earth. It would set the standards for closed systems research. The size, complexity, diversity and sophistication of the facility required the development of new technologies, and the ideas and concepts fundamental to the project were products from unique innovators. Biosphere 2 remains a visionary facility in thought and concept, nearly two decades after



Photo Credit: Gill Kenny

its completion.

Closed ecological systems are environments that are self-contained and self-sufficient. They are closed as systems in that they do not exchange matter with the environment outside of them. Also, there has to be a sequence of exchange of matter from one species to another. The waste products of one species would, as a result, be used by another, with the goal of building “synthetic” ecosystems. Future space colonies will require closed ecological systems. Moreover, interplanetary travel and planetary colonization will require the following: 1) protection for the occupants of the vehicle/structure 2) ability to produce and store food, water, resources, and recycle of these resources 3) recycle/disposal/elimination of waste products.

Research into closed ecological systems, or CES, is relatively new. It is also exceedingly difficult to pursue. The technical challenges faced in the design and production of closed systems increase exponentially as the size, volume, and diversity of the enclosed ecology enlarge. The most popular and simplest commercially available systems range in size from a small fish bowl to a large fish tank. These terrarium styled sealed glass containers or Ecospheres usually house an aquatic organism (like brine shrimp) or an individual plant or a couple of plants, some water and air. The more complex systems of this size include an organism like a fish.

Contrastingly, the size of the structure called Biosphere 2 is 3.15 acres total. This building includes a rainforest, an ocean with a coral reef, a wetland, a savanna, a desert, and farmland and space for human residence/workshops/laboratories. An enormous variety of species for the project specifically were included. Creating the individual biomes was an incredible challenge that required innovation and advances in various technologies, which ranged from structural to biological.

Eight persons were sealed within this facility for a period of two years. New groups were on a schedule to be sealed in, every year, for the duration of a year. Originally, there was great demand and a strong competition for the opportunity to be one of the eight “biospherians”. It did not appear that there would be a shortage of, or lack of interest in finding willing participants for the experiment. However, the momentum of the experiment and the interest of the public waned, after the installment of the first group. When the second group was sealed in, they did not remain for the given year.

Almost immediately after the second group exited prematurely, the nature of the facility was transfigured. Columbia University became the managing entity and the biomes were separated from each other. This was done through the hanging of

plastic sheets, so the biomes could be studied with a greater isolation from each other. Never again would it be used as a closed system, and the concept, to study the biomes that were created under manipulated levels of carbon dioxide that was pumped into the facility and discharged from it as required for the research no longer required the participation of humans in the self-contained environment. Thus, the experiences of the original eight “biospherians” was rendered unique and “one of a kind.”

As it would come to be, division would turn out to characterize this unique experience. The eight “biospherians” broke into two factions. The breakdown of the once friendships, described as “intimate” prior to the beginning of the experiment, were no more. Hostility between many of the participants still exists today. One can’t help but wonder that if the eight original participants had known that their opportunity would be the only one of its kind, would they have had a different experience. Perhaps they might have been a little more tolerant of each other had they known that the data compiled in their two year term would be the only data compiled in that facility. The fact that their experiences have not been duplicated renders the lives of these people more unusual than originally thought to have been. Even more than these persons themselves had anticipated when they embarked on their two-year journey.

What could possibly compare to that experience? It is not unlike landing on the moon. What could one do after having that type of experience that would in any way compare to the uniqueness, intensity, and profundity of those two years in the space-colony analogue? And there were others whose lives were just as engrossed by the experience despite not having been sealed inside. The same question applies to those people.

Despite how one feels about the Biosphere experiment, there is no denying that it was a magnanimous, and visionary project: staggering in proportion. Certainly, it was the largest privately funded project oriented towards the pursuit and development of space travel – and to a new approach of studying our global ecology since a miniature biospheric system was created - to this date. Even in the civilian realm of space, Biosphere 2 is regarded as the largest, most ambitious, and closest analogue to a space colony ever built. As such, it is the most significant attempt to research human factors in space travel. The danger of being involved in projects like this is that they tend to be the climax of the lives of those who participate significantly and the remainder of those persons lives is rendered a *dénouement*. Ultimately the determination, of whether this is reality or not, will belong to the individual. A look at the activities of the pivotal players in the Biosphere experiment may enable that determination.

## THEY CAME FROM BIOSPHERE: Eleven People from the Project

### John Polk Allen

**J**ohn Allen conceived of and invented the Biosphere 2 project, and is one of its co-founders. He held the title of Executive Chairman and Director of Biospheric Research Development, and Engineering for Space Biosphere Ventures, the parent company that built the Biosphere 2. He holds a degree in engineering from Colorado School of Mines, an MBA from

Harvard, and an Engineering Physiology certificate from the University of Michigan. Allen is widely published and is seen as quite the Renaissance man: in addition to scientific publications, he writes and publishes poetry, drama, prose, and has created films all under the pseudonym Johnny Dolphin.

Currently, Allen is Chairman of Global Ecotechnics Corporation, which is described on its web site as “engaged in the development and application of innovative ecotechnics projects and biospheric design and engineering with an education and



information division to further the first two objectives." Biosphere 2 was a project of this company. Allen has continued to develop projects through this corporation since Biosphere 2.

A division of this company is the Biospheric Division. As the name suggests, there are similarities between these projects and Biosphere 2. This division has, according to its website, completed projects in "7 countries on 4 continents." All of the projects of this division "incorporate the latest advances in energy efficient recycling technologies to achieve a harmony between the architecture and surrounding environment."

One project, the Earth to Mars Project, is "a long term, comprehensive program to design, construct and operate an Earth based prototype life support system that will simulate a base for a manned mission to Mars." This project is conducting scientific and engineering tests on systems for the Earth to Mars Project in "Laboratory Biosphere" a 12-foot cylindrical, 1400-cubic-foot closed system. So far, this chamber has been used extensively on food production. More information, including a log of tests, can be found on the website: [www.glob-alecotechnics.com](http://www.glob-alecotechnics.com)

Another division of Allen's company is the EcoFrontiers division which "implements and operates" different projects around the world that involve combining the processes of ecological improvement and economical stimulation. This division lists as its projects Birdwood Downs in Australia, a five thousand acre savanna grassland, used to demonstrate and model pasture regeneration and appropriate environmental technologies. The project produces capital by manufacturing natural wastewater treatment systems using constructed wetlands and native plant ecoscapes. Other projects include a thousand acre forest project in Puerto Rico, a farm in Southern France, an ocean-going sailing ship, the *RV Heraclitus*, and an art gallery in London.

Clearly, Allen has not strayed from his pursuit with Biosphere 2. He continues to research, develop, promote and succeed in projects similar to Biosphere 2 that are intended to contribute to and enhance space travel and habitation. The Earth to Mars project is a clear example of this type of project. This facility is located at the Synergia Ranch in Santa Fe, New Mexico, where Allen actively devotes a lot of his time and energy to this effort.

Allen also contributes to projects that are intended to improve upon and preserve living systems on Earth, and which others from the Biosphere 2 project are involved. He co-founded and held the Chairman's position of a company devoted to saving coral reefs and researching the beginnings of different cultures: the Planetary Coral Reef Foundation. He held this position until 2006.



John Allen

Photo Credit: DPSnyder

## Abigail Alling

**A**bigail Alling was one of the first eight Biospherians, and the developer of the ocean system of the Biosphere facility. After her mission in the Biosphere, Alling stayed on at the Biosphere facility and was part of the managing crew for the second mission. This mission ended prematurely when United States marshals occupied the property and ordered Alling and others off it, supposedly because co-owner Ed Bass decided Biosphere 2 was being mismanaged or wished to take control from his partners and co-owners, who included John Allen and other key Biosphere 2 managers. Upon realizing that the property was being seized, and before vacating the property, Alling and her peer, Mark Van Thillo, succeeded in communicating the circumstances to the eight persons sealed inside. Alling asked them what they wanted to do: stay inside or get unsealed?

The eight people inside would become unsealed. When Alling and Van Thillo opened the airlock, the two were both apprehended and charged with vandalism. Alling and Van Thillo were vindicated of the charges, but Alling's relationship with the financier Ed Bass would never recover. As a result, she would not return to the facility.

Alling co-founded and was CEO the Biosphere Foundation with John Allen and established a division the Coral Reef Foundation. Her and Van Thillo continue to run this company and direct a research ship—*The Infinity*—to study many of the world's coral reefs. Additionally, Alling is active in the Mars to Earth project, as she was in charge of its design and development.

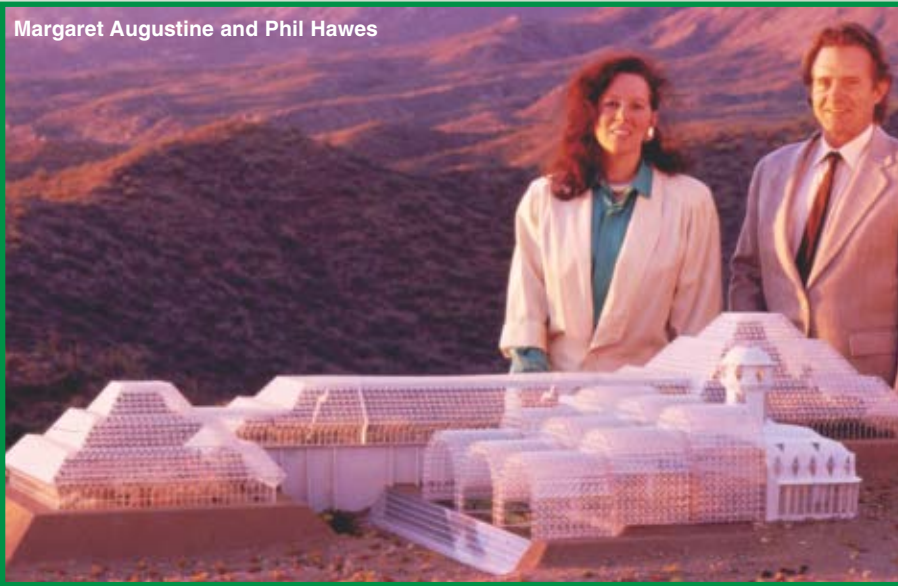
Alling co-authored a book about her experiences in Biosphere II with Mark Nelson and Sally Silverstone, entitled *Life Under Glass: The Inside Story of Biosphere 2*.

## Mark Van Thillo

**M**ark Van Thillo was one of the original eight Biospherians. His role in that experiment was to maintain and operate the technical equipment the facility depended upon in order for it to function as an integrated whole. The amount of equipment and the technical complexity of the system is staggering in proportion. Van Thillo was so competent and innovative that his peers nicknamed him "Laser".

Van Thillo remained at the Biosphere facility and assisted as support for the second crew until he was evicted from the facility with his partner Abigail Alling. He also worked at the Global Ecotechnics Corporation as the Vice President of Technical Systems and Quality Control after his experience with Biosphere

Margaret Augustine and Phil Hawes



2. Currently, he continues to work with Alling at the Planetary Coral Reef Foundation in the capacity of Chief Operations Officer. According to that website, Van Thillo "manages the research equipment and technical systems required to maintain and operate the SV Infinity on its continued expedition to map and monitor coral reefs worldwide." *The Infinity* is a 120-foot ketch that is outfitted as a research vessel and is crewed by students and research personnel.

## Mark Nelson

A foundational and fundamental figure in the development of Biosphere 2, Mark Nelson is a pioneer in ecotechnology. He is now devoted to improving and advancing the science and engineering that is involved in ecology. His work after being one the original eight in the Biosphere 2 facility can be considered unrivaled. He co-founded and directed the Institute of Ecotechnics long before being involved in the Biosphere project and has been ceaselessly involved in projects. After Biosphere 2, Nelson received a Master's degree from the University of Arizona and a PhD from the University of Florida in renewable natural resources, wetlands science and systems ecology. Nelson has participated in much ecological and closed system research, which has resulted in a resume with considerable accomplishment. His prior experience designing, building, and maintaining ecologically innovative and advanced facilities was invaluable in the same processes of the Biosphere 2.

Nelson has an extensive publication history and he has published frequently since Biosphere 2. Besides co-authoring *Life Under Glass* with Alling, he has applied much of the results of the research done at Biosphere 2 towards space sciences and its activities. Nelson has also worked extensively on water regeneration and wastewater treatment and is currently Director of Wastewater Gardens International

Jane Poynter and Mark Nelson



[[www.wastewatgardens.com](http://www.wastewatgardens.com)] which has implemented wastewater treatment and reuse through constructed wetlands in eleven countries worldwide. Mark was in charge of the wastewater recycling system inside Biosphere 2 and was inspired by the notion of using natural systems to solve problems exemplified by using constructed wetlands for this purpose. After Biosphere 2, he went on to develop his "Wastewater Gardens" approach which uses a very high biodiversity of plants. Additionally, Nelson is actively involved in the Earth to Mars project at the Synergia Ranch in Santa Fe, New Mexico.

## Sally Silverstone

Also one of the original eight Biospherians, she was, according to the *Biospheric* pages of the Global Ecotechnics site, "responsible for management and coordination of architectural division operations, financial administration and cost control for Biosphere 2." Silverstone co-authored *Life Under Glass*, and also has a respectable list of research oriented publications since the Biosphere 2 experiment. Sally continues her keen interest in organic agriculture started when she was involved with the highly productive, sustainable, non-chemical agricultural system of Biosphere 2. Silverstone worked in the Global Ecotechnics Corporation as the Vice President in charge of Agricultural and Horticultural systems, and in the Planetary Coral Reef Foundation as the CFO until 2006.

She was for many years the Project Director of Global Ecotechnics' Puerto Rican facility: the Tropic Ventures Rainforest Enrichment Project at Las Casas de la Selva.

## Roy Walford

Dr. Roy Walford had a high profile career as a medical doctor before Biosphere and maintained it after his enclosed experience. He was and advisor for the World Health

Organization as an immunologist, and was a member of the National Institute on Aging. He had also served as a delegate to the White House Conference on Aging in 1981. Walford was a long time Professor in the Medical School at UCLA and was on Emeritus status, when he went to Tucson to participate in Biosphere 2.

Photo Credit: Gill Kenny



Walford was no stranger to the media when he became a Biospherian. His first debut in the media resulted from developing and using a system to beat casinos. *LIFE* published an article and photograph of Walford and a friend, describing their escapades in text and photos. Walford had published books and popularized weight loss diets based on eating a nutrient-rich but calorie restricted diet.

Walford is unique amongst the others involved in Biosphere because he had a high profile career that included media attention that was not related to nor founded on his association with Biosphere 2. The Biosphere period for Walford, although relevant to his previous pursuits, because he was the staff physician, and curiously, because of shortages in food in the Biosphere, his previously mentioned diet was chosen as a means to economize on supplies. However, Walford's time in the Biosphere could otherwise be regarded as a non-sequator: unlike the others he did not remain in the milieu of ecology. Walford published a best seller called, *Beyond the 120 Year Diet*, after his experience in Biosphere. His experience in Biosphere 2 did inspire Walford to a deeper appreciation of "holistic science" since some of the controversy about Biosphere 2 was a continuation of a long-standing tension in science between the reductionistic and holistic approaches

## Jane Poynter

**J**ane Poynter wrote a book about her experience in Biosphere 2: *The Human Experiment: Two Years and Twenty Minutes in Biosphere 2*. While inside the facility, Poynter managed the farm, but she had also participated in the project from its inception. She is, thus, one of its foundational contributors. She has maintained a very active career since her involvement with Biosphere.

While inside Biosphere, Poynter and fellow Biospherian Taber MacCallum founded a company devoted to designing and developing life support systems for environments encountered in outer space and deep water: Paragon Space Development Corporation. Paragon is currently in agreement to develop the life support systems for Bigelow Aerospace, and is pursuing the NASA contract for the Constellation Space Suit System.

Poynter is pursuing a high profile in the media with television

## Sally Silverstone



Photo Credit: Gill Kenny



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Mark Nelson

show hosting, writing, speaking and maintaining blogs. She advocates to, "go green," and Paragon is putting resources into designing state-of-the-art green buildings designed for efficiency, and ecological friendliness.

## Taber MacCallum

**T**aber MacCallum was the analytical chemist in the Biosphere. He and Poynter founded Paragon while inside the facility, and his post-Biosphere career is embodied in the history of Paragon. He is the CEO and Chairman of the Board for the company.

Poynter and MacCallum married a year after resuming their journey outside of the Biosphere facility. He has acted as the Principal Investigator of experiments that were developed by Paragon to be conducted on the Shuttle, the International Space Station, and the Mir Space station.

## Linda Leigh

**L**inda Leigh was the rainforest manager for the Biosphere. Since then she became an educator. Immediately after her experience in the Biosphere, she pursued academia at the University of Florida where she worked in the Systems Ecology and Energy Analysis program. She applied her education at the Drylands Institute in Tucson, where she participated in field ecological studies.

Leigh spent the last seven years using her experience at Biosphere and her academic background to expose young students to the principles of closed ecological systems and inspire younger minds to be aware of and be concerned about the ecology. Leigh returned to Biosphere 2 in 2002 where she co-created a program to teach high school students about closed ecological systems. She also works with Phil Hawes on the Global Eco Village team, mentioned below.

## Phil Hawes and Margaret Augustine

These two people were the architects of the facility itself. Designing and building the facility required exceptional minds with exceptional abilities. Both Hawes and Augustine created a structure that is an incredible hybrid of engineering and art, the animate and inanimate, and the physical and metaphysical. The structure speaks for itself as the embodiment of accomplishment, innovation, vision, and beauty. For these two to rival the Biosphere 2 project in their lives would almost necessitate something non-

terrestrial or Apollo-like in scope.

Augustine has made her career in the eclectic. Her other projects include the "Caravan of Dreams Performing Art Center and Desert Dome" in Fort Worth, Texas, (a performing arts center with a nightclub, theater, restaurant, retail, residential complex and domed cactus garden with 350 species of cacti from around the world) the Manaus National Park and Visitor Center (for the Government of Bhutan in collaboration with the World Wildlife Fund), and the Hotel

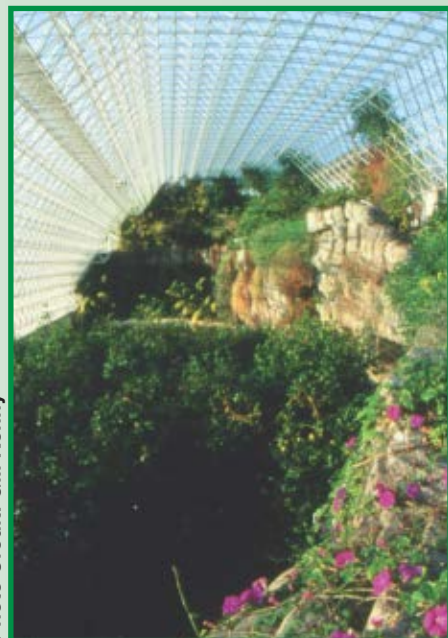


Photo Credit: Gill Kenny

Vajra in Katmandu, Nepal (an ecotourism hotel, restaurant and Cultural Arts Center Complex). All of these projects are not in the league of Biosphere as far as budget or purpose is concerned, but all have a unique, eclectic and sophisticated flavor that separates them from the mainstream.

Phil Hawes's education and background is as unique and awesome as the Biosphere itself. The list of projects that he has participated in, since Biosphere, are too numerous to mention. He has taught at various institutions, and has designed architecture degree programs. He has designed communities and developments like "Hilltop, a neighborhood village for 450 persons on 4.6 acres. A mixed use residential-commercial-industrial prototype with wastewater treatment marsh and 90% water recycling." He has published, lectured and presented exhaustively in the years since Biosphere 2 and is Project Director of Global Eco Village, a development group that builds sustainable communities.

Currently, Hawes is working on an EcoVillage in Amarillo, Texas. An EcoVillage aside from being sustainable ecologically and reliant on the recycling and reclamation of the resources that go into it, considers and integrates, according to the Global Eco Village website, "small scale manufacturing firms" that "will be engaged in processing the materials, and developing the components, necessary to build, and afterwards to sustain the Eco Village." An EcoVillage is a comprehensive and alternative social structure. Everything from the education system, to health, traffic, and other species and their presence is considered in the Eco Village plan.

All of these people (and more that were not mentioned) came together at the right time to create an exceptional and unique project. For some, the Biosphere 2 project will be the most transformative experience of their life. For others, Biosphere will be one of a couple or even a series of "one-of-a-kind" experiences. All of them were fortunate to have been involved in that project: it does not appear that a project based on closed ecological systems will come anywhere near the scope, scale, complexity or sophistication of Biosphere 2 for a long time to come, perhaps never. Perhaps, the longer the lapse in this type of experiment, the more "ahead-of-its-time" the Biosphere becomes, and the more unmatched the experience of those who were involved.

*John George is a Masters candidate in Space Studies at the University of North Dakota. He has a JD from the University of Nevada Las Vegas, and majored in Philosophy at UC Berkeley. His interest is in space law.*

*Deborah Parrish Snyder is the publisher of Synergetic Press, specializing in books on biospherics and ethnobotany. She was the Director of Publications and Educational Programs for the Biosphere 2 project from 1985 - 1994. She is also Exec. VP of Global Ecotechnics Corporation, and is a Director of their savannah pastoral regeneration project in Australia.*



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## Space and National Security Challenges Facing a New American Administration of 2009

By Eligar Sadeh

Eisenhower Center for Space and Defense Studies  
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**W**hat are the policy options that must be considered in an era in which the United States (U.S.) reliance on space for national security is irreversible? The key space and national security issues and challenges that a new American Administration and Congress will face when coming to power in January 2009 must be addressed sooner rather than later. It will be essential to do so as a new leadership in Washington, DC formulates a national security strategy.

The U.S. military is dependent on the use of space assets for both force/power projection and for state-building activities. There is as well the recognition that military space can address "non-traditional" security concerns, like energy security and environmental security. A fundamental challenge that arises is the extent to which a policy of space as a "sanctuary" is maintained, with the assurances of free access and use by all states, versus a policy that seeks space denial, control, and superiority.

Sanctuary is the cornerstone of all national space policies formulated from the time of President Eisenhower to the current national space policy of President Bush. Further, sanctuary is the generally accepted interpretation of the Outer Space Treaty of 1967, which established the basic legal principles that guide the use of space. These principles, among others, as they relate to military uses of space, include: space as a commons with free use and free access for all states and their entities; peaceful uses of outer space implying the use of space for the betterment of humankind; no military bases or weapons of mass destruction in space and on celestial bodies; and non-interference with the space activities of others.

It is the sanctuary idea that has allowed for the asymmetric advantages that the U.S. possess in the use of space assets for national security purposes. At the same time, the vulnerabilities of space assets to interference and disruption, such as the possibility of kinetic kill events in times of conflict with other states, has led to the realization that space control and space denial are necessary. The Chinese anti-satellite (ASAT) test in January of 2007 served to reinforce this view. As a result, the security space leadership, most importantly the leadership of the U.S. Air Force space program, has publicly stated over the last several months that space is no longer a sanctuary.

This view challenges the past fifty years of space policy, law, and practice in regard to the access and use of outer space for national security. An additional challenge lies in how the U.S. would formulate and implement a national security space policy based on space control and denial to achieve space superiority. For this challenge, there is the issue of how to formulate a deterrent strategy and to develop capabilities to counter threats to space assets. This begins with the need for the U.S. and the international community to find ways to maintain a sufficient level of space situational awareness (SSA) to enable decisions and proactive actions, such as self-defense and even pre-emption, to protect space assets. Other ways forward for effective deterrence lie with operational responsive space, defensive and offensive counter space doctrines and operations, and space weapons.

With the exception of the priority placed on SSA, all the deterrent capabilities considered by the national security space community face several obstacles to any successful implementation. One obvious obstacle is that of resource constraints. Given the priorities for SSA, communications, positioning, navigation, timing, and remote sensing, the resources are not likely to exist for developing a comprehensive set of capabilities that could achieve space control and denial. This is further exacerbated by acquisition processes, often plagued by cost and scheduling problems, which make any realization of space control and denial a proposition that can only be realized in the longer term, possibly ten years out or longer, and at cost to all the priorities that currently give the U.S. asymmetric advantages for national security.

Moreover, U.S. export control policies, namely the International Traffic in Arms Regulations (ITAR), further undercut efforts that allow for asymmetric advantages. ITAR damages national security by placing legal and bureaucratic restrictions on the U.S. military use of commercial space assets that rely on a robust satellite industry. This includes risks to the military use of: commercial satellites for operational support; advanced satellite technologies developed in the commercial sector; and foreign suppliers for satellite components and services needed for military operations.

In the final sum, there are four policy options to address the need for space sanctuary and the necessity for protection of space assets. On one hand, the U.S. can learn to live with the status-quo and the subsequent vulnerabilities of space assets. On the other hand, a decision can be made to foster policy changes that could provide some protection for space assets. Though, this option is beset with high political and legal consequences, and budgetary trade-offs with assets that provide for force support and enhancement for the U.S. military.

A third way, which is the position of the Bush national space policy, is to strike a balance between the two, i.e., maintain support for sanctuary, but state the right for space control and denial. This position tends to force a trade-off between sanctuary and protection. The fourth option alluded to herein, is to develop a "space" deterrent strategy. With this approach, sanctuary can be maintained and the right to defend sanctuary for all spacefaring states can emerge as a shared interest internationally.



*Dr. Eligar Sadeh is the Founder and President of Astroconsulting International that provides specialized assessment and educational services to advance the development and exploration of space. Sadeh has more than twenty-five years of experience in the space community and currently serves as Associate Director of the Eisenhower Center for Space and Defense Studies at the United States Air Force Academy. From 2001 to 2006, Sadeh was an Assistant Professor of Space Studies in the School of Aerospace Sciences at the University of North Dakota. This is the first installment to a three part 'op-ed' series on space policy challenges facing a new American Administration in 2009.*

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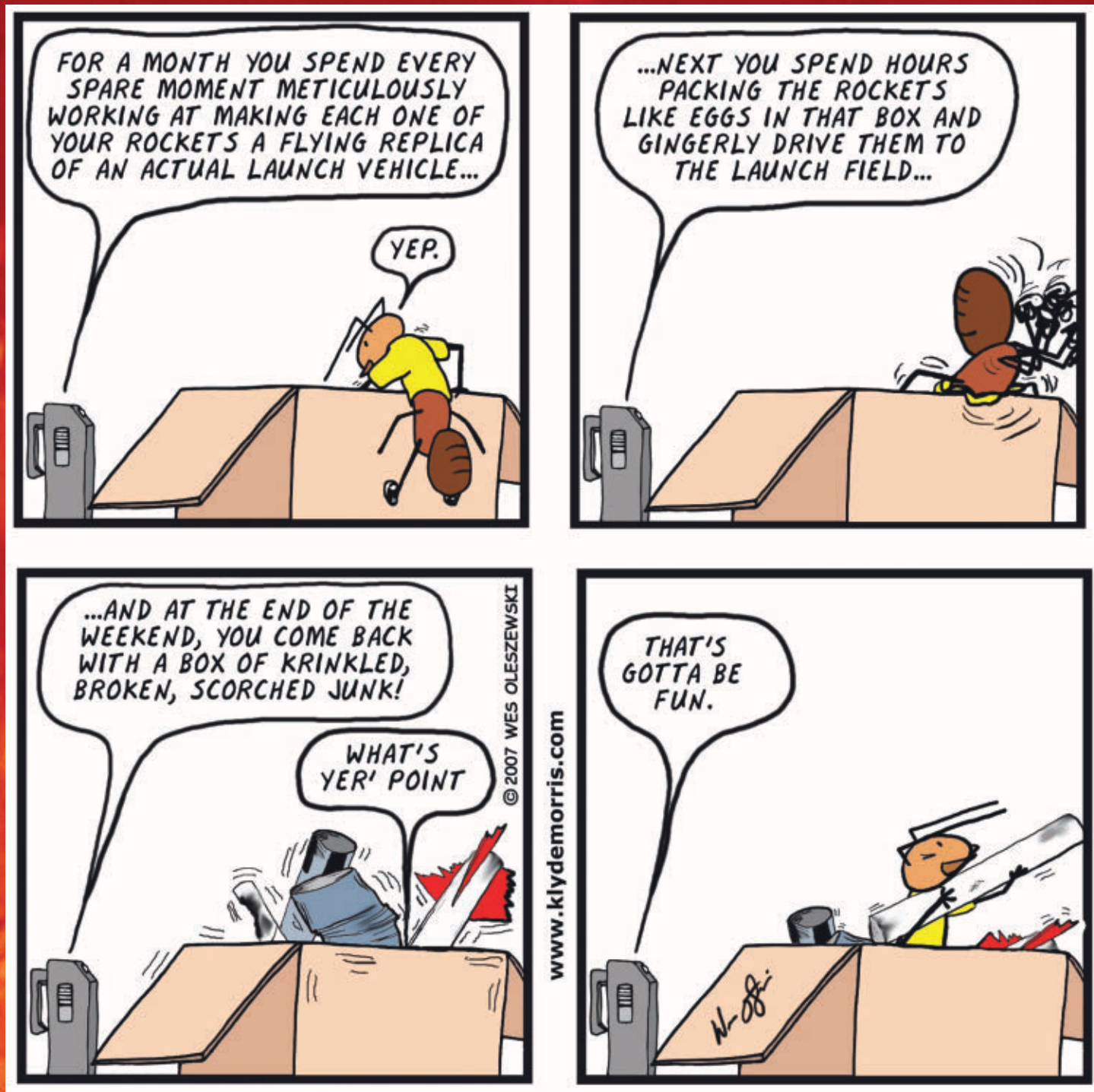
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