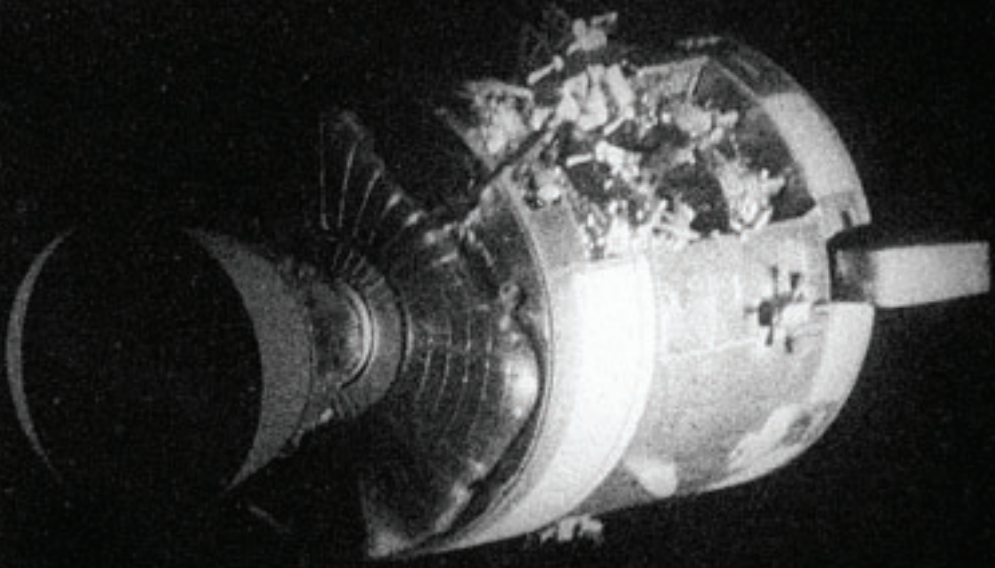
Moonbeams

Apollo 13

Special Essay Edition

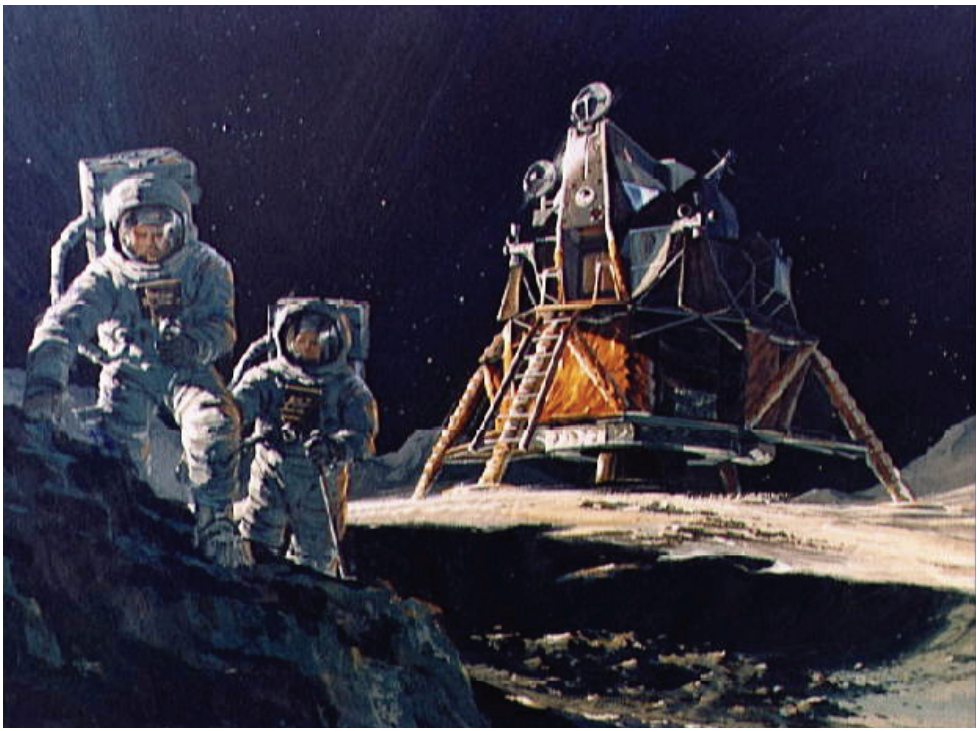
Why Is Manned Space Exploration Worth the Risk?



Survival on the High Frontier

Published by the Moon Society
and Writers Cramp Publishing
Cover Art by Charles Lesher

Cover: This is the best image the crew obtained of the damage done when one of the main oxygen tanks overheated and blew up. The explosion wreaked havoc throughout the innards of the Service Module, rupturing the other oxygen tank and blowing out the side of the spacecraft.



Artist's rendering of what the Apollo 13 mission would have looked like on the moon.

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Editors Note: This Special Edition of Moonbeams is dedicated to the heroes of Apollo 13. In partnership with the Moon Society, Moonbeams is proud to co-sponsor an essay contest commemorating the 40th anniversary of their survival.

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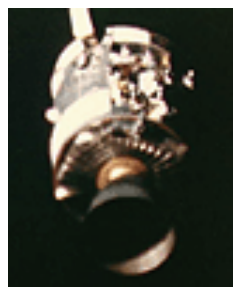
Houston, we have a problem

The Apollo 13 mission launched at 2:13 p.m. EST, April 11, 1970 from launch complex 39A at Kennedy Space Center. It was to be the third mission to land on the Moon. An explosion in one of the oxygen tanks crippled the spacecraft forcing the crew to swing around the Moon and return to the Earth without landing. The mission crew consisted of James A. Lovell, Jr. commander, John L. Swigert, Jr., command module pilot and Fred W. Haise, Jr. lunar module pilot.

The Apollo 13 mission was aborted en route to the moon after about 56 hours into the flight due to loss of service module cryogenic oxygen and consequent loss of capability to generate electrical power, to provide oxygen and to produce water.

Spacecraft systems performance was nominal until the fans in cryogenic oxygen Tank Two were turned on at 55:53:18 ground elapsed time (GET). About two seconds after energizing the fan circuit, a short was indicated in the current from fuel cell 3, which was supplying power to cryogenic oxygen Tank Two fans. Within several additional seconds, two other shorted conditions occurred.

Electrical shorts in the fan circuit ignited the wire insulation, causing temperature and pressure to increase within cryogenic oxygen tank 2. When pressure reached the cryogenic oxygen tank relief valve full-flow conditions of 1008 psi, the pressure began decreasing for about nine seconds, at which time the relief valve probably reseated, causing the pressure to rise again momentarily. About a quarter of a second later, a vibration disturbance was noted on the command module accelerometers.



The next series of events occurred within a fraction of a second between the accelerometer disturbances and the data loss. A tank line burst, because of heat, in the vacuum jacket pressurizing the

annulus and, in turn, causing the blow-out plug on the vacuum jacket to rupture. Some mechanism in Bay 4 combined with the oxygen buildup in that bay to cause a rapid pressure rise which resulted in separation of the outer panel. The panel struck one of the dishes of the high-gain antenna. The panel separation shock closed the fuel cell 1 and 3 oxygen reactant shut-off valves and several propellant and helium isolation valves in the reaction control system. Data were lost for about 1.8 seconds as the high-gain antenna switched from narrow beam to wide beam, because of the antenna being hit and damaged.

As a result of these occurrences, the CM was powered down and the LM was configured to supply the necessary power and other consumables.

The CSM was powered down at approximately 58:40 GET. The surge tank and repressurization package were isolated with approximately 860 psi residual pressure (approx. 6.5 lbs of oxygen total). The primary water glycol system was left with radiators bypassed.

All LM systems performed satisfactorily in providing the necessary power and environmental control to the spacecraft. The requirement for lithium hydroxide to remove carbon dioxide from the spacecraft atmosphere was met by a combination of the CM and LM cartridges since the LM cartridges alone would not satisfy the total requirement. The crew, with direction from Mission Control, built an adapter for the CM cartridges to accept LM hoses.

The service module was jettisoned at approximately 138 hours GET, and the crew observed and photographed the Bay-4 area where the cryogenic tank anomaly had occurred. At this time, the crew remarked that the outer skin covering for Bay-4 had been severely damaged, with a large portion missing. The LM was jettisoned about 1 hour before entry, which was performed nominally using primary guidance and navigation system.

A Focused Advocacy for Human Space Exploration

by Edward N Brown

It is generally agreed by most people that exploration and discovery are good and beneficial for future life and wellbeing. What are not in universal agreement are the approach that should be taken, the cost/resources that should be allocated, and the Risk that should be allowed. As we acknowledge and appreciate this year the heroic efforts involved in the rescue of the Apollo13 astronauts 40 years ago, many people are asking "Is human space exploration worth the Risk?" If we are to answer 'Yes' to this question, we must be prepared to provide a convincing argument to support that position.

It is said that beauty is in the eye of the beholder. The same can be said about Risk. The degree of Risk involved in undertaking an activity can be estimated reasonably well by experts. Complexity, resource availability, and timeframe drive the estimate. But the degree of Risk that is tolerable by an organization or an individual is a much harder thing to ascertain. So when asked the question "*Is it worth the Risk?*" the answer is not straightforward. It depends upon the Risk tolerance of the evaluator. Four well-known factors drive the Risk tolerance. Furthermore, the relevant tradeoffs are different for an individual considering undertaking an activity, an advocate proposing that someone else undertake an activity, a commercial establishment contemplating the prospect of starting an activity, and a governmental organization deciding whether to pursue an activity. Each has their own set of needs, desires, constraints, fears, and avoidances (henceforth abbreviated NDCFA) that influence

their tradeoffs regarding Risk tolerance.

Let's look at the case of the advocate. To successfully advocate for something, you have to know your target. Then you have to "*see through his eyes*"; to figure out what his NDCFA are, so you can try to persuade him to align his thinking with your own. Now let's consider the question of whether manned space exploration is worth the Risk. As an advocate, we believe that it is, but who are we trying to convince, what are their NDCFA, and how should we proceed? It is important to note that we are talking about "exploration" and not travel, commerce, or pioneering. This will steer our approach.

"Exploration" can be defined as the search or investigation of the unknown, with the aim of making discoveries that will maximize the tradeoff of self or group NDCFA. There are three relevant types of travel based "exploration". The Experimental type may have instances where human tended experiments have value, but in general, manned programs compete poorly with unmanned robotic programs because of the high cost and safety disparity. The Geophysical type may be applicable to small-scale proof-of--concept efforts, but these niche programs always have environmental and popular ramifications. However, the experiential type is driven by the desire to affect the tradeoff of NDCFA by improving sensory awareness of the surrounding environment. At the group level, these programs are usually under the purview of government organizations, and this is where we should concentrate our advocacy. Space tourism, adventure, vocation, or settlement might be applicable at the individual level (which has a very different NDCFA set), but large-scale experiential type exploration is applicable to the government realm because the NDCFA are nationalistic.

A good place to start to understand the US Government's

NDCFA is to review the current US National Space Policy. Of the seven Goals stated, Goals 1, 3, and 5 are very relevant to human space. Although it is hard to pinpoint, I'm betting that the Goals that contain the words "strengthen leadership" are the key needs and desires. These Goals also give insight into the fears and avoidances, which must also be considered. Therefore, the central argument around which we formulate an answer to the original question must involve the concept of retaining the position of US world leadership in space.

The advocacy argument is this: The nation that leads the world in human space exploration will lead the world in the projection of its political, economic, value, and belief systems. It would be unthinkable to allow another nation with a different set of priorities to be the world's leader in the projection of those systems to the rest of the world. This was the driver behind President Kennedy's challenge to the nation in 1961 and it is still valid today. The most important sentence in his May 25 Message to Congress is "We go into space because whatever mankind must undertake, free men must fully share." That says it all. To insure that freedom, and not tyranny, will be the predominant social institution as mankind explores the space frontier, the US must be the world's leader. That is the overarching reason why human space exploration is worth the Risk. Loss of leadership could result in loss of freedom and diminution of our hardearned values, beliefs, and economic wellbeing. Our foreign policy is based on that precept. It is the overriding need of the US Government.

There are a lot of catch phrases that can support the argument. "Oh, by the way, human space explorations will also _____". You can fill in the blank. "improve economic prosperity by creating jobs, enhance national security by providing in situ observers, increase the future science/engineering workforce by inspiring

youth, improve civil operational efficiency through maintenance/repair of space assets (Hubble)", come immediately to mind. There are others and they're all important.

Finally, it is sometimes tempting to wax eloquent about how human instinct (curiosity) or human destiny (species survival) compel human space exploration. While this may gather emotional support among the already converted, it won't get you any political sway in Congress or the Executive branch.

In conclusion, by following a focused approach to advocacy, we can maximize its efficacy. We can respond 'Yes' to the question "Is human space exploration worth the Risk?" with a specifically tailored answer that targets the key NDCFA (along with supporting arguments) of US Government leadership. Of course, a good advocacy would also have prepared counter-arguments to respond to critics, lobbyists, and antiadvocates. But that is the topic for another essay.

Edward N Brown

A member of the Moon Society

Position: employed with a major aerospace company as a Senior Engineer

Experience: over 25 years experience in the formulation, design, and development of human rated flight systems and subsystems

Publications: extensive writings on the technical aspects of human space flight, the systems orientation, and the resulting philosophical, political, and humanistic implications

Education: Ph.D. Kensington University, M.S. Union College, M.S. Rensselaer Polytechnic Institute, B.S. New York Institute of Technology

Manned Space Exploration is Worth the Risk

By Jared Treadway

Apollo 1. Soyuz 1. Soyuz 11. Challenger. Columbia. To date, twenty-one brave space explorers have lost their lives while pushing back the frontier of humanity. When they died, not only did their families enter a black period of mourning, but entire nations grieved. In that grief were heard the rumblings of those who argued the futility of manned space exploration. They insisted that the deaths of these brave astronauts and cosmonauts were unnecessary, and that manned space exploration was not worth the risk of losing our sons and daughters, mothers and fathers, husbands, wives, and dear friends. Perhaps they have a point… perhaps.

Fear of loss is a powerful incentive to play it safe. Nature has provided us with a deeply rooted instinct to protect those whom we love, and this feature has helped us to survive as a species in the face of countless dangers. Yet, fear isn't the only mechanism by which humanity has survived. Our mobility and vision have again and again drawn us to the horizon in search of greener pastures. Our will to survive led us out of Africa, across Asia, into Europe, and into the Americas. Our adaptability to a variety of environments laid the world at our feet. And even when the horizon had been conquered, the sheer challenge of diverse landscapes compelled brave women and men to scale Mt. Everest, race across Death Valley, swim the English Channel, or dogsled across Antarctica. Tackling a challenge brings out the best in humanity, plays to our strengths, strengthens our weaknesses, and

strangely fulfills an oft-ignored void. Nature threw down the gauntlet, and humanity answered.

Yet, for restless humanity, another challenger now taunts; one that is akin to past challengers, yet dwarfs them by its vastness. The vacuum of space is monstrous, unforgiving, harsh, and takes no prisoners. Hitherto our challenges have taken place on our home turf, terra firma, where adaptability, though challenging, is possible. In space, however, humanity must rely solely on its ingenuity even to breathe. Like Sirens, other worlds call across unfathomable distances, beckoning to be explored. Humanity hears the call, feels the instinct to answer, but is intimidated by the danger. Having tamed nature, humanity has fallen prey to complacency and fear, and has excused itself from the call reverberating from its own nature by appealing to the twin chimeras of expense and danger. But the call cannot be thus ignored.

The risk of not exploring space with a robust manned program is greater than the risk of losing our astronauts. Environmental concerns, energy production, the population explosion, and the risks posed by earth-crossing asteroids are all potential dangers to the human race as a whole, and are best answered through an aggressive program of manned exploration and settlement of the solar system. These problems simply cannot be solved through robotic exploration alone.

If current projections hold, the habitability of the Earth will be drastically different within the next fifty years. Some scientists estimate that our environmental pollution has snowballed to the point of no return, and that much of this damage to the environment is irreversible. Technological innovation enabling life to survive in hostile environments will undoubtedly progress as humanity settles on other worlds–a progress driven by necessity

rather than sheer profit. Although Earth's environment is not expected to become as intolerable as other worlds, such technological advances will surely provide solutions to later Terran environmental problems.

Energy production in space, though costly, is a long-term investment in our future. Space solar power is being taken seriously by some politicians as a clean, credible option, and the ultimate benefits of such a program could be revolutionary. Such power space stations were envisioned by the late Gerard K. O'Neill as manned outposts where scientific research and station repairs and construction are carried out by ever-expanding manned crews. Such stations would someday become true colonies, essentially ensuring humanity's survival apart from the Earth.

As the population of the Earth increases, problems concerning food production, sanitation, and clean water will also multiply. Such problems will have been dealt with in depth and from different angles by intrepid space pioneers, such as the first settlers of Mars or the moon. Fresh perspectives on such pressing issues will spawn equally fresh, innovative solutions.

Life on our planet has been molded by several planet-wide extinctions. The extinction of the dinosaurs was almost certainly caused by a rogue asteroid or comet that slammed into the earth 65 million years ago. The ability to maneuver and work in space is a necessity if we are effectively to deflect a potential planet-killer. In addition, if a giant asteroid or comet should catch us unawares, it would be wise to have humanity spread throughout the solar system in order to ensure our survival as a species.

Above all, however, stands one truth: when humanity ventures among the stars, we will pass a fundamental milestone in our existence as a species. We wandered out of Africa, emigrated east and west, crossed oceans, conquered the skies, and harnessed

the power of the atom. Now humanity will have reached a new level of existence–that of a space-faring species. Space is our manifest destiny, and will be hampered only by a lack of will power and imagination. The call has gone out, the challenge made, and we can feel the very marrow of our bones urging us onward, upward, and outward. It is time for us to fulfill our destiny as a species. It is time for humanity to take the sage advice of Polonius: "This above all, to thine own self be true."

Jared Treadway
A member of the Moon Society

Manned Space Exploration Is Worth the Risk

By Dorothy Diehl

Exploring the unknown has always been fraught with risk for Homo sapiens over the last one hundred millennia. It is true that back then, humans lived in tribal societies and stayed on familiar terrain until environmental conditions changed and threatened their survival. Faced with doom if they stayed put or the possibility of survival if they explored the unknown, early humans left their homes on the plains of central eastern Africa and migrated south or north. In the north, subsequent generations pushed on westward or eastward across Asia eventually finding an Ice Age land bridge to the Americas.

Down through the ages this human willingness to take risks to escape hunger, poverty and/or persecution motivated many peoples to face what they did not know and, in spite of death decimating their peers, the survivors conquered that unknown. Sometimes, the driver for human exploration was the possibility of obtaining great wealth like gold and spices. Usually there was a commercial element lurking behind many expeditions of exploration, such as the great Lewis and Clark Expedition of 1803-1806. Yes, they drew maps of previously uncharted terrain and recorded many observations of previously unknown plant and animal species. However, the purpose of that expedition—to find a water route connecting the upper part of the Missouri River to the Pacific Ocean—was a commercial one. The ensuing wealth that would come to the United States, if a Northwest Passage were

discovered, was more important than the many risks posed by such an expedition.

In our own time, the decision to send men to the Moon and return them safely to Earth was driven by the military threat of the Cold War when the Soviets successfully launched Sputnik, the first artificial Earth satellite. Our national prestige was ranked as more important than the personal safety of the astronauts. If the stakes are high enough, humans will run any risk that arises. The public did not vote for the Apollo Program; it was an executive order by President Kennedy.

Since the end of the Apollo Program, space exploration has been relegated to robots as cheaper and more expendable than human astronauts. Many robotic missions have been extremely successful. Now there is no driver to risk human lives to explore space beyond Earth. Of course, we are curious about what's out there, but the robots are slowly and partially satisfying that curiosity. And we are safe as clams on our lovely home world, the Earth. The fact that human explorers could, at great expense and great risk, make many more discoveries much faster in space than all the robots sent there has no traction with U.S. citizens.

However, if a group of people, perhaps from some other nation, decides to go to the Moon to explore ways to make a permanent settlement there and they succeed; then, the reports of that success will raise the possibility of new real estate and exciting jobs. Like the opening of the Oregon Trail in the nineteenth century, a permanent human settlement on the Moon in the twenty-first century will stir us to action. Those who come in on the ground floor of a new frontier not only acquire wealth but also make names for themselves in human history.

It is inevitable that new discoveries on the Moon will lead to new technologies, new ways of life, and eventually to Mars and

the asteroids. Destiny will beckon to those who dare great achievements. The innate urge to explore the unknown that is buried in our genes will finally express itself again. We will relegate robots to support roles where they belong. Yes, we will consider the risks and take them in stride as the shuttle astronauts did when they assembled the ISS and repaired the Hubble Space Telescope. Instead of crawling centimeter by centimeter onto the Space Frontier exclusively with robots, we will finally sprint there with human explorers.

Dorothy Diehl

Dorothy is a retired planetarium teacher living in a small town in the Willamette Valley of Western Oregon. After almost forty years of happy marriage, she is now a widowed grandmother with a wonderful family, most of whom live nearby. Besides keeping up with family and friends, she still maintains her home complete with a large yard and vegetable garden.

She also keeps up with the latest space and astronomy news. Dorothy is a long-time member of the Oregon L-5 Society, which is a chapter of the National Space Society. She joined its predecessor organization, the L-5 Society, in 1979 and wrote articles for their magazine. She thinks that the chances now of becoming a space tourist are about zero but she is still enthusiastic. The next best way for her to visit space is by writing science fiction. Dorothy hopes you have enjoyed her story.

Manned Space Exploration Is Worth the Risk

By Tom Burkhalter

Since 1960, 101 people, mostly Russians and Americans, have died either during the course of space flight or in accidents related to preparations for space flight. According to NTSB statistics, almost that many people in America alone will die, in a single day, in automobile accidents. In a single week in this country, based on U.S. Labor Department statistics, more people will die in workplace-related accidents than have ever died in space flight related accidents. In a single year in this country, based on U.S. NTSB statistics, more people will die in airplane accidents than have died in space flight related accidents. Any argument that manned space exploration is physically "too risky" would therefore require us to ban, by the same argument, driving to the supermarket to shop for eggs, to work for a living or flying a Piper Cub.

Manned space exploration is without doubt expensive. Economists would ask, what is the benefit we obtain at the risk of the money spent? As for that risk, one spends money to make money. The technological spinoffs of the Apollo program alone created more jobs and economic opportunity – in short, made more money – than has ever been publicly acknowledged. Input the term "Apollo program spinoffs" on any Internet search engine and consider the ways in which our economy benefitted from that one program. As an humble example, today's athletic shoes are based on materials derived for use in the space suits NASA astronauts wore on the Moon; at the other end of the spectrum,

magnetic resonance imaging depends on digital signal processing techniques developed for Apollo. What is the economic value of early diagnosis of a brain tumor?

Arguing the technological benefits of manned space exploration, however, might be beside the point in assessing the relevant economic risks. Adjusted for inflation, the Apollo Program would have cost about 300 billion dollars in 2008. Congress, just before Christmas of 2008, gave over three times that amount to bail out a banking industry that made bad business decisions. The decision to undertake the risk and bail out the banking industry was made after only the most minimal debate of the risks and consequences. What benefit will we, as taxpaying Americans, receive for that economic risk?

There is risk and expense involved in manned space exploration but the risk appears to be no more than that present in those everyday activities described as "business as usual." Perhaps, though, since it seems evident that even this level of risk is considered unacceptable by many people, one should identify what manned space exploration actually does for us as human beings.

Manned space exploration, by definition, takes us where no one has gone before. Perhaps it isn't so obvious that it increases not only the store of human knowledge and experience, but the level of human potential. "Human potential" in this context means the scope of what we dare to dream of accomplishing, for ourselves and for our children. Manned space exploration is not only the stuff of dreams, but in a very literal and much more important sense, the stuff from which dreams originate.

Before Apollo "going to the Moon" was only a dream, an idea belonging to science fiction. But on July 20, 1969, we knew that human beings were on the Moon. "Going to the Moon" passed

forever from the nebulous realm of science fiction into the factual realm of human history and experience. To look at the Moon during the Apollo landings was to know, and not merely to have faith, that anything is possible to human beings. What Apollo did for us then is what all manned space exploration does for us: When dreams are made real previously unknown dreams become possible. The human potential increases.

To explore, redefine and expand our full potential as human beings, to restore and maintain that spark of the heroic within not just some of us but each of us, is therefore the benefit conferred by manned space exploration, and that is worth the risk. Manned space exploration proves to us that whatever our problems, we can find a solution. Manned space exploration is the living, dynamic symbol of hope for the future, of that better tomorrow that is the fundamental promise of America. To acknowledge anything less is to deny our full potential – and what that potential might become in the future where no dreams have yet reached.

Tom Burkhalter

Tom was born in Georgia in 1954. His parents could never decide if the first word he ever said was "airplane" or "star" which only shows he's been an aerospace nut from the beginning. Along the path of life, Tom has acquired degrees in mathematics and law and worked as a restaurant manager, an insurance rater, a stable hand, a flight school dispatcher, a proofreader and copy editor, pizza delivery driver, a paralegal and an engineering technician. At present, Tom lives in Hickory, NC, with a wonderful woman who loves him despite his many flaws. In his spare time, Tom volunteers at the Hickory Aviation Museum and pursues his omnivorous tastes in reading.

The Case for Manned Space Exploration

By Valentin Peretroukhin

"Space, the final frontier" has fascinated the minds of Mankind since antiquity. The 20th century saw great leaps of innovation that allowed humans to not only travel to space, but to also set foot on a completely different celestial body and return home safely. During incredibly unsettling times of war, violence, and social unrest, these audacious accomplishments were an inspiration to the masses and a true symbol of human ingenuity. At the climax of the "space race," the public's exuberant sense of hope and excitement for human space travel allowed governments to invest a considerable amount of money into fostering new ideas and technologies. In the decades following that era, the world's social dynamics and demographics evolved and many factors that initially promoted space exploration disappeared, along with much of the unified excitement for exploring distant frontiers. With the general public's support dwindling, it is now becoming exceedingly difficult for many developed countries to justify funding manned space endeavors.

Around the world, the American lunar landing of 1969 certainly marked the peak of public interest in space exploration. Over 600 million people, a record television audience at the time, watched as Neil Armstrong stepped down the ladder of the lunar module and uttered the iconic phrase, "One small step for man, one giant leap for mankind." Upon their return to earth, the astronauts reception was akin to the welcoming of renaissance

explorers, filled with extravagant parades and glorious stories of strange foreign lands. The awe and excitement that surrounded this first trip slowly dwindled with later Apollo missions as the process was inherently repetitive and suddenly seemed entirely accomplishable. Beginning in the mid 1970s, the extent of human space exploration began to shift focus to creating inhabitable "stations" in low earth orbit and building various efficient ways of transporting humans to these stations. Though interplanetary exploration continued, it was, and still continues to be, fulfilled entirely by unmanned space probes.

As human participation in space exploration declined, so did the inherent public interest for any extraterrestrial missions. The reason for this can be found on magazine stands, in arenas and schools around the globe: Mankind is an incredibly social species. Our evolutionary supremacy on this planet stems from our competitive nature, our ability to work in groups and our ability to share information and pass on relevant knowledge. Furthermore, the intrinsic ability to put ourselves in the perspective of another person – the concept of empathy – is one of the key distinguishing factors that separate humans from other primates. For people to be able to relate to, and empathize with, the accomplishments of said space explorations there must be a human face attached to them.

One of the main arguments against human-based extra planetary travel, and perhaps why no country has attempted it since the Apollo missions, is the shear cost of developing technologies safe and practical enough to send humans to another world. The money for space endeavours is there, yet the public is extremely wary of spending billions of dollars on unmanned missions that often fail because of careless mistakes and miscalculations. In a manned mission where all decisions are

scrutinized and much more rigorous precautions are taken, and the public is empathetic of the risk of human life involved, justifying high expenses is a much easier task. Additionally, more than just appealing to the public, astronauts bring an entirely different approach to exploring different planets and moons. Humans are incredibly dynamic and can perform many things that a robot simply cannot do. An astronaut can provide a holistic overview of a new unknown environment – in addition to the simple images, videos or other sensory data of a probe -that can be incredibly helpful in understanding its various characteristics.

Apollo 15 Astronaut James B Irwin, staring back at our world through his command module window, described the earth as "a marble, the most beautiful you can imagine. That beautiful, warm, living object looked so fragile, so delicate…" From this incredibly unique and bonding view point, all of Mankind, no matter what race, sex or creed is a part of Earth: a beautiful, vibrant, diverse world in the dark empty abyss of space. In his book, Cosmos, the great astronomer and popular author Carl Sagan writes of this phenomenon, "if a human disagrees with you, let him live. In a hundred billion galaxies, you will not find another." In times of distress, a country's investment in exploring distant frontiers serves as an inspiration and a vital source of hope for many of its citizens. The best example of this occurred in the late 60s in the United States. This decade was marked by several prominent assassinations, a much disputed war in a completely different continent, the threat of nuclear annihilation, a struggle to eliminate segregation and a multitude of oncoming social reforms. Throughout all this turmoil, the Apollo Astronauts were seen as heroes, unifying the nation and providing hope when all else seemed to be in a state of disarray.

Thus, in just over 150 years after its conception, space

exploration is now a crucial part of the development of Mankind. In a dynamic, multi-dimensional world, it is imperative that we continue to challenge ourselves to explore distant frontiers and not be intimidated by the prospect of human space travel. Space is no longer simply a bragging right for the most developed nation – it may contain many answers to the daunting challenges our species will face in the next millennia. The future generations of Mankind will rely on our courage and our ingenuity. In the words of H.G. Wells, "life, forever dying to be born afresh, forever young and eager, will presently stand upon this earth as upon a footstool, and stretch out its realm amidst the stars."

Valentin Peretroukhin
Toronto, Ontario, Canada

Manned Space Exploration is Worth the Risk

By David Stoica

Change we can believe in. That is the rallying cry that propelled President Obama into the U.S. Presidency. That is the rallying cry that resonated with the American people. We all want change, and we all want change to be in the positive direction. We want our future to improve. We want our country to improve. We want our planet to improve.

Is Manned Space Exploration worth the risk? There is the risk of close calls, as demonstrated by Apollo 13. There is the risk of accidents, as demonstrated by the Apollo 1, Challenger and Columbia accidents. However, Manned Space Exploration is worth taking this risk, because it is a great opportunity to improve the future of our planet.

I reached the conclusion that Manned Space Exploration can improve the future of this planet, by looking at the history of this planet, to see what the major causes of change were. The two major causes of change were technology and war.

War has created many of the changes in history. Boundaries of countries change as a result of war, but at a very great cost. People are killed. Cities are destroyed. Cultures are lost. War is destructive in nature. Even if one side wins, the planet as a whole has lost. Wars cause change, but not in the positive direction. Wars do not improve our planet. War is not a desirable agent of change.

Technology is the large driver that has advanced civilization in the past, and it is the large driver that will advance our planet in the future. It is technology that has raised our living standards, and has advanced civilization.

If we are to decide to make investments in technology, to improve our planet, we need to aim well. What are the drivers of technology? The two major drivers of technology are the space program, and the

military. Investments in both arenas have created technical advances.

Military investments are not the optimal method to improve the future of our planet, even though there is rationale for military investments for the purposes of national defense. However, by its very nature, technical advances in the military tend towards advances in destruction.

Manned space exploration is the other major driver of technology. It is oriented in a direction that is positive, rather than negative. Manned space exploration has created technical advances that have advanced this planet, in a relatively short period of time. Why is manned space exploration such a driver of technical development? It is manned space exploration is such a difficult prospect, that it requires technical advancements to proceed. It is this very difficulty that presents the challenges that forces inventions to occur. Meeting the challenges of manned space exploration is the best driver for positive technical advances that have the potential to advance our future in the positive direction.

Manned space exploration presents challenges for long term living in the closed ecosphere of a space vehicle, or a space habitat. The answers to the various challenges will help answer our challenges for living in the closed ecosphere of planet Earth. Manned space exploration is a great opportunity to take advantage of the old cliché that necessity is the mother of invention.

A major technical challenge of manned space exploration is the problem of using resources. Technology needs to be developed to use resources more efficiently in space. This space technology can then be used to use resources more efficiently on this planet.

Yes, there are risks to manned space flight, but there are risks to everything. There is the old axiom that the safest ship is the one that stays in the harbor. However, the ship that stays in the harbor does not accomplish much. To advance in manned space flight, there is the risk

of loss of life. However, the risk of loss of life in manned space flight pales to the risk of loss of life in war.

Part of the technical challenge of manned space exploration is the technology to create safe manned space exploration. The technical advances in reducing risks in manned space exploration may create technologies that reduce risk in everyday life on this planet. There may actually be a net gain in facing the risk issues head-on.

The mere process of pursuing manned space exploration is the key to technical advancement. It is worth investing in the future of this planet. It is worth investing in technology. It is worth investing in manned space exploration. The investment in manned space exploration is an investment in the technology that will advance this planet. That is the big picture.

We all want change we can believe in. We want our future, and our planet to improve. The way to create this change, that we desire, is to invest in manned space flight, despite the risks.

Manned space exploration is an investment in the future of our planet. It is absolutely worth the risk!

David Stoica

David has been a fan of the space program all of his life. During the Apollo era, he kept a scrapbook of newspaper articles about the Apollo flights. David received a Bachelor of Science Degree in Metallurgical Engineering from California Polytechnic State University at San Luis Obispo. Since college, David has worked as a Space Shuttle Engineer for Rockwell International, and then Boeing. He has worked in the departments of Laboratories and Test, Materials and Processes, Quality Engineering, and Reliability Engineering. David is currently a component engineer for the Space Shuttle Main Propulsion System (MPS).

Hacienda Heights, CA

Risk Mitigation in the Development of Space Resources

By Scott E. Shjefte

Introduction

It is basic to understanding that the Human Race needs resources to survive and prosper. It is assumed that use of more resources to allow the Human Race to grow, expand and prosper is a GOOD thing and is very desirable. It is a given that Earth has limited resources. Observations by science have shown that space resources are boundless to several thousand orders of magnitude in energy, territory and materials. This leads to the conclusion that it is GOOD and desirable to explore and develop Space Resources for use by the Human Race.

The Question

How to best explore and develop Space Resources for the Human Race?

The Answer

The United States of America Capitalistic Assumption:

Exploration and development of Space Resources can best be done by creation and activation of numerous business plans that optimize success by risk mitigation.

The business plans with the advantage:

Human involved Space Exploration and Development.

Why?

1. Incremental improvements occur by close inspection and analysis by people; methodologies that are not enhanced by remote operations.
2. Quantum improvements come from intensity and focus by a person that is best achieved by full immersion in a situation; this is less likely to occur with remote operations.

3. Fast response and correct response to unexpected events are more likely to occur if you are close to the investigation or development. Experience has shown that tele-operated equipment and robotic equipment is slow, inflexible, and costly to make fool safe and even then is error prone.
4. Learning/productivity improvement is faster when all senses are involved.
5. Personal involvement is a great motivator for success. People involved at the leading edge will try the hardest to succeed. This is especially true when meaningful rewards are provided.
6. A great leader is fully involved and inspires others to participate and to invest in a successful plan. The greatest of business plans has multiple champions! We (humans) insist on having Heroes; robots make very poor heroes.
7. Off Earth Humans will create an immediate market for space developed resources that will allow boot strapping of the collective Space Exploration and Development business plans.
8. Territory is valuable. Throughout history to claim territory, a person has to take possession and hold it. This is called homesteading. As the saying goes possession is nine tenths of ownership. Based on my understanding, the Moon, comets, asteroids and the rest of the planets belong to whoever gets there first and holds on. Or is it whichever country, corporation or individual who gets theirs firsts and holds on? The new land grab is on!!!!
9. Piracy and theft is also a problem. Property and

equipment tends to get up and walk away if no one is actively watching. Being there it is easier to defend, watch, and take appropriate action.

These last two items are a bit of the seamier side of things but realism is needed in the consideration of a successful business plan.

Of course many more reasons exist but long list get boring so it is requested that additional answer points of 10 and beyond be provided by the creative reader …Send them to sesame_space@rocketmail.com for inclusion in future supplementals to this essay.

Conclusion

It will not be easy but for Humanity to grow and prosper we will need tens of millions to invest and more than a few handfuls of individuals to create and champion well considered Space Exploration and Development Business Plan as soon as possible.

There is one more thing that is not part of any business plan.

To best experience the wonders and joys of the Universe it is best close up and personal - not mult-millions of miles away! This may be the best justification of all for Human Space Exploration – to experience the thrill of living the Adventure.

Please join with us in opening the doors to the rest of the Universe.

Scott E. Shjefte

A member of the Moon Society

Brooklyn Park, MN

Manned Exploration is Worth the Risk

By Jim Sloan

I am a child of the '60s. While the space program was building to the Moon landing I was in elementary school studying the exploration and settlement of North America. There wasn't a doubt in my mind that the space program would lead to the establishment of a nation or nations that would span the Solar system and possibly beyond. So what price is too great to pay for the creation of a new nation?

In balancing risk we must also think in terms of what is returned to us. I believe the true issue here is that many cannot and will not accept the value of space exploration. Again, as a child of the '60s I heard many argue that the space program had no value. In time I saw the division between manned and unmanned space exploration. I took this to be a simple ploy to divide the supporters of space exploration in order to make it easier to destroy us. Another ploy that is used is the question of where space exploration should be in our National priorities.

Those who doubt that the space program has any real value are a minority, much like those of us who have absolute faith that space is the next frontier. The majority is in a wait and see mode. They grant the potential of space, but are uncertain whether that potential can be realized. Their uncertainty has bought us the time to act.

Our technology has matured and we are seeing a transition from a space program determined by voters to one that is determined by investors. There will still remain the old guard, those that think of themselves as the experts, who will seek to regulate this new industry, but we must trust in the greed of government for only if this new industry succeeds can it be taxed. We must trust that there are those who have the dream and will join the government not to block private industry, but to help it.

As a child of the '60s, I was a part of an exciting time when the United

States became unified behind a single, outrageous goal of reaching the Moon... It was a time when anything was possible. I doubt that there will be another time such as that. The '60s was also a time of a loss of innocence. Before the Viet Nam war, I believe we trusted our government to make the right decisions for us. Now, I think we are more inclined to question those decisions. I see this like the moment that we first realize that we are adults and can no longer rely upon our parents. For me as an engineer, it meant questioning the government's decisions in the space program and realizing how we could have done better.

There was also in the '60s, the back to the land movement where people sought to take more control of their lives by returning to a simpler life producing only what they needed in the way of shelter and food. This taught me that there are two economic realities in our lives. There is one economy necessary to fulfill our most basic needs which can be met by our own labor and a second economy that is based on trade. An economy that uses trade to secure the most basic of needs such as energy cannot survive.

As the old Chinese Curse goes, "We are living in interesting times." As we use up the resources of the Earth, we shall reach a point of stagnation where we can only produce the necessities of life. The meek shall inherit the Earth. Before that time we will have gone forth, expanding through our Solar system and then beyond to explore our galaxy. As an engineer I can imagine the future, I know what is possible and what is not. I can see us building outward into space. I can see the cost of reaching orbit dropping. I know that settlements will be built. As to why they will be built, that is because a few of us have a hunger to explore and a need for a place to rest

Jim Sloan

A former member of the Moon Society

Is Manned Space Exploration Worth the Risk?

By Fred Hill

Perhaps the primary reason we must accept risk is that it is unavoidable. Most of us try to avoid risk. We forgo hang gliding, scuba diving, bungee jumping, etc. So is there risk in sitting at home talking with friends on the phone?

Definitely. Trouble large or small will find you! No matter where you are, trouble lurks.

For example: One bright summer day, as a youngster, I was outside watching a painter working on side of our house. The work was progressing smoothly.

Then I looked the other way. There was a sizable cloud and its edges were moving rapidly.

I was fascinated and continued to watch as the cloud grew larger and darker. The cloud was churning violently. Then it happened: there was a brilliant flash of light and deafening clap of thunder. I jumped and ran into the house as torrential rain commenced.

My mother was sitting on a stool holding her ear. "The phone just went dead," she said. I continued past her, looked upstairs, and announced: "There is blue smoke upstairs."

Mother then ran next door and called the fire department. A fire truck rolled up minutes later and the firemen quickly took care of the problem.

The next day I got a full explanation from the telephone repairman. Lightning struck the pole across the street from us and followed both phone and electric lines into our house. There it destroyed the phone and a wall lamp in grandma's bedroom. It also destroyed the lightning arrestor on the phone line (but it did its job), and then set fire to an electrical junction box in the attic.

Ok, so you can't completely avoid risk, but isn't *'exploration'* just asking for trouble? Perhaps, but there are many reasons to explore. Sometimes, just for adventure, or discovery. Or out of necessity. After successive crop failures or an invasion folks look for an alternative. Explorers know or can find suitable lands worth moving to. That is how most of our readers (those living in the USA for example) got here. Their ancestors (and mine) wanted out of Europe and learned that there were good places across the Atlantic Ocean where one could build farms or businesses and live quite well.

If we earthlings run into trouble, we might want to consider the Moon or Mars for example. There are lots of people (adventurers and explorers) who are willing and able to do it.

NASA had no trouble recruiting people to go to the Moon. Those astronauts did a remarkable job exploring the Moon and others are eager to return or go on to Mars. One day some of us may be looking to move off Earth. We will be glad someone was willing to design and build spaceships, do the exploration, and show us the way.

Fred Hill

A member of the Moon Society

Manned Space Exploration Is Worth the Risk

By John Hadden

On April 11, 1970, the Apollo 13 Moon Landing Mission launched into space with Astronauts James Lovell, Fred Haise and John Swigert. Two days later an explosion occurred that made a Moon landing unachievable and that possibly, none of the Astronauts would survive. Fortunately, a concerted team effort at NASA resolved the dire situation, and the crew of Apollo 13 landed safely on April 17th.

Was it worth the risk to send more Astronauts to the Moon? The cause of the explosion on Apollo 13 was understood and changes made to make sure it did not happen again and four more Apollo Moon Landings took place and brought back valuable Lunar soil samples.

A typical Lunar Soil sample has 40 percent oxygen, 20 percent silicon, 12 percent aluminum, 6 percent titanium and 3 percent magnesium. What can be done with these materials?

According to Dr. Peter Glaser, with the silicon, photovoltaic cells can be made to capture Solar Energy, and this energy will be five times stronger than on the surface of the Earth as there is no air in space. To hold the photovoltaic cells together, titanium can be used for structure. Two years ago the Hubble Telescope used its ultraviolet sensing ability to look for titanium on the Moon. It found a huge deposit at Aristarchus Crater. Also two years ago, Managed Energy Inc. did a test in Hawaii, it sent a helicopter sixty miles out just above sea level with a microwave sensor aboard. It beamed microwaves to that location to see if it could receive the energy and at what intensity. The results were good; this test showed that microwaves could be received from space. The photovoltaic cell array would be called a Solar Power Satellite, a good location for it might be to place it in Geo- synchronous Orbit so that it stays above the same point above the Earth all the time and beams its low-cost, pollution-free energy to a receiving antenna array

placed near a city, able to receive energy from the Solar Power Satellite day or night, regardless of weather conditions.

As more and more Solar Power Satellites come into use, there would be less need for coal-burning electric generating stations, or nuclear power generating stations or hydroelectric dams. Thus we can use this low-cost electricity to heat our homes and businesses in the winter, to run air conditioners to cool our homes and businesses in the summer, and not worry about adding additional greenhouse gases to the Earth's atmosphere.

Low cost access to Space could be done with a vehicle such as XCOR Aerospace's Lynx that can take off and land at any airport suitable for jet powered aircraft. Powered by a rocket engine, presently it is being developed to carry the pilot and one passenger. Hopefully, larger vehicles will be designed and built to carry bigger payloads to and from Earth orbit.

It's too expensive to use material from the Earth, we'll need to go to the Moon for that. How to go? Maybe we could use Nautilus Modules made by Bigelow Aerospace, inflatable habitats made from many layers of Kevlar; they have had two successful space tests so far and could be used on the Lunar surface to house the miners that will collecting the titanium and silicon that we need. Attached to the Nautilus Modules could be a Magneto Plasma Rocket engine made by Ad Astra Rocket Company to transport payloads to and from the Moon. To protect passengers on the Moon Shuttle from cosmic rays, we could use a device made by Dr. Ruth Bamford that is being tested at the International Space Station presently. Eventually there will be enough Solar Power Satellites to meet our energy needs, by then we will have substantial infrastructure in Space and on the Moon to start building O'Neill Colonies. The environment of the Earth can be duplicated in Space Habitats, gravity can induced with rotation of these large cylinders, atmosphere is maintained inside, orientation to the Sun

will control temperature. All the present occupations will be needed and new vocations will be generated. Every country on Earth can build their own Space Colonies, the rich countries can help the poor countries, keep in mind there are a lot of poor people in the rich countries as well. This will make good jobs and nice homes for every Human Being born for many thousands of years, an end to poverty, with no more worries about earthquakes or hurricanes or tornadoes or floods or tsunami waves, we will be able to control the weather. We can start small, the first Colonies will be construction shacks, a crew will work for one or two months and then a new crew will come in to take a turn, the goal will be to build a larger construction shack so that a larger crew can stay working there longer and build the first Space Colonies to house say ten thousand people. The next one might house one hundred thousand people, after that an O'Neill Habitat for one million people, then, one for ten million people, the size of a large city. When we start building Space Colonies that will house one hundred million people, those colonies will be equivalent in land area to Brazil or India, there's lots of room to build in Space

At the start of the twentieth century, the world population was about two billion people; by the year 2000 it was a little over six billion people. Can we triple that again to 18 billion people by the year 2100? Estimates are that Spaceship Earth will reach full capacity in about 40 years around the year 2050, with about 10 billion people. And at that time, hundreds of millions of people will die from starvation and malnutrition every year. Manned Space Exploration is definitely worth the risk. We need to start now!

John Hadden

A member of the Moon Society

The Test

By Martha Adams

I won't get cold feet now. Looking out thru the port, I see two people in space suits out there. They'll fetch me back into the lifespace, if I fail. That is not an option. I've done my prep. I'm ready for this. Technically speaking. Now I hit the Big Red and the usual warnings happen. Of course the System knows what test I'm getting and who is getting it. The lock will open and Poof! I'm breathing space.

If you're going to space walk bare, you want your gut empty and then you degas on pure oxygen. When the space comes in, you don't hold your breath. I'll have maybe ten seconds to cross three meters of open space, enter the other airlock, and hit the Big Red there (it's a toggle). This is a test. OK on my training and the mockups practice. I'm fine. I don't feel ready for this. I key the mike. "Ready?" The reply comes, "Go for it, Laila!" So here goes.

Well, I did it. I'm sore but ok. This counts big toward my qualified adult status. Primitive societies have those coming-of-age tests I've read of. That's what I just did, and there's good reason for it. Out here you must know how to cope with a little space, seeing as it's always just outside the shell. So we get some of that into us and we see we don't die instantly. It's a learning experience us Belters all need and get.

Us kids in school talk a lot about growing up. Back on Terra, you just grew up. Not here! Growing up here, your first assignment is you make yourself grow up. Do you want a neighbor who can't cope? Who is too tender? Who can't fix or make the machines that keep our lifespace warm and alive? To show you're good enough is the only way to know you're good enough.

Back on old Terra, people didn't think about us bringing Darwin out here with us. It turned out, we did. We had to. If I'd failed this, I might have found myself classified 'Export.' Bad news, that. But now

I'm almost a grownup and I'm thinking about my Responders rating.

Us kids think lots about Responder qualification. No Responder is a nobody. The Responders are those of us who prepare for something to go wrong, to get out there and fix it. There are nearly a thousand people here now, a huge number of people, and more than half of us have made Responder. That's not too many, considering how close the real universe is to right here, and it's hostile. All fourteen billion light-years of it.

Well! Here's an email. It says Congrats, I passed my test. Ha. How would I not know that? This really means the System worked, my records are up to date, and I won't have to do this particular test again. So now I get a vacation, since breathing space does take a little out of you. For the rest of this day I can do something fun. The Daisy Tree comes in soon and I'm going to watch her touchdown.

The Daisy Tree is an old freighter with a long story. She was originally built in Terra orbit from parts made on Terra and carried out to orbit. (Out of that deep gravity well --expensive!) She's a lander, not a deepspacer. She carried freight from Terra orbit out to Harriman Base on Luna. Then people began to move here to the Belt where the good stuff is, and the Daisy Tree followed.

She doesn't go back down toward Sol now. She's here to stay, and our industrial base is making more Daisy Tree ships. For commerce around the Belt. Everything anyone has, someone makes. Our air and water and lifespaces, particularly. We recycle everything, including us; but no single settlement can make everything anyone needs. So we have several settlements with the Daisy Tree and other freighters.

People getting here was engineering science, but living here is economics. Business economics! Which around here, stands next to air, water, and food because that's how those things happen. Later on tonight, I want to review my economics. Like everyone does, because here in the Belt, economics is what life is.

Watching a ship touch down here is interesting, even in this low gravity. Lots of mass, little weight, low velocity. So then I'll go over to the drome and do my daily heavy time, and watch the sparrows there. Sparrows are fun and we have got them thru a few generations so we think they can live out here in space. But I think they'll need a few more generations yet to figure out the drome's centrifugal gravity.

Oh, here's the news. The astronomy people are studying blue gem exoplanets, so they built a big synthetic telescope. It's basically several large orbiting interferometers. You can do this out here, they keep station in orbit because there's not a lot of g around. They timeshare from System. This works fine except when Jupiter comes by. Now they are doing exoplanet atmosphere and weather studies.

And the cosmology researchers who are thinking about how the universe is made, have got together with some engineers and they are playing with an ftl drive. That's very interesting. The challenge is to get out there and then return usefully near to where -- and when -- you started. Einstein says you can't do that. He was right about a lot of things but he didn't have the real universe just outside his door to stir up his thinking. No place like here to think about getting farther out yet.

Biographical note. Laila Stoney, age 14 at this writing, currently resides on Leskish, an asteroid which orbits between Mars and Jupiter at a mean distance of 3.3 au from Sol.

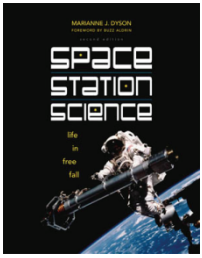
Martha Adams

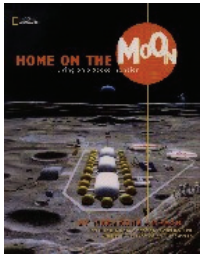
A member of the Moon Society

Many thanks to our panel of judges. It was hard to select just three so we spread the wealth and awarded some extra prizes. Special thanks goes out to Marianne Dyson. She led the effort and did a marvelous job!

Below is a photo of Marianne and Fred Haise taken at NASA JSC Apollo 13 40th anniversary party. (04/06/10). Yes folks, it was held on the moon! Wish *you* were there? I do!

Photo Courtesy of Marianne Dyson and
Writers Cramp Publishing





http://www.mariannedyson.com

Submissions Guidelines

Moonbeams preferred genre is Science Fiction as it relates to colonizing space and the moon but we will accept other genre including nonfiction. You do ***not*** have to be a Moon Society member to submit.

Moonbeams is about two things: authors getting their work published, and making the case for space colonization

Successful submissions must stick to accepted physics: no faster than light warp drives, no worm holes, no time travel, no transporters a la Star Trek and no alien monsters. No magic, no fantasy. Last but not least, no social, political, or religious diatribes. Send us a plausible story about the colonization of space and the moon and we will publish it. But don't stop there. The subtitle "Tales from the High Frontier" indicates that stories can be set anywhere in the Solar System. Nonfiction submissions on science and technology must be thoroughly referenced.

Everyone is welcome to submit pieces up to 10,000 words. We have a micro-story category, Letters Home, with a glass ceiling of about a 1000 words. We also welcome comments and/or reviews of prior Moonbeams stories.

We currently do not accept paid advertising in Moonbeams and thus, we produce no revenue stream. Therefore, authors cannot be compensated and will retain full rights for republication elsewhere.

Submissions should be in electronic form. MS Word 2007 is preferred but we will accept text files or other common word processor formats. All submissions that need to be keyed in will not be considered unless prior arrangements have been made. The preferred method of submissions is via email with the subject set to Moonbeams Submission. We will accept mailed cd/dvd at the following address:

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Exchanging links is ok if your link is clearly space related. Moonbeams reserve the right to say no to any submission.

These guidelines are subject to review and will be adjusted as we go. Moonbeams is YOUR magazine. Let's have some fun with it, shall we?

The Editor