"Towards an Earth-Moon Economy – Developing Off-Planet Resources"

Moon Miners' Manifesto

www.MMM-MoonMinersManifesto.com

MMM Classic Themes — Select Editorials

Why Editorials? Why some, not all?

In compiling the MMM Classics volumes, with precious few exceptions, editorials were not included. Why? Yes, some addressed temporary conditions, and are of no lasting interest. But indeed, many MMM editorials through the years have addressed concerns that remain pertinent today, if indeed they are not timeless. So we have taken another look and here reprint those "In Focus" editorials that, we think, speak to conditions and issues still very relevant today.

These pieces represent the editor's opinions alone, and have never been presented as the opinions or policies of the Lunar Reclamation Society, the National Space Society, the Artemis Society, or the Moon Society. There are none for the first year, as we didn't start writing editorials until MMM #11.

The Topics:

The relation between the Moon and Mars in Manned Space Exploration Policy is clearly the number one issue addressed. What we mean by "space" differs widely among "space proponents." This is a critical issue. Space is more than the boundary layer of Earth, a place for space stations and satellites. This is a realm already part of Earth's "econosphere" and will take care of itself. It is the endless frontier, beyond that needs our attention.

The endless hiatus between Apollo 17 and what we all want to come next is a key topic. There is much we can do to make the next human lunar opening a stronger and more lasting one.

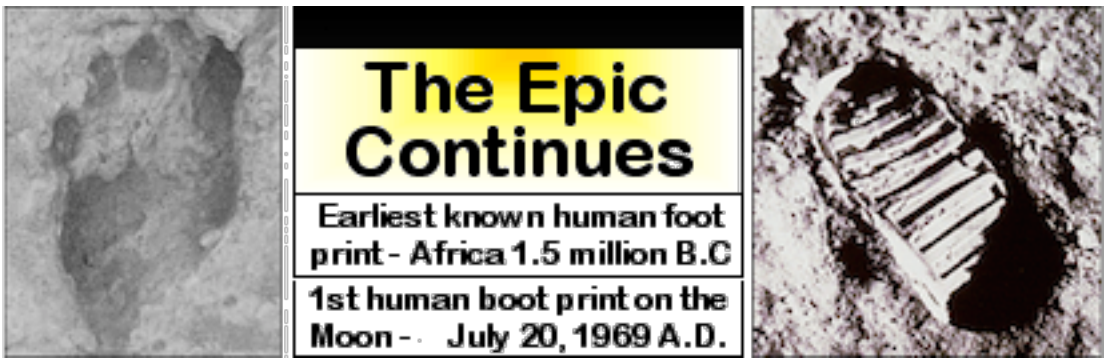
Asteroids, promise and threat, are looked at and put in perspective with a nearer term threat: space debris, which could end up confining humans forever on our home world.

Lunar Frontier Life will be both much more difficult and more rewarding both at the same time than many Science-Fiction-bred enthusiasts imagine.

The Shuttle is both a remarkable piece of engineering and a chimera designed by committee to be everything but what it was supposed to be, designed for clearly misunderstood goals.

Biosphere and environmental research, space tourism, the incentive of prize money, the search for "life" and other topics are addressed.

But at the top is the mistaken belief that anything rational can possibly come from the political process. **PK**



From "Out of Africa" to InterContinental to InterPlanetary to InterSolar

NOTE: The opinions expressed in these essays and editorials are those of the writer, and should not be construed as views or policies of the Milwaukee Lunar Reclamation Society (the publisher), of the National Space Society, or of any of its participating chapters, or of the Moon Society. They are meant to be food for thought and to encourage discussion, in the hopes of encouraging more well-thought out decisions and policies. **PK**

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MMM #11 - December 1987

Space Oases and Lunar Culture

Even well-meaning admirers have cast **Moon Miners' Manifesto** as a "special interest" newsletter. As editor, I must take responsibility for this common misappraisal. I had stated that we wanted to explore the heights to which a self-sufficient lunar civilization could rise, given the constraint that it must seek to develop, as far as possible, relying solely on lunar ores that are poor in hydrogen, carbon, and nitrogen. The **Manifesto** has gotten good marks for this effort in its first year of publication. But for many whose dream is living on an O'Neill-type space colony or settlement or oasis, these discus-sions have perhaps seemed irrelevant.

This shows our failure to realize that what may be perfectly obvious to us, doesn't necessarily suggest itself to others: namely, that, in the early decades, the availability of volatile-rich ores from asteroids and other sources cheaper to access than upports from Earth, will be at best sporadic. As a result, pioneers in free space oases will find themselves in much the same straights as hardy lunar settlers. Unless they are fantastically prosperous (pluck your brains our of free fall) and can afford heavy dependence on Earth-sourced materials, they too must build their cultures largely on the possibilities inherent in volatile poor-lunar ores. Lunar-type cultures will be the rule!

Thus, in the early decades, space colonists too will be forced to give up a way of life based on the casual use of paper, wood, plastics, and the whole host of addictive synthetics based on hydrogen, carbon, and nitrogen. This will color their whole way of life with its implications for building products, household furnishings, and other domestic wares, clothing, information media, sporting goods, toys, arts and crafts, etc. If you are truly interested in pioneering free space as opposed to surface environments that come with constraints, you will find enlightening ideas on what such frontier life will be like in the pages of MMM.

We belatedly invite you aboard our Mainline Express to a thousand space futures. To catch up, as we have already left the depot, read MMM Classics #1 covering the first year of articles, available in PDF format from

http://www.moonsociety.org/publications/mmm_classics/

Note: In this issue, #11, we begin a series of articles on Space Oases, more commonly known as "Space Settlements," "taking a second look," that continues through issues #s 12 and 13. See the MMM Classic volume #1 to read these. **PK**

MMM #12 - February 1988

A Pro-Breakeven Policy

[**BREAKEVEN**: the point at which the space pioneer returns as much value to the Greater Earth Economy (GEE) as he/she demands from it.]

The more remote "breakeven" is perceived to be, the less likely it will be that steps necessary to bring it about are taken. "Break-even" can be brought closer by reducing the amount of resupply needed to maintain each man-hour on the Moon or in free space by any and all means possible. An aggressive Pro-Breakeven Policy (PBP) demands pre-development of the technologies settlers will need, to provide for as large a portion of their material needs as possible out of naked lunar soil. Moon Miners' Manifesto can serve no more important function than to stimulate such activities as will hasten that day.

Already mentioned ["Bootstrap Rockets" in MMM #4, p. 6] is perhaps the single most important project for a Pro-Breakeven Policy – development of a rocket engine to burn liquid lunar oxygen with powdered lunar aluminum, so that the cost of Earth to Moon imports (including personnel) is essentially reduced to the Earth to LEO cost, instead of some ten times higher. This is a sine qua non technology. If it remains science fiction, then so does everything else.

Next in importance, and calling for guts the government, and the public, is unlikely to find, is an early decision to bypass the astronaut corps at the start of the lunar return project, in favor of personnel willing to go to the Moon to stay and not look back to Earth and Clear Lake City. Sorry, but astronauts do not have the right stuff! For every 150 lbs of replacement person sent to the Moon "base," 150 lbs of hydrogen (enough to make 1350 lbs of water with lunar oxygen) could have been sent instead to boost settler reserves, or 150 lbs of other needed supplies. Sending people "one way" to the Moon will require commitment and determination. This will horrify timid politicians as well as most noted space writers. The Lunar Initiative must be run not by those who intend to remain on Earth, but by settlers-to-be and their supporters.

When supplies and equipment must be sent to the Moon, the path of least resistance will thoughtlessly follow a "coals to Newcastle" policy: needless importation or co-importation (one-way containers) of items made of elements already abundant on the Moon, e.g. iron/steel, aluminum, and materials with a high oxygen content. Alternatives, admittedly more costly to fabricate on Earth, but enormously more welcome on the Moon, would be containers made of copper, tin, brass, duralumin (a 35% copper aluminum alloy), polypropylene and other "reusable" plastics, etc.

To maintain morale, hobby activity must be allowed for, and hre two birds can be killed by one stone by providing equipment for the "settlers" – lets not be afraid of the word – to use to make homewares from lunar glass and ceramics, for example. Not only will this spare time activity be contributing to "Breakeven," it will be a great boost to the settlement spirits.

The most difficult thing will be the first step, getting space supporters themselves to adopt the Pro-Breakeven Policy by shattering their own misplaced confidence in NASA expertise, and underlying, unexamined, self-defeating policies. The boat needs rocking! Let's get to it! **PK**

MMM #13 - March 1988

Importance of the Long View

Many people in the space movement are impatient with those of us who look too far ahead, and who casually leapfrog the hard-to-win step-by-step advances that must be made before consideration of further projects can become practical. Thus we are counseled to put aside talk of what may or may not be possible decades down the road. The only thing to do now, say some, is to push the Space

Station, a heavy lift booster and an orbital transfer vehicle. Once we have these, then we can turn our attention to the next steps.

We all know that these three items above are prerequisites for the Moon Space Settlements, Solar Power Satellites, and Mars. But the problem is that not just any sort of Space Station will do, nor just any kind of heavy lift booster, nor just any kind of orbital transfer vehicle. Without our sights clearly on the longer-range goals that will require very definite standards, specifications, and capabilities, what we build in absence of foresight may be useless.

We seem hell-bent to do just this with the proposed NASA US/Allied Space Station. The results from a recent poll of **Space World** [at this time serving as the Magazine of the National Space Society] readers listed the most important functions of a Space Station to be, in this order:

(1) Facilitate flights to Moon and Mars

(2) Build and service space platforms

(3) Research in Life Sciences

(4) Materials Processing

In contrast, the NASA planned facility would concentrate exclusively on #4. A skimpy 32 cu ft space (one and a half refrigerators) is to be dedicated to life sciences, and the other capacities won't be configured at all.

Yet phone tree alerts continue to advocate blind support of the NASA design on the grounds that "it is better than nothing." [The next 20 years of "nothing" will show that to have been unacceptably bad advice.]

But not only is it important to look at ensuing goals such as the establishment of a permanent manned lunar base Antarctic style, it is also necessary to look well beyond such a science-only beach-head toward what kind of human presence on the Moon we want eventually. Otherwise, the initial base will be poorly designed to serve as a springboard to genuine settlement with prospering mining and manufacturing facilities to support Man's continued thrust into the Solar System at large. Most NASA/industry lunar base designs are myopic in this way. They take themselves as the end of the road and lead nowhere.

Finally, it is important to look to the ultimate goal of opening space to human out-migration and to demonstrate not only the feasibility of such settlements, but also, and above all, their livability if we hope to get the general pubic behind this goal. Those who think that we can enthuse the populace with plans for an Antarctic-style caricature of human presence beyond Earth, lead all of us astray. Such a goal becomes the end-of-the-road and leads nowhere.

It is interesting to note that in the above-mentioned Space World poll, 67% of the responding National Space Society members believe that the main thrust of the Space Program should be to develop an Earth-Moon economy. Just 23% picked exploration of Mars and other destinations, while only 14% would be satisfied with commercialization of low-Earth orbits. Only 4% identified strongly with the "broad, incremental" approach that has been the Reagan Administration hallmark. We should all take notice! **PK**

MMM #14 - April 1988

Opening the Space Frontier: The Goal of Our Society

Many people are "pro-space" in the sense that they want to see this country have a "strong" space program. That does not mean that they are for (or against) an open space frontier. This country could pull out all stops on a program of thorough robotic exploration of the solar system, even launch a Return to the Moon with a permanent Antarctic-style Moon Base, and join an internationally crewed Mission to Mars.

None of this would open the space frontier to you or me, or to our children!

The frontier could remain closed except to astronauts, scientists, payload specialists, technicians, and/or soldiers. Examine your dreams! Antarctica, to give the common ill-chosen example, is a

closed frontier. That is not what excites us, gives depth to our dreams, and moves us to action. WE, you and I, we want a future in which WE can have a part!

When the old L5 Society and the old National Space Institute agreed to merge – (this became official at the Pittsburgh ISDC on March 27, 1987) a declaration of purpose was signed by the Presidents of both parent organizations, which declared the goal of the new National Space Society to be

The Establishment of Human Settlements Beyond Earth

"Human Settlements"- not just garrisons, mind you, be they military or scientific: Jim Muncy, who authored the text of this declaration, testifies in a recent letter that this "purpose" is openly scoffed at by many members of the NSS Board of Directors who called it "outlandish" – precisely!

[Note: Over the next several years, leaders and members of the former L5 Society would succeed in gaining clear control over the National Space Society, supplanting those without this vision.

The rest of this editorial is not reprinted here as it deals with NSS internal politics of the time. NSS has gotten well-beyond the stances taken in these early days, and has been at the forefront of the effort to get the public and our politicians to look beyond whatever half-measures count as progress, even though they lead nowhere, to become an organization that is spearheading the drive to open space to mankind in general, and we are proud to be a part of that team, and are proud of the role that MMM has played in articulating our vision.]

MMM #15 – May 1988

Without Strategic New Projects, We Must Fail!

[The following is a rewrite of the original, in an effort to extract the timeless message from the organizational political polemics of the time, which are irrelevant.]

Since the dawn of space activism in this country with such pioneering groups as the L5 Society and the National Space Institute, enthusiasts have been impatient with the pervasive apathy of the public, the media, and of Congress and the bureaucracy. To counter this indifference, we have brainstormed ways to create a groundswell of support for our vision of how things should be. The going has been rough. Hamstringing our approach are two fallacious assumptions that stand or fall together.

(a) Only the government – through NASA and its client contractors – can put into place each and every element needed to establish an open space frontier.

(b) Society members, you and I, are only good for writing letters, making phone calls, and gadfly work in general, and as yet more ciphers in a hopefully growing list of supporters – a list to wave in the face of stubborn politicians with other priorities

Limiting the project-track of NSS and of its members to browbeating Congresspeople and increasing public awareness and support, as important as these things may be, by them-selves and without reinforcement, will not win us the prize we seek.

Business as usual means resting content that NASA will do all the needed research. Our role is to then ballyhoo the "Teflon hoopla" of "spin-offs," a tactic which is only good for diminishing opposition. "Spin-offs." Which can come from any cutting edge technology program, will never win true converts. Mean-while, the spin-off regime leads our economy into ever-greater dependence on a space economy not headed in the right direction. The result is that "Space" becomes more expensive than it has to be, because "spin-offs" get charged to the space budget and not to the spin-off using consumer.

[In the next issue, MMM #16, we explain how the opposite paradigm, "spin-up" could be used to predevelop a glass-glass composites industry that could serve as a close analog of a technology most useful on the Moon, with all the R&D being done for here & now terrestrial profits, with the investment being paid for by "consumers" as opposed to "taxpayers." This paper is online at:
http://www.lunar-reclamation.org/papers/glass-composites-paper.htm]

(1) Our Society can first of all push **the feasibility of self-supporting settlement beyond Earth relying on non-terrestrial resources.**

(2) Then we can work to **lay the foundations for using such resources by pushing the opposite consumer-paid "spin-up" techno-logy development pathway.** The result would be that

needed technologies could be put "on the shelf" earlier, with little/no expense to the space program.

NASA, by confining itself to R&D of hardware and systems needed for short and intermediate range goals, both out of budget necessity, and in deference to Congressional short-sightedness, gives us the opportunity.

Of course, not all NSS members would have the talents and background to undertake such work. But those that do should be encouraged to do so. And in general, entrepreneurial work that helps advance these goals should receive much more attention from the Society.

We can also encourage such entrepreneurial activism in the public at large. This can only help people understand that we all have a stake in this vision of the future.

A second project track our Society would do well to push is **to develop and host an information exchange service** for an exchange of ideas by members and others on possible terrestrial benefits of technologies that will be needed to truly open the space frontier. Then, entrepreneurs could step in to try to find economical pathways to advance such technologies for their own profits, here and now. This is a way to put the economy at large at work predeveloping the future space frontier.

[Over the next ten years, this concept would be developed by the editor into the "**University of Luna**" proposal. With the help of David Dunlop, Moon Society Director of Project Development, we tried to get such a virtual institution started, but it proved to be too much of an undertaking – for the time being.] **PK**

MMM #16 – June 1988

Frontiers Have Rough Edges

A major theme running through many of the articles in the Manifesto has been this dual one:

- √ Settlers can become largely self-sufficient on a volatile-poor world like the Moon and in free-space oases initially dependent on lunar-sourced goods and raw materials.
- √ This effort will involve widespread substitutions (and "doing without" when substitutes can't be found) that will take some getting used to, as the pioneers wean themselves from an Earth-learned addiction to sophisticated organic materials so easily produced on the home-word only to be casually used, often just once, sometimes not at all, then just as casually thrown away.

The transplantation of human society from Solar Planet 3A, Earth, to Planet 3B, the Moon, will involve definite sacrifices for the early trailblazers.

There seem to many who, misguided by ill-thought out science-fiction scenarios, look forward to life on the space frontier in the expectation that there they will find the latest, the most advanced, the most sophisticated possible technological cultures. Such persons would best be jolted out of such illusions and advised to stay home, on Earth. For to tell the truth, for some decades following the opening of out-settlement, it will be on Earth that the highest, most advanced, most sophisticated material civilization will exist, at least in the more fortunate areas. In contrast, off-Earth homestead scenes may seem insultingly drab, tedious, harsh.

Even so, 17th and 18th century Europeans who wanted the material best and most genteel that life had to offer remained in Europe. Even so, 19th century Eastern State Americans who wanted as comfortable and as materially gratifying a life as possible, remained in Boston, Philadelphia, Charleston. The frontier is for those for whom other things are far more important than creature comforts and sophistication.

Life in the new "outer Siberias" will be simpler, yes simpler, even if forever dependent on high technology. And it will also be a more authentic and honest life, with more attention given to things that count. There will be religiously rigorous recycling and careful accounting for everything.

The premium on craft, creativity, and ingenuity will be high; and the opportunity to indulge in consumerist shopping binges all but non-existent. There will be glory for both teamwork and for individual contributions, but precious little room for unproductive self-involvement.

Despite the dependence on high technology, there will be a new partnership with nature in ark-sized biospheres, a heightened sensitivity to our symbiosis with plant and animal life, a realization that man and living nature thrive together or perish together.

Such prospects ought to appeal to many environment- and ecology-sensitive persons in the Mother Earth movement, types that many of us space advocates customarily dismiss as not worth courting, on the grounds that these crusaders often seem to want to throw out the technology-baby with its bathwater.

But this is a constituency that can enrich us and provide us with strength in alliance that we may never realize if we disdainfully choose to go it alone. If we love our cause, well set our egos aside and patiently woo these also concerned and ener-getic individuals. Lets go together, those of us with com-plementary right stuff! The rough edges of this frontier are a rasp for personal and cultural baggage best left behind. **PK**

"Single Planet Species don't last.
Multi-World Species 'live long and prosper.'" - John Young

MMM #17 - July 1988

NSS and Chapter Polycentrism

For some strange reason, some people have a driving need to impoverish the universe by insist-ing that everyone agree on some anemic unified approach, "so as all to pull in the same direction." But the only thing available down this road is the "least common denominator," something cherished by stingy minds.

But if we truly want to build a rich, full, and diversified space-faring future, the best approach is to allow individual and local talents, interests, and energies to work them-selves out. This strategy will bring to light a whole wealth of things that could never be begotten by any unified (socialistic) plan, which puts all its eggs in one fragile basket.

Many people fear diversity, insisting that it can lead only to conflict and mutual destruction. But **wisely nurtured diversity cross-fertilizes and leads to the highest united multiple** which beats the diaper-load out of the lowest common denominator approach any day. The leader, who would have everyone march in lockstep, leads (empowers) no one. Such leaders, bewildered by the confusing diver-sity of talents and energies of those "to be lead," would waste them. That is not what leadership means.

Our Society is not a corporation or a military unit. It is a collaboration of many individuals with differing talents, skills, and insights – things to be enabled, not stifled. Chapters cannot be "ordered" to do this or that. They are free associations in their own right. Order them to do something that is not in keeping with their interests and abilities, and you just succeed in getting them to "take their football and go home."

Chapters can undertake projects that the Society at large cannot. However the Society can bless these projects and assist and promote networking between chapters and individuals with things in common. By enabling, match-making, and cross-fertilizing chapter projects, the overall productivity of the Society is greatly enhanced. That there is such diversity is not a sign of disorder and lack of leader-ship, but a sign of great depth and richness and potential productivity. Homogeneity is the stuff of small minds.

The National Space Society can only thrive on such polycentrism. As chapters and as individuals, we must seize the initiatives that our talents and energies illuminate. The Society should encourage, foster, and facilitate such cross-fertilizing diversity. Discord enters only when one person tries to re-duce someone else's vistas to one's own underfed worldview. We must not fear diversity but welcome it. It is our ticket! **PK**

MMM #19 - October 1988

Seizing the Reins of the Mars Bandwagon

To succeed at anything is **to create some thing that others can build upon**. There can be no other criterion of achievement that is not self-delusory. By deliberately choosing being first in a race as the measure of success, and spurning the Von Braun blueprint (a LEO Space Station for the assembly of reusable lunar ferries) in favor of a lunar-orbit-and-rendezvous mission profile, the Apollo strategists explicitly chose to fail by the only standard that would eventually matter. They were politically conditioned to prefer the ephemeral gratification of a temporary center stage. The opportunity to construct a transportation infrastructure that could serve **continued ands sustained lunar exploration and base maintenance** was expediently shelved.

Many Mars zealots would have us repeat this mistake. On the other hand, there are those in our Society who would have us concentrate on infrastructure alone, shutting their eyes to the absolute certainty that without a declared goal, this infrastructure [read the NASA Space Station "Freedom"] will be mis-designed, mis-built, and inappropriate as a stepping stone to anywhere.

It is common to portray NSS as the Moon Party and the Planetary Society as the Mars Party. We accept and encourage such a distinction at our peril. People on both sides of the Moon-Mars debate do the future of humankind in space a serious disservice by escalating this impatient, misbegotten polarization. What we sorely need is a Moon-Mars consensus.

Those who believe we can build an autonomous space-faring civilization based on volatile-poor lunar resources alone are surely living in the Land of Oz. And those who think that this lunar resource shortfall can be made up by Earth-approaching asteroids (which, owing to infrequent windows can hardly be more than sporadic targets of opportunity in the near term) ignore the laws of orbital mechanics. Without the additional regularly accessible resources of Mars" moonlets, Phobos and Deimos, an Earth-Moon economy will be doomed to inevitable collapse, however valiant and brilliant an effort is made to make a go of it - a futile exercise.

Imagine an alternative solar system in which neither "Earth" nor "Mars" have natural satellites (much as Venus and Mercury do not) and in which there are no asteroids. Then try to construct a scenario by which a system-ranging civilization might arise despite such handicaps. Hard, isn't it? Yes, we are blessed - by chance or by design is not to the point! But to blueprint a spacefaring society while petulantly (yes, that is the word) ignoring those assets handed us on a silver platter is patently stupid.

The Moon needs "Mars PhD." Mars needs Phobos, Deimos, and the Moon. This interdependence and complementarity will be the keystone of our future. Without this axis, we cannot economically fill cislunar space with space colonies and solar power satellites. Without this backbone, we cannot realistically develop asteroidal and cometary resources. Without this anchoring, we cannot access the wealth of the outer Solar System.

Those of us who want to postpone a "choice" between the Moon and Mars PhD are just as off track as those of us who what to rush such a choice.

The truth is we will either have both Moon and Mars, or we will have neither.

The one pragmatic strategy which alone promises us this Moon-Mars synergism is to court the considerable ranks of Mars advocates and convince them that what they really want is not just a quickie release of pent-up curiosity in a one-shot exploratory picnic, but a sustained opening of Mars leading to permanent human presence there, to development and self-continuing settlement. Instead of dismissing the chances for such a realization, we ought to be at the front, brainstorming the options.

Once Mars hopefuls are converted to the goal of making Mars a second homeworld for humanity, Lunar settlement and economic development will be assured, since it is the only way such an opening to Mars can be sustained in the face of certain and inevitable political and media disenchantment.

A Mars program worth pursuing includes the Moon and the Moon's needs. It enlists government financing of the infrastructure and technologies needed to open the Moon: deep space vehicles, closed loop life support systems, pocket-sized hospitals etc. And then it leaves the way open to private enterprise and multinational consortia to take it from there.

On the other hand, if the government is not occupied with Mars, i.e. if it is not benignly neglectful of the Moon, then no doubt the Moon will see activity, but as a closed frontier of a handful of gov-

ernment run Antarctic-style science stations. Unfortunately, there are many of us whose sights have been so lowered that they would be content with so token a presence.

The Moon is the first and most important (in terms of potential trade tonnage) part of the formula for an open space frontier. But it does not supply the whole underpinning. It is best that the attention of our government(s) be focus on the most all-encompassing, inclusive space vision and that is the opening of Mars to permanent presence and not mere exploration as the criterion of success. Then we'll have it all: an open frontier that will eventually include the whole solar system as the rightful range of our species. It is time for all space enthusiasts to awaken to these facts and to seize the reins of the Mars Bandwagon, leading it where the Planetary Society is far too timid and visionless to venture. The challenge is great and it is upon us now. If we avoid it, we fail. **PK**

MMM #20 - November 1988

Wooing the Astronomical Community

Most of us know one or more amateur astronomer friends who are oddly aloof to the cause of the space frontier, if not quite hostile. For those of us who come to the space movement out of a prior interest in astronomy, myself included, this seems puzzling indeed.

To us, studying the stars and wanting to go out there are one and the same.

But there are reasons for the uneasiness some of these fellow spirits show around us, and with a little self-examination, they are not hard to find. Above all, we are identified with the manned space program, which since it has been forced by bureaucratic mischief to drink at the same budgetary trough as unquestionably deserving planetary exploration probes, is cast as the rival, instead of the natural ally that common sense indicates it should be. Now while most of us are very much interested in, and enthusiastic about, planetary exploration probes, **we have been guilty of not working hard enough to isolate the planetary exploration part of the budget.**

As a society, NSS has been complicit by negligence. Yes, we have endorsed the National Commission on Space Report and the Sally Ride Report, but this does not address the problem. Perhaps we've been too busy fighting the effects of the NASA budget being paired with that of HUD. In both cases, we've made a lot of noise about symptoms and not made nearly enough nuisance of ourselves concerning the root cause. The National Space Society needs to speak out in its policy positions, both in favor of a more ambitious planetary exploration program, and above all in favor of its budgetary independence. Even the choice of missions should be made apolitically; perhaps, for example, by the National Science Foundation in consultation with planetary scientists, and not be forced into some demeaning swimsuit beauty contest before jaded congressionals. We've been letting others trap us into the zero sum game.

But secondly, and even more importantly to some, we are identified with a plot to destroy forever the beauty of the night sky (at least, far from city lights) by planning a permanent orbital necklace of solar power satellites, each far outshining Venus, and perhaps relegating the Milky Way to a racial memory. **The fault here too lies in negligence, this time on the part of the former L5 Society and of Space Studies Institute.**

Recently, the solar power satellite concept has had a thorough overhaul by Space Research Associates in Seattle, working under an SSI grant, to identify ways in which the lunar-sourced content of such structures could be maximized. This study was quite successful and defined an SPS that was 99% lunar-sourced (v. 90%) at only an 8% penalty in mass. **This encouraging reworking of the flagship concept of space development needs an encore.**

For the task now at hand, is once again to rework the entire SPS design concept, this time in an effort to define design and construction alternatives that will minimize the visual intrusion of an SPS unit in Earth's night sky. We call for a design goal of a reduction in apparent visual magnitude (without reduction or power rating) of at least 5, that is a hundredfold dimming. Impossible? No when can say that until we have tried all options. If we go to parabolic collectors for solar turbines, rather than stick with photovoltaic concepts, and if we look for other places where albedo changes can be made, such a drastic goal might be approached, and, who knows, surpassed.

If we love the stars, we should spare no effort to preserve our ancestral right to see them.

Which brings us to a point well-taken by Diane Fearne-Desrossiers of Lansing L5 (MI): “How can we expect city-dwellers to be interested in space, when we can no longer see the stars within the city? We ought to join ranks with those in the astronomical community fighting sky pollution from unnecessary use of unshielded and high pressure sodium vapor city lighting.” We second the motion. If those in San Diego and Tucson who have fought the good fight and won, would be so kind as to give the rest of us a primer (background knowledge so that we know what we are talking about, and campaign methods) we would be on our way to restoring dark skies and the lure of the stars to all our land.

Finally, we call n NSS to augment our policy position in support of a permanent manned Moonbase by coupling to it, support of a farside radio and optical astronomy facility. Optical? Yes! From the prime sites in Aitken and Mare Ingenii/Thomson, the Magellenic Clouds, the nearest galaxies to our own, are always above the horizon, ideal for a dedicated observatory.) Some will caution us to secure one site at a time! But it is a mistake to seek any goal without the guidelines demanded by the next step clearly in sight. This coupling can only serve to make the case for a Moon base stronger, not weaker. This second lunar outpost, possibly assisted by the first, would do much to burst open the lunar frontier.

Yes, there are those who would seek an unmanned farside astronomy facility, and ban human presence on the Moon altogether. But the penalty for this thinly disguised contempt for civilization is a far more limited installation than one human-supported and staffed. PK

MMM #21 - December 1988

Space Debris: Our Silence Betrays Us

Articles in recent issues of several space interest magazines have called our attention to the growing problem of space debris. It is a sad commentary on the depth of our concern, that in each case the writer begins with an alarmist headline only to end up telling us not to worry, to go back to sleeping on the job - for that is what we have all been doing.

NORAD is currently able to keep track of over 7,000 tidbits of orbiting flotsam, and it is estimated that there are hundreds of thou-sands of fragments up there below the thresh-hold of detection but large enough to do significant damage “when and if.” But what’s the big deal? Between 100 and 600 miles up, to pick a range handy for a back-of-envelope calculation, there are over 100 billion cubic miles of space.

The point is that almost all of this debris could have been avoided. It is the result of carefree and slovenly housekeeping. Quite like our alleged primate progenitors who to this day cannot be housebroken, mankind, in chip-off-the-old-block fashion, apparently cannot be “planet-broken. We insist on fouling our own nest; in space it has been business as usual.

Many of us in the space movement, also consider ourselves environmentalists. But we have gung-ho fellow travelers for whom space development and environmentalism seem to be antithetical. Unless we can change the minds of such, we will eventually undercut all our efforts to open wide the space frontier.

Whoa! Let’s not rock the boat! Our job is to gather support for NASA and not question how it does things. Oh? The truest fiend is one who is not afraid to offer constructive criticism. Fear of antagonizing those we hold in awe is immature. We pride ourselves in being people of the future: foresight is supposed to be our business. Unless our advo-cacy is to be a joke, NSS must be watchdog as well as friend.

Just what is at stake? Most of us perceive our number one priority to be bringing down dramatically the high cost of access to space. Continuing to be silent about space debris, which can make those high cost soar even higher, is counterproductive. We are equally concerned about the relatively closed status of the space frontier. It is a prime directive of our shared NSS vision to open the space frontier to general civilian activity. But looking the other way while hazards are needlessly increased to the point where insurability may become impossible and access to space becomes akin to combat duty, gives the lied= to our earnestness.

The offending space flak is generated in several ways; jettisoning of final booster stages, of farings and other no longer needed paraphernalia; use of explosive bolts; rare but increasing collisions;

deliberate explosions, detonations, and impacts. A workshop might come up with ways to reduce such practices, or better yet, avoid them altogether by better design.

Our RVs on Earth have holding tanks. Should not our spacecraft also? As vast s it is, LEO-space is no more a bottomless sink than are Earth's oceans. Farings could be kept, moved aside, to be extended outrigger style in a deadman's device to increase drag and hasten deorbiting of derelict satellites. Perhaps that is a naïve idea, but if it spurs a better one, the suggestion serves a purpose.

Maybe it is time for a World Space Authority to heavily tax improperly designed boosters, satellites, and other traffic to orbit. Mission profiles must be looked at. Debris impact statements should be required for a permit to launch. There could be incentives for salvage, but realistically, most of the mess already generated cannot be cleaned up. Rather our attention must be on ways to avoid worsening the situation. Yes, it's a lot of unwelcome hassle. But in the end, we'll be glad we faced up to the challenge.

The problem is not going to go away, and w in the National Space Society owe it to our own dreams to come to grips wit it even at the risk of becoming unpopular. **PK**

MMM #23 - March 1989

Of Milestones and Goals

Milestones and goals are two very different things. We equate them or reduce one to the other at our peril. Landing men on the Moon and returning them safely to Earth was a milestone. Milestone's don't have to make sense by themselves, but must be judged by how well they advance a goal. If all we hold before ourselves are milestones, one after the other, it becomes all too easy to call a halt, to take a forever-rest, to question the sense of it all. In the space movement, we have never lacked for milestones, only for goals.

After the failure of Apollo to generate its own-follow-up (as milestones adrift from goals cannot do) many counseled, and still counsel an **incremental build-up of the lacking infrastructure.** And so we are now in pursuit of a second-guessed series of milestones: the shuttle, the space station, the man-rated orbital maneuvering vehicle, etc. There is no argument about the need of each of these, but only about how well each can actually serve to further a silent goal unshared with the nation a a whole when we allow each to be designed without reference to that goal.

The movement today is to invest the next milestone in the series, a permanently manned Moon Base, with the aura and dedication deserving of a goal. We set for ourselves a trap. We must stop playing the incrementalist game. Incrementalists are in control at the moment, in our own Society and elsewhere. It's time to strip this philosophy of its stolen garments and to expose the empty nakedness underneath.

A Moon Base, to be sure, would be an exciting development. It certainly involves a more substantial 'presence' in space than we have today. But defined as such, it is not likely to go beyond the stillborn limits of the model that some – all too many – hold up for emulation: that of the Antarctic base. The reasoning given in this self-delusion is that such a base would be a foot in the door and that the rest will follow in time. Apollo was a foot in the door, and nothing followed. A strictly sterile result would be inevitable if this nation were to adopt "a" "Moon Base" as its goal.

It is necessary to point out that after all the decades we have spent in Antarctica, a continent that holds the bulk of the world's fresh water locked in its ice cap, we still import all our water from New Zealand. We have learned to survive in Antarctica but we have not even tried to "live off the land" **on its own terms, in a self-reliant way.** Our goals in Antarctica have been pure detached science. On the Moon, despite hopes for more, budgetary restraints would confine a Moon Base to the same set of dead end purposes. Plans for pressing lunar resources into service, even to partially defray costs, would be an easy target for budget cutters.

We would do better to ban the phrase Moon Base from our vocabulary. What we really need is a **"Lunar Resource Station" whose principal function is to demonstrate the feasibility of self-expansion using lunar resources**, i.e. to begin learning to "live off the land."

Continued lunar science will be vitally important to serve this purpose. An ever more thorough understanding of the Moon's past history and a more complete knowledge of the present mineralogical

distribution will be essential if we are to use her resources to best effect. But it is not necessary to wait upon further science (beyond a **badly needed lunar polar orbital mappper precursor mission**) to begin initial development. What we face is the **choice between a science-only base at the cost of billions** while people are starving, or **a station to initiate economic payback, where even more science can and will be sup-ported at a relatively small incremental cost**.

It is not enough to provide a shelter for scientists to titillate their curiosity, and ours, and then return home. Our purpose must go well beyond this to make the Moon **a second human world**. To this end, our **milestone station** must have the capacity and equipment to make substantial progress in learning to use the raw material on hand in the lunar soil to support beachhead expansion in a "bootstrapping" manner. **If expansion is to be an afterthought** (and the term 'moon base' risks just that,) **it will end up being a forgotten dream** and you can carve that quote in marble. Those with pretensions to worldly wisdom and political savvy can protest, but history's lessons are ever so eloquent.

Now the redefined milestone of a "**Lunar Resource Station capable of self-expansion"** is still just that, a milestone. Granted, it is a better milestone because it pays better respect to what ought to be our goal. We haven't mentioned that as yet.

We do need a goal in our space endeavors both for the nation and for the National Space Society. The current incrementalism in official favor (in both cases) is a cruel hoax. It teases us forward with groundless hopes. Our goal cannot be "more exploration" if it is to relate to pressing needs on Earth instead of competing with those needs, **Our goal, transcending any specific milestones, must be to INTEGRATE SPACE RESOURCES WITH EARTH'S ECONOMY** for the betterment of the overwhelming majority of mankind who will continue to live here, lofty pipe dreams aside, for the foresee-able future.

The big silly debate these days continues to be "Lunar Base versus Mars Exploration." But lets adopt instead the transcendental goal just proposed without specifying milestones, and everything will fall into proper place, **a Lunar Resource Station being the downpayment.** Steps to begin utilizing other space resources will follow, putting into place an economy of organic independence. And then all of us, or our offspring, will find ample roots to realize our separate favorite dreams.

We have supported the Return to the Moon Petition currently being circulated [Spring 1989], but only because it includes the issue-skirting phrase "and commercial endeavors." As a sentiment expressing national purpose, it suffers from the characteristic myopia of any milestone pretending to be a goal.

What we need right now is not a bigger, better milestone, but **a transcendental goal that will exert an irresistible tidal force on all our efforts**, reshaping them where needed

For this purpose, neither "Moon Base" nor "establishing communities beyond Earth" works. Granted, it is always easier to promote a concrete milestone. Yu can grasp it, draw and color it, budget it, compare it. Yet no amount of effort can turn a milestone into a goal.

Fellow space advocates, anything worth doing is worth doing right. A little pain in realigning our sights now, will save almost certain disappointment later. **PK**

MMM #24 - April 1989

A Banner-worthy Goal!

Many of us space advocates are al too painfully aware that our own 'premature' birth dates and mortality conspire against our ever participating in the actual unfolding drama of the realization of an open space frontier. Others are unwilling to admit such a possibility and have deep held hopes of personally blazing the trail. Whatever our private expectations, most of us have found a particular niche on the would-be frontier in which we think we would be most at home. Speculating about such a nice gives us great vicarious pleasure and drives us on. Some of us would pioneer the Moon, others Mars, or the asteroids. Or perhaps we would wildcat dormant comets, or work on the construction of giant space colonies, or run a tourist motel out by Saturn. Some of us may even dream of inventing an interstellar drive. Meanwhile we chafe at being exiles in time, born too soon!

And also, meanwhile, we lie (yes, we've all learned to lie, or will soon so learn) to others about our 'unusual' passion. For we learn, all too quickly, that such visions, however viscerally exciting to us, leave most people cold. We come across as pathetically out-of-touch with reality, even cruelly indifferent to the world's many terribly urgent needs. We stand silently accused of a cruel and selfish escapism.

In response to expressed or latent hostility of those concerned with a litany of 'more urgent' problems, as well as in reaction to the apathy of those concerned with nothing beyond the gratifications of the moment, we've come up with various strategies. We talk about the many spin-offs of space technology, for example. Teflon-hooplah is seen as the answer to those who ask "what's in it for me?' While spin-off benefits are real, they are not the reason we are pushing the envelope of human horizons out into space. In offering spin-offs to the public as 'the reason' for space exploration and development, or as a palliative to help swallow the high capital development costs involved, we're being dishonest, even cynically so, both to the public and to our own dreams as well.

Some have tried to anchor the hopes of the space frontier on the persuasive value of fear. They see in the militarization of space, something upon which civilian access can be piggybacked. The S.S. Paranoia is their space ship. This course is laden with pitfalls and the chances of it backfiring tragically seem to this writer, considerably greater than the Alice-in-Wonderland likelihood of success. Behind it all is the unspoken pessimism that if it were not for mutual hatred and fear of peoples of Earth, we could not hope to realize a space-faring civilization.

Anther growing fad is to use the dark side of humanity as a launch pad in a subtler, more sublimating way. Thus we are told that we should go "to Mars Together" as an arms-race substitute.

The rival option is to set up an Antarctic-style science base, and possibly a farside observatory, on the Moon. Proponents of this option cite the priceless value of science without the need to know in advance what improvements in life such enhancements of present knowledge might bring. If both the SDI crowd and the Mars crowd pay too much homage to the worst of terrestrial crises, the Lunar Science crowd goes to the other extreme and plays ostrich.

Why do we have to lie to the public about our motivations? Why do we have to keep our "real agendas" hidden? The answer is that all too often we ourselves have no real grasp of **The Goal** but see only particular milestones with whose realization we can individually identify. Nor do we agree amongst ourselves for the same reason: we mistake these milestones for goals.

Let's stop this nonsense! **The only goal we can be honest about with the pubic, the only goal we can undefensively ballyhoo, is one which relates to the real Environmental-Economic problems of our home world.** Such a goal was first formulated by Gerard O'Neill in his book, The High Frontier, before that phrase was usurped and twisted by the fright & might crowd. According to this vision, space resources would be put to work to furnish Earth's growing energy needs in a way much friendlier to the environment than coal, oil, fission, and even hydroelectric plants.

A funny thing happened on the way to the forum (where we tell the good new to the public.) Too many became captivated by the vision of space colonies, one of the proposed components of the energy from space scheme, and mistook these future celestial oases as the goal. To these supporters, serving Earth's needs has been merely a handy means to that goal.

The O'Neill vision is one that needs to be ever refreshed, ever reformulated. Solar Power Satellites need to be rethought to see if they can be designed to be less obtrusive in the night skies of Earth. Nor should they be seen as the only possible means of realizing the goal. Lunar Helium-3 is also a candidate. The future will likely see both. As attracted as we are to individual facets of the original High Frontier scheme, we must be honest enough with both ourselves and the public to reserve our highest loyalty to the goal – nothing sort of rescuing Earth's environment with greater economic justice than possible any other way.

This goal needs to be ever restated concretely, addressing the terrestrial crisis in the most relevant way. For example, today's buzzword is the Greenhouse Effect, a very real concern (though some say we should be sure it is upon us before we rashly do anything to prevent it!) Power from space is the one viable alternative we have to continuing to warm the Earth by surface power generation. It is also very possible that power and resources from space (and some technologies developed in anticipation, e.g. glass-glass-composites or Glax™) can slowly reduce the rate at which our tropical forests are being clear-cut, leading to irrevocable gross mass extinctions.

Many environmentalists are highly stirred up about the rape of the planet, but have yet to grasp that until a different regime governs the microeconomic decisions made by individual and families, the

juggernaut of habitat (and **Habitat Earth**, with a big H) destruction will continue. **Only space resources offer an alternative**.

Some critics see space resources as the dues-ex-machina (God our of a machine), an improper recourse. But **Space is an integral horizon of our planet**, and out hinterland. The Solar System IS Greater Earth. Not to use it would be to perverse. **Space is an Earth resource** - let that be our cry. Let us work to show the many ways space development can address the mundane problems with which all thinking people are concerned. Space is not pie in the sky; it is future bread on the table. Space is not a luxury. **Space is a necessity if we are to survive the adolescence of our species.**

Integrating space resources into Earth's economy in a way beneficial to all her inhabitants is not a vision that we have to keep close to the breast, that we have to be shy about, that we have to serve by offering substitute sops to the public. It is a goal we can shout about from the rooftops. Being in the service of such a goal is a badge we can wear with pride. Only ignorance, our own included, stands in the way.

Dedicate ourselves to this goal and all our individual private fantasies will see the light of day: science camps, resource stations and eventual settlements on the Moon, a permanent human frontier on Mars, self-contained colonies in free space, asteroid mining, and much more. Instead of being divided by such words as Moon, Mars, and Space Colonies, **space advocates should be united by the word Earth.**

Working to keep it that way should be our reason for going into space. That is the only thing deserving the term, "Goal."

MMM #27 - July 1989

Apollo 11 plus 40: A Look 20 Years Ahead to July 2009

What steps humankind will take, on the road "Back to the Moon to Stay" during the next twenty years will depend in no small part on the initiatives, or absence thereof, of individuals, like you and me. We live in a time when the disappointing size of the pie of which we all want a larger share is becoming increasingly apparent to all. Given the budgetary facts of life which no amount of political activism can change, it requires an act of self-deluding faith to continue to believe that government funds, inefficiently and erratically spent, can deliver to us the keys of some future Luna City.

If we continue to put our faith in the kind of bureaucratic-industrial complicity that promises to deliver eight berths in low orbital pace sometime in the next twenty years for thirty billion dollars, we can't seriously expect to progress much further. The price tag for a permanent settlement on the Moon installed the NASA way, will surely cost an order of magnitude more than any figure yet mentioned by supporters relying on rose-colored glasses.

To reduce substantially the enormous capital investment that will be required to achieve a truly open space frontier in which many people work and live off-planet, calculated creative risks need to be taken. No government on Earth can muster the fortitude to take these personal, technological, engineering, and political risks Nor will any amount of political pressure by a vanguard faction instill such political courage.

The job can only be done by the people actually willing to forsake the planet of their birth to pioneer the harsh landscapes of the Moon, or by their spiritual ancestors. This is how the New World was settled from Alaska to Tierra del Fuego, from Newfoundland to West Australia. If this people-to-be does not come together to do what needs to be done, human presence off planet will never be more than the token one of fragile, prosperity-dependent, research garrisons continuing to call Earth home - a sad, teasing caricature of our aspirations and clearly a dead end. It is difficult to understand the widespread willingness to travel down such a yellow brick road.

Yet there is an energetic minority that is beginning to scout another way:

= They are the research associates of Space Studies Institute, working to develop the critical path technologies needed to bring humanity's outward thrust to the essentially economic, not political, point of no return

= They are the individuals and organizations that make up the Lunar Prospector Team which hopes to design, build, and launch a modest lunar polar resource mapper to gain the knowledge necessary before lunar resource station planning can take on a new level of seriousness.
= They are the entrepreneurs developing the forgotten and overlooked technologies for cheaper access to space.
= They are students of the political process who see the possibility of drafting and enacting practical legislation that will help remove obstacles, purposeful or unthinking.
= They are the visionaries sketching the outlines of technologies settlers will need to live off the lunar land, thereby reducing the need for imports and developing new exports to the point where a settlement could become a paying proposition, its existence no longer at the public pleasure.
= They are the creative businessmen seeing in these Moon-appropriate technologies profit-able Earth-side applications that will allow them to be developed in anticipation o that they are ready to go when needed.
= They are those willing to put the dram of permanent human communities beyond Earth ahead of other personal interests, foregoing luxuries and indulgences that might other-wise have been right-fully theirs in this self-centered era.

But are there enough of these spiritual Lunans born in exile, of these spiritual space frontier folk born out of time, to meet all the challenges of this multi-faceted epic agenda? No small part of that answer may lie within you, the reader. The inexhaustible potential of the individual to make critical contributions should never be underestimated.

In 2009, we could have a small NASA outpost on the Moon, perhaps permanently occupied, but more likely intermittently visited – as was Skylab. Only a closed band of elite would have the opportunity of participating on such exotic "science picnics."

Or we could have a home-ruled self-expanding Lunar Resource Station with a few hundred people steadily evolving into a full-blown settlement populated by me, women, and children come to this raw world intent on making it their home and loving it. On the horizon would be a bright future supplying the needs of new space stations, low-Earth orbital tourist facilities and factories, space colonies, asteroid mines, Mars exploration bases and settlements – more than enough economic grounds to support half a million or more souls on Old Grey by the 2100.

It is not necessary to get the many to change their futile efforts to accomplish "Cradlebreak" from Earth solely as a public works project – government funding of some needed technology is indispensable. But it is necessary that enough of the rest of us come together to form a critical mass. You, yes you, can play a part!

Ad Astra Via Luna! **PK**

[Obviously, we were too optimistic, as the 40th anniversary of Apollo 11 has come and gone with no more than a false start that wasted a lot of money on a poorly chosen technological path.]

"If you can dream it, you can do it!" - Walt Disney

The best way to predict the future is to be busy creating it.

Measure a man by the opposition it takes to discourage him,

MMM #28 - September 1989

The "I-Word" and a Timely Vow

President Bush's recent suggestion (until Congress concurs, celebration is premature) that beyond Space Station Freedom (another uncertainty), this country should set its sights on a permanent manned lunar outpost to serve as a stepping stone to human exploration of Mars, occasioned a public outburst, both pro and con. These reactions have served up to us both great opportunity and great challenge.

Reactions from various Congresspeople were in some cases predictable and partisan, but in other cases, shed new and welcome light on the attitudes toward space of many legislators who had previously managed to skirt the issue. This offers unexpected assistance to us in framing our correspondence and other communications with our representatives. We can see more clearly the work cut out for us.

Nowhere is this more clear than in public comments made in the course or random sampling efforts by the media. While much of the public does support a strong civilian space program, there is a stubborn and disquietingly sizeable constituency that clearly has other priori-ties. It seems obvious to most of us that a good deal of this opposition is based on ignorance: - ignorance of already realized benefits from past through present efforts on the Space Frontier; ignorance of the relevance of space technologies (current and expected) to some aspects of "pressing Earthly problems;" ignorance of science in general is fostered by limp-minded educators; and the anything but innocent ignorance of those who neglect even such painless avenues of continuing self-education as watching the Evening News on TV

Space advocates, some prestigiously placed, who continue to espouse ever more exciting adventures in space while making no mention of possible economic benefits more direct than technology spinoffs and more relevant, unwittingly contribute to the hardening of such prematurely negative attitudes. It serves no purpose to mention names (recall the old saying about shoe size) but certainly Mr. Bush's statements put him in this company (which, naturally, includes those most enthused about what the Chief had to say.)

While any public consensus about out future directions in space, if any, may be an unreachable goal, it is a terrible mistake to dismiss opposition. We must work harder to meet the concerns of those who currently line up on the nay side. This we can do by convincing others whose attention is elsewhere, that space development promises benefits that will address the very concerns that preoccupy them.

Our recent, still timid, overtures to the environmentalist community are a case in point. To those concerned about the availability and clean generation of energy, we need to speak with a greater command of the facts. This means more research into nagging unknowns and replacement of our confident but pseudo-religious faith in the tools that space will someday offer, with demonstrable argument and step-by-step exposition. To this end, we owe it to our own beliefs to financially support continuing (SSI) research on the "Critical Path" to a reachable future that will see a significant community of human living and using the resources off-planet.

All too often, we are paired not with someone receptive to new ideas, but with the openly hostile. Patiently listen to, and agree with their concerns, and point out that it is just these shared cares that have led you to your present point of view. (If you can't make the connection, do more homework!) Above all, vow to never let discussion proceed in the form of spending on space vs. spending on Earthbound problems! If you do accept such a comparison, you've already lost. We **spend on symptoms** of Earthly problems. We **invest in** space-related **research and development** that promises to give us some vital tools for tack-ling some of the causes of those problems. Hopefully, our continued faithful usage of the "I-word" will encourage some reexamination. **PK**

"No grimmer fate can be imagined than that of humans, possessed of godlike powers,
confined to one single fragile world." Kraft Ericke

Always listen to experts. They'll tell you what can't be done and why. Then do it.
- Heinlein

"The human race shouldn't have all its eggs in one basket, or on one planet. Let's hope we can avoid dropping the basket until we have spread the load."
- Stephen Hawking

"Yesterday is history, tomorrow is a mystery
and **today is a gift; that's why they call it 'the present**.'"
---Eleanor Roosevelt---

MMM #34 - April 1990

Earth Day 1990: The Space Benefit

The sense of Earth as a fragile Oasis in Space has been greatly enforced by the "View from Space." The snapshot of the "full Earth" taken by the Apollo 17 crew during their return from the Moon is quickly becoming the most popular photo of all time. Earth-love is in. Oasis-smarts are in.

The contributions of space technology to the cause of preserving what we can of the biological and environmental heritage of the Living Earth as we inherited it from previous generations of stewards are already considerable – even fundamental to our present attentiveness, meteorology and communications satellites have played supporting roles to the various national Landsats.

In their starring roles, these latter multi-spectral thematic mappers have not only afforded us an ever-updated real-time census of Earth's forests, agricultural lands, deserts, and the snow cover. They have also revealed land-use patterns, and shown blight, drought, silt-content of waterways, red tides and many other aspects relevant to understanding and realizing the true state of the Environment, and the rate at which it is changing, usually for the worse. To act appropriately, we need knowledge, and Earth-monitoring satellites have given us an "authority" to consult.

"You ain't seen nothin' yet!" goes the saying. The nine giant Earth Observation Satellites (EOS) that will form the keystone of NASA's "Mission to Planet Earth" in the coming decade, are necessary to give us accurate knowledge of al the key environmental "hot spots" and the means of timely assessment of the effectiveness of whatever well-intentioned remedial measures we have taken.

But the future role of Space Technology in the battle to preserve – and even restore – the Earth goes well beyond the distinguished service of Space as a vantage point for which to detect, observe, and monitor. In a somewhat belated but extremely welcome admission, NASA, in its report tot he President on Moon-Mars options, notes that by one or more of three options, **"The Moon has a role to play in the long-term supply of clean electricity to fill Earth's needs."** Those three options are Solar Power Satellites, fusion power plants using lunar Helium-3, and relay transmission of power from a ring of solar arrays on the Moon itself.

Clean electric power generation will not solve all of our planet's environmental problems. As we learn to learn how to design the viable mini-biospheres needed to re-encradle our settlements on unearthly horizons, we will learn lessons invaluable to our efforts to restore and preserve balances within Earth's surviving fragmented eco-systems. And as we learn to operate ultraefficient and thorough recycling systems in these space frontier communities, some of that technology will apply to situations here below. **This "Biosphere Effect" will be major.**

A healthy Earth must also include a healthy cultural environment with real opportunities to burst out of dream-squelching spiritual limits and horizons. It must express itself in a reinvigoration of education and of youthful dreams and opportunities. It can do this only through interaction with an endless frontier. The renaissance of arts and crafts stimulated by frontier forms will be part of this phenomenon.

Earth and the human soul will share a common fate. If, in misplaced concern, we act contraceptively to keep "Earth-life on Earth," in search of some lost pastoral Eden, we will have plunged ourselves into a hell of no escape instead.

Earth Day 2070, the 100th Anniversary

What environmental achievements might we have realized Earthside eighty year from today as a benefit of space technology? Exploiting one or a combination of those three "space-resource-based options for eco-safe electrical power generation listed above, we could expect a stabilization of the trend in global warming, and end to acid rain, some relief on the pressure to cut forest growth for fuel and farm-lands, a spread of intensive greenhouse vegetable gardening a slowing of the pace in plant and animal extinctions, and a greatly reduced disparity in the general living standards between developed and under-developed worlds.

No-holds-barred economics might give way to an alternate game based on ecocustoidal economics. While nations may yet cling to the illusion of sovereignty, various international institutions may channel a significant portion of nations' real interdependency. Modeling an acronym after an ancient Roman goddess of the Earth, T.E.L.L.U.S., or Terrestrial Ecocustodial Liaison and Logistics Services or

some-thing of the sort, may work to guarantee that previously slippery multinational conglomerates operate responsibly. Rather than

U.N.E.S.C.O. rather than the old U.N. General Assembly, may be the one body with representatives form all Earth and off-planet nations alike. For while much of the U.N. agenda would be irrelevant and inapplicable off-planet, shared educational, social, and cultural concerns will always bind mankind's far flung communities.

A.I.D.S. may no longer refer to the once dreaded and now long-forgotten disease, but to the Asteroidal Impact Deflection Service, the current analog of military preparedness only now aimed at inanimate objects capable of snuffing out life on Earth, rather than against fellow humans. And, whether we have listened to intelligent signals from other star systems or not, will have detected the oxygen-sweet signatures of other Earth's around nearby star-suns.

Earth Day as celebrated beyond Mother Earth itself, might naturally be transformed into a corresponding "Children of Mother Earth Day festival held throughout off-planet civilization. The matriotic toast, "To Gaia ad the Gaiacules!" – sums up the spirit of celebration of our Human-Gaian origins. Observed on a rhythm set by that calendar variant in use in each case, this holiday will become the occasion for rededication to the continued eco-custodialism and bio-enrichment of al the offspring Oases of Earth-life that we have established throughout the solar system.

Time to Recast the Spin-off Argument

Lagging woefully far behind the stunning engineering feats of the Space Program are requisite developments in "biospherics," the technology of setting up "naturally" closed-cycle eco-systems **in which to re-encradle our-selves** in the hostile environments of the space frontier. Without this, there will be neither Space Colonies, nor Lunar and Martian Settlements. As (if!) we catch up here, various spin-offs in eco-custodial know-how (near 100% recycling systems, learning to live "downwind and downstream of ourselves," etc.) will eclipse yet more gadgetry in both immediate relevance and ultimate economic payback.

When we "pitch space," these are the spin-offs to highlight! **PK**

MMM #36 - June 1990

Biospherics Research Lags Behind Hardware R&D

If you read between the lines of most space scene commentaries, be they exhortations or complaints, one thing becomes clear; the writer seems to think that if only we would invest in the necessary hardware, budgeting more money for engineering research and development, we could bust the Space Frontier wide open. This is the case especially with those who would set deadlines or timetables for reaching this milestone or that one, e.g. "We ought to have a permanently occupied Moon Base by the year 2001!"

Something very vital is being forgotten. In the process, these forgetful space advocates are working unwittingly to set us up for another painful false start, å la Apollo.

To establish communities beyond Earth that are more than mere caricatures, **we will need to provide mini-biospheres** in which settlers will live within closed-cycle environ-mental life support. We still lack any work-able ideas of how to build such a system.

Arizona's Biosphere II notwithstanding, our ideas on how to set up the mini-ecosystems that will fully support our existence without being crushed by our demands upon them, are at best, so much theory. In this light, even such modest and basic projects as the Milwaukee Lunar Reclamation Society's Guidelines for Experiments in Lunar Agriculture intended to zero in on minimum Lunar nightspan lighting requirements, and other projects such as determining the most practical and timely way to turn sterile moondust into serviceable soil, are little more than cute amusements. There is so much practical biosphere know-how that we lack! And we beg to fail if we don't address that lack.

By and large, a majority of space-interested persons come from the ranks of persons excited about engineering and computing developments, technological spin-offs, and the hard sciences. This

makes for a very lop-sided, poorly rounded membership. This biased balance is inevitably reflected in Society policy and strategy.

It cannot be stressed enough that any spacefaring civilization must also incorporate appropriate biosphere and agriculture expertise. We could reduce launch costs to a dollar a pound, and build a NASP fleet, even a space elevator and fast nuclear rockets by the hundreds – and the Space Frontier would remain teasingly beyond our grasp, if we have not also learned how we can re-encradle ourselves in the hostile reaches beyond Cradle Earth, in which unearthly settings we propose to make ourselves equally at home.

NASA has now put CELSS (Closed Environmental Life Support System) research on hold for budget reasons. Where is the protest from space enthusiasts? We are more concerned with Shuttle-C, fair-play for also-ran entrepreneurial launch companies, and other worthy but far less critical initiatives. Dared the would-be homesteaders of our past head west solely equipped with know-how about covered wagons, telegraphy, mining, and horse-shoeing?

NSS sorely needs to broaden its recruitment pitch, and supporting literature, in an all-out effort to bring into full participation those whose backgrounds, or hobby interests, include biology, ecology, eco-systems, agriculture and gardening, even animal husbandry. The Society's excellent monthly magazine, Ad Astra, should reflect this balance correction by soliciting appropriate articles. NSS has said in the past that it foresees an open frontier in which there will be a place for people of all walks of life. That boast should be effective up-front policy, not just afterthought and window-dressing!

Many of us are impatient, blaming the government for delays in producing the hardware we'll need. Meanwhile, we naively assume that once the hardware is ready, everything else will fall into place without our having to trouble our collective selves about it. It is both silly and self-defeating to set timetables and deadlines on such a deficient basis. We ought to be more concerned with making sure that all we will need is in place before we return to the Moon to stay, than with when we will do so.

PK

MMM #37 – July 1990

Paradigm Shift

Cancellation of Moon-Mars Plans? A Crisis Brought Upon Ourselves!

One of the points about which various editorials and feature articles in MMM have been most insistent in the past three years, I that it I vitally important that we Return to the Moon "to Stay" for the right reasons, and properly prepared and equipped with technologies as yet not fully developed that will be needed to ensure that any such outpost is on the road to becoming economically self-supporting as soon as possible. Why? To escape annual threats of cancellation rising from predictable budgetary pressures back home. But this can happen **only if we make "off-planet resources" the "headline," not a mere foot-note**, in our Space Frontier Saga.

Unfortunately, this has not been the case. Too many of us have felt it **unnecessary** to talk about use of economically relevant resources, believing that such developments will only come in the remote future (as they will, if we don't ensure otherwise!) and that this "heady" talk of "development" is premature. We were in the minority in expressing grave misgivings about the wording of the "Return to the Moon" Petition, in which the phrase "for commercial purposes" seemed to us too cryptic to get the message across to the public and the government. We regret that events may be proving this fear justified.

All too many innocently believe that the mere "thrill" of space or other intangibles such as technological spin-offs and educational benefits are of themselves enough to convince those with other agendas to rethink their priorities. But even if a strong case can be made for the economic merits through spin-off, of space development, that would only justify R&D and not space ventures themselves.

If space R&D spin-offs justify no more than space R&D itself, it is also true that similar benefits can come from other more "relevant" research and development programs just as easily as from in-

creased money for space. Jimmy Carter felt comfortable cutting Space Spending because he thought, quite reasonably, that similar benefits would flow form Alternative Energy Research.

Space enthusiasts have been on a starvation diet since December 14, 1972, when Gene Cernam lifted his left boot off the lunar surface. When you are ravenously hungry, it's easy to throw common caution to the wind when food is suddenly thrust before you, dismissing any worry about how safe it ay be to eat. Last year, when President Bush, largely in response to the movement's poorly argued insistence, announced that this country should return to the Moon with a permanently manned outpost as a prelude to manned exploration of Mars, most of us voraciously ate it up.

Yet Bush made no mention of integrating lunar resources into a greater Earth-Moon economy – a poisonous fatal flaw. Congress, whom we have failed to educate about such possibilities, can hardly be blamed for seeing the Moon-Mars initiative as an obscenely ire-levant indulgence in thrill, excitement, and adventure – something properly funded by discretionary income, that, in point of fact, we simply do not have.

In plain truth, we have brought this current crisis upon ourselves by taking impatient shortcuts. If the Mikulski-Traxler "veto" of the Space Exploration Initiative is upheld, we can expect to see a wholesale thinning of the ranks of space advocates as our fair-weathered friends drop out, discouraged and disillusioned.

That should hardly discourage the rest of us! There are more than a few people, ready, willing, and able to pick up the pieces. Cancellation of the Bush Moon-Mars plan – if it comes to that – need not be the end. It is within our power to turn this "dead end" into the "beginning," to transform a "worst possible calamity" into the "best thing that could ever have happened." Those with such healthy positive attitudes have the chance to write the next chapter in space.

We need to begin by changing our own attitudes. First, perhaps a majority of NSS' growing membership (near 30,000) feels both that it is the government's job to open the space frontier, and that it is with the government's power to do so. My own "loss of faith" in this revered tenet dates from NASA's first announcement that it 8-man space station would cost $8 billion, or a billion dollars a berth! In the light of such estimates, it seemed crystal clear to me that the idea of government "opening" the space frontier for significant numbers of people was pathetic "let's all pretend, now" fairytale.

Second, clamoring impatiently for deadlines promising the soonest possible gratify-cation of our fantasies, (and turning milestones into false goals) must give way to rolling up our own sleeves and seeing to it that everything we need to do a job "right" is in place **first!** That job done, the timing will take care of itself.

Most talk of commercial space initiatives has been unimaginatively limited to the question of access to the "threshold" of space, neglecting major opportunities, both Earth-side and beyond. Access, without plows, won't open any frontiers. Space advocates need to widen their horizons!

On this point, MMM has tried to point the way by seeking to identify those technologies needed to make autonomous settlement possible, and which can also be pre-developed and pre-debugged now for profitable Earth-side applications, thus anticipating need. **This is the "spin-up" path.** Unlike the spin-off path, this approach has consumers pay for the R&D up-front, which then puts technologies needed to open the Moon **on-the-shelf**, cheap and ready-to-use when needed.

In contrast, the traditional direction of technology transfer makes space an order of magnitude more expensive than it needs to be, all in order to pamper a "parasitic" consumer economy. What is needed is to totally reject the quasi-religious reverence many yet show for this "spin-off" aspect of the NASA mandate.

We must leave behind fellow-travelers unable to change their mindset on this point. If we patiently do our homework, either researching the entrepreneurial possibilities, or as entrepreneurs, enlisters of entrepreneurs, or donors of "ulterior venture" seed funds, suddenly everything will fall into place for industry and government together to return to the Moon, to establish economically viable operations, **complete with settlers.**

Too many will settle for wooden nickels.

(1) NASA has estimated that its Moon-Mars venture would cost $500 billion. But the agency's track record makes it likely that the cost will balloon to some **tr**illions of dollars. NASA maintains, in rebuttal of "unrealistic" counterproposals, that there are no shortcuts, no cheaper roads to space. But such an assertion appears to me to be, plainly and simply, so much self-serving Texas snow.

True, industry is reluctant to risk capital. But are not the reasons of this conservatism mostly artificial

(2)? First, we've failed to work out for industry a carefully reasoned self-terracing business plan wherein each small-but-profitable venture bootstraps the next. "That's not our job!" object most of our leaders! Is it not deceitful to boast that a spacefaring civilization is our goal and yet shirk necessary steps to that end?

(2) Industry has no incentive to "rival" the government's deep pocket approach. Once the government is no longer playing a mischievously preemptive role, industry will at first cautiously, then ever more confidently, fill the vacuum.

(3) Industry is discouraged by estimated costs; but those costs at enormously inflated

(a) by the spin-off approach

(b) by the government's willingness to approve cost overruns and not enforce design-to-cost constraints

(c) by compulsive government meddling micro-management practices, and

(d) the government's innate inability to undertake ventures that would entail risks unacceptable to the increasingly risk-shy public at large.

"Government Space" has to be much more expensively "safe" than actual volunteer pioneers would be wiling to accept as part of the territory. In this light, the true "disaster" in the Challenger "loss" is revealed to be the government's predictable response. Sorry, but if you disagree, and even some astronauts do, perhaps you aren't really settler material, at least not in the tradition of our pioneering forefathers. In last analysis, only those with the real "right stuff" can open space.

[Stage direction: Exit the Res Publica, the government, any government.]

Speaking of risks, many in the space movement are willing to hinge our future in space on the high stakes gamble that we can change how the government and the public think. If so, this change in attitude will only occur in the aftermath of actual accomplishments on the spin-up path sketched above, that is by faits accomplis.

In contrast, we think that the idea of an economy-based spacefaring civilization is much too important to take the windmill-tilting chance that we can convince the public by lazier (yes!) traditional political action roles.

What is the sense of making the realization of OUR dream utterly dependent on the fickle whims of those who do not share them!

We, no one else, must take charge of getting the job done. The government "trip" to space is just that. Time to get off that drug. The treatment center is open!

The collapse of the Public Works approach (or paradigm) does not at all mean that the nation's government has no role to play. Rather, it means that we "render unto Caesar what is Caesar's" and undertake to do the rest ourselves. It is still vitally important to change public policy to remove disincentives and to provide positive reenforcements to space development **as an economically-grounded venture.** Where supply (access to space etc.) waits upon demand, the government has an important historical role in finding ways to guarantee the latter, and thus "prime the pump."

It is also still vitally important to continue, and even redouble our public out-reach efforts. But this will get us nowhere, unless we **headline** the economic rationale of integrating off-planet resources in a "planet-plus" economy, our pith tailored to enlist would-be entrepreneurs first, and more fans/spectators/voters second.

Cancellation of the poorly thought-out Bush plan could be the best thing that ever happened, if we learn these lessons from it! We, not the government, should supply the bandwagon, and then sketch the proper leverage points for government assistance, not government direction.

This will mean putting **our** private, and networked talents in service of **ou**r dreams – that means **homework!** It begins with hard self-examination about our own personal priorities and time-budgets. "Being on the team" should mean more than playing leader-appointed roles: paying dues, making calls, writing letters, and voting. Chanting in unison "open sesame" before the closed gates of the Space Frontier will not make those gates budge.

Conventional space-activist wisdom has failed us. A paradigm shift is long overdue. To the Stars! **PK**

MMM #38 - September 1990

Sometimes, you have to look a gift-horse in the mouth!

After the balance of the planned Apollo missions were canceled (A18, A19, A20) and early NASA and contractor schemes for taking the next step to a manned lunar outpost put on indefinite [multigenerational it now seems] hold, space enthusiasts grudgingly recognized that we had taken impatient shortcuts to the Moon (it was apparently no more than a race we had to win) that had left us without a suitable foundation on which to settle-in off-planet.

We had cheated in not following Von Braun's scenario that had called for a Low Earth Orbit LEO Depot first. Now we had no choice but to take time out to "build infrastructure," the infrastructure not needed to win a race. This depot would be necessary to support a sustained level of activity on and around the Moon – out beyond LEO. And, ideally, we should be piggybacking our steps on apropos profit-making activities in near space.

Here we are, going on eighteen years later, and what do we have to show for our patience? We are deeply thrilled by space exploration and by demonstrations of new levels of achievement. For some, those of us involved with sustaining, talking up, defending or apologizing for the status quo, that seems enough. If you are one of these, and you have the right to be, things look merely "annoyingly disappointing." You front confidence that NASA will surmount its problems of the moment and resume its tortuously slow pace of spectacular achievements.

But for those of us who compare progress to the basic template of Von Braun's clearly marked road map back to the Moon, it is hard to find a single technology demonstration or achievement of this interminable intermission after Apollo's "Act 1" that puts us as much as one step closer to our return than we were on December 15, 1972.

√ We have not cut costs to orbit.

√ We do not have anything, even on paper, that looks remotely like an honest space depot.

And our efforts to expand Earth's economy above the fringes of the atmosphere have been a pathetic farce.

Freedom Station will never be Depot-function friendly, no matter how many after-thought gizmo-features are forced upon it.

(1) It is being optimized for an incompatible function

(2) It will be placed in a less-than optimum orbit

To be honest, Freedom Station may not even serve very well as a platform for micro-gravity experimentation, its designed purpose! If Hubble, with its outrigger solar panels shudders for five minutes every time it passes into Earth's shadow, and for twenty minutes every time it reemerges into sunlight – a cycle repeated every 95 minute orbit – imagine how Freedom Station will quake with its immense boom-based solar arrays!

Freedom may prove to be only a slight improvement over lowly sounding rockets, providing us with less than an hour of quiet micro-gravity at a time. And you thought that all that was wrong with the Freedom design was its weight, the price, and the need for nine hours of EVA maintenance every day!

Even if we find some way to dampen the thermal space quakes (as by using semi-free-flying lab modules with limp electric power leads?), lofty dreams of micro-G processing for profit are fast falling into disrepute – though some prefer to ignore the mounting evidence. Despite years of work in Skylab, Salyuts, Shuttles (with and without Spacelab) and Mir, the first useful product with "volume economic potential" has yet to surface. Some will insist that the very short periods of micro-gravity we've had available (in the West), up to 9 days, have been insufficient. Such excuses betray an ivory tower innocence of industrial economics. The longer any Industrial process takes to run its full time, the more economically difficult it is to attain break-even production volume with a set capital investment. (Winemakers will disagree.)

Space manufacturing should ideally be using non-terrestrial materials for non-terrestrial uses – a different formula entirely than the one which now guides experimenters, rooted in their perva-

sive unwillingness to factor in the capital cost of access to off-planet materials. There **is** a middle ground here, and we will take up that topic in a future essay.

We are not alone in pessimism about current and planned "tracks of micro-gravity research. Indeed, it is hard to find anyone without vested group- or personal-interests in keeping Freedom Station alive who believes otherwise anymore. The Soviets have already conducted more than a thousand micro-gravity experiments aboard their Salyuts and on Mir, achieving results "of no practical use."

It may seem tempting to dismiss this failure by pointing to the profound lake of entrepreneurial experience and innovativeness in the USSR. But that is both not quite accurate and way too facile. Mark Ratner writes in Bio/Technology that "there has been no proof of principle with growing crystals in space, much less of doing anything on a commercial level with compounds." And European Space Agency Beatrice Lacoste says ESA is "diffident about publicizing it materials processing work because the whole concept has been oversold." Robert Staehle of the World Space Foundation says it may be another four, even five decades before we are able to reap profits for micro-gravity research! **It is clearly time to rethink what jobs we are designing Freedom Station to do!**

Plainly and simply put, we made up our minds to build the world's most expensive laboratory before we had adequately determined that it was the right kind of laboratory for the right kind of research. Many of us have spent considerable energy, bashing people like Senator Bill Proxmire and astronomer Carl Sagan, who asked only that we learn to crawl before we attempt to soar. In hindsight, we maligned them for their misgivings – because we were impatient to take the greatest strides possible. The impatient always view patience as the enemy, rather than their own haste. The Reagan-NASA "Station" was a gift horse not to be looked in the mouth!

NASA chose to derail efforts to first orbit a commercial free-flying man-tended micro-gravity facility. And space enthusiasts by and large condoned this.

What we have been trying to do with Freedom Station is much the same as if Henry Ford, flush with the success of the Model-T, decided to dispense with reasonable intermediate steps and plunge headlong into the development of the Ford Taurus. Why have we embarked on such a course?

√ to guarantee a full work load for all eight NASA centers

√ to garner the maximum political support form the greatest number of possible supporters, and

√ to stroke the quasi-religious convictions of those who believe NASA must spurn off-the-shelf knowhow, in favor of ever-newer trans-cutting edge technologies.

As a result, what NASA proposes to build, and most of seem ready to endorse without hesitation, is a station that is overweight, yet too small, and too impotent, for that much money, and which would require more shuttle launches to erect and service them than our present fleet of pterosaurs could support, and which will require a crushing load of extra air-lock maintenance activity such as we have yet to demonstrate ourselves capable of, day-in-day-out. The offered solutions, of course, are more money and more technology R&D. Money spent and work done, the finished Freedom Station would be unlikely to function as planned. So what is Plan B?

Instead of not-too-late participation in the definition and design of our next step after our Model-T Skylab, space activists in general have chosen the lazier, more passive tack of signing on to the Reagan-NASA gift-horse. Sometimes you have to look a gift-horse in the mouth. An incredible amount of money and time has been wasted.

But it is not too late to change course.

Space Station Freedom ought to be abandoned now, or redesigned and retargeted,
Before we throw yet more good money after bad.

Preliminaries to Plan B:

First off, it is time to get it straight once and for all that the notion of having only one LEO facility, in which both laboratory and depot functions are combined, is both illegitimate and indefensible.

- √ An International LEO Laboratory is conveniently placed in an orbit handy to the primary launch and resupply pads servicing it. High inclination orbits are ideal for remote sensing Earth observation studies.
- √ An International LEO Depot is not orbit-neutral. To escape totally unnecessary narrowing of launch window to deep space, from once-an-orbit to once-a-day, a LEO Depot should be in an equator-hugging orbit.

To make any LEO Depot work, we have to supply it with fuels as economically as possible. This means fuel-scavenging facilities above to handle both cryogenic and non-cryogenic fuel residuals from booster stages arriving in LEO. Such fuel stations should co-orbit with both the LEO Lab and the LEO Depot to feed off traffic to either location. An orbit-jockeying tanker to transfer scavenged fuels from LEO Lab to LEO Depot would be part of such a system. Avoiding the need for a tanker and one of the scavenging facilities by combining both Lab and Depot in a non-equatorial orbit would preclude optimum Depot function

A LEO Lab that is not modular enough to be easily expanded as user work-load increases, is not worth building in the first place. Freedom Station is not such a critter and this was clear form the outset, despite incredulous protests to the contrary. It should be started cheap and small, with larger and/or more sophisticated and elaborate facilities added later. This "don't build ay of it unit we can guild all of it" mentality has our researchers "treading vacuum" while the Soviets keep contentedly putzing away.

The International LEO Lab ought to be designed as an ensemble, not as a single structure. From the vantage point of manned space operations, we should prioritize a variable gravity facility before anything else. Two External Tanks, co-tethered or separated on a simple boom, will do. If one pole of the axis of rotation points sunward, solar panels could be mounted on the ETs' sun-facing side.

What about commercial LEO Labs? That's another editorial. Meanwhile, many activists have spent a lot of time, effort, energy, and even money, supporting this misbegotten Freedom Station, because it has been the only game in town, and **would at least involve people in space.** There is no argument there!

But we are giving the public the wrong impression of what manned space should be about, and we are turning inward, using orbit space to focus on Earth as if our planet did not belong to a larger system, as if it did not have a hinterland loaded with resources that could someday feed a larger Earth-Space economy that would maximize living conditions here on Earth. By believing that the government has to lay the foundation for everything, We have gotten off-track. But worst of all, we are spending little effort to keep the real future in the public eye. **PK**

MMM #39 - October 1990

Wanted: Commercial Manned Access

You may think we won a big victory when NASA grudgingly agreed to put some expended Space Shuttle External Tanks into orbit for reuse by entrepreneurs. Oh? And how does anyone get up there to do whatever retro-fitting may be called for? Not on the Shuttle! Reagan put an end to that (and we cheered, remember?) The days when a company could pay the fare for the likes of a Charlie Walker are long gone. Private money is not green enough! What alternatives are there? Presently, but one: buy a Soyuz flight.

Actually, until American industry can come up with some home-grown alternative, it might be in US interests to feed the Soviets hard currency by agreeing to let them commercialize the Soyuz/Progress system in the West. Not so unthinkable, now, is it?

So what should our entrepreneurs and cheerleading activists be busy doing? Building more undersized rockets to boost up microsats? It sure does seem that the terrible truth has yet to dawn on the space activist community. We get all charged up promoting HR2674, a well-intentioned initiative, despite its counter-productive nationalistic protectionism – a shaky start. Meanwhile, we still have no commercial manned space access. None! Nor do we have the ABCs for any Plan B.

But we do have some options to provide commercial manned space access one day!

- √ Find someone to advance either of two paper study vehicles: The **Phoenix alias SSX**, or MIT's **Space Van** design. The SSX seems the more viable option at the moment, given the interest shown by the Space Defense Initiative people. But if they build it, would they let anyone else buy or lease one?
- √ Design some new vehicle from scratch

√ Wait 15 or more years for a commercial aerospaceplane

√ Coax McDonnel Douglas to "dust off" the plans for the **Gemini** spacecraft, or by the plans from them, update their electronics, and start an assembly line. The tooling new longer exists but finalized blueprints for a field-tested vehicle do.

"Gemini?" you fluster, "you're crazy man! That'd mean that we haven't made any real progress in 26 years!" Well, if by "we" you mean those of us who would make new homes "off-planet," that's exactly what the naked truth is. The US Shuttle and Space Station are two irrelevant and flashy ultra-high-tech developments on a dead end track that apparently is leading us nowhere.

Is it sinking in yet? In all these too-long years since Apollo 17's splashdown, we have yet to see the government, or our vaunted aerospace industries, build us a simple honestly "commercially usable" item fo space infrastructure.

Like it or not, Soyuz and Gemini are "it" for anytime soon. We might even rename the resurrected mid-60s craft (Pollux?) if that would make this medicine go down any easier. Such a rehabilitated Gemini could e as reusable as the shuttle, with a much quicker turnaround time via a new snap-on/snap-off ablative shield. We even have the ideal booster, a Commercial Titan (Martin-Marietta.)

Unlike the Mercury capsule, the Gemini was truly flyable. It supported EVA activities with its resealable hatch, could dock with other spacecraft and structures, and it had modular working parts easily replaceable from outside the craft. This feature would enable the quick change-out needed for frequent re-fights for which it could be made ready by a Spartan crew. And though this option was never exercised, it was designed for runway or inland water landings via parasail, without an expensive standby fleet.

Its Titan launcher could also co-boost modest detachable cargo-holds aft of the Gemini shield. And Air Force plans for a Manned Orbiting Laboratory mated to the Gemini-Titan transport system could be exhumed and updated rather quickly in comparison to a facility designed from scratch.

And there is the point. We could use the aging Gemini plans to get us into commercial action fast, meanwhile start working on plans for a much improved successor system.

But the question is "is anyone game?" Silence is so eloquent! **PK**

For once you have tasted flight you will walk the earth with your eyes turned skywards,
for there you have been and there you will long to return.

Leonardo da Vinci

MMM #40 - November 1990

The Siren Trap of "Intransitive Space"

I remember talking to someone on the phone and mentioning the National Space Society. It was soon apparent that we were speaking two different languages, not connecting at all. It turned out that this guy was from the advertising business. In particular, he was an agent for the ad-posters on the side of city buses, and to him, "space" meant a place to put an ad. He naturally took it that I was talking about some national fraternity of advertising people.

This may seem an amusing anecdote, but I fear in fact that "Space Advocates" themselves are beginning to talk of "apples and oranges." In the following phrases – National Air and **Space** Administration, **Space**faring, and **Space** Frontier – "space" would seem to be used in one single, unambiguous sense. By failing to recognize that we are increasingly using this word "space" in two neighboring but quite distinct meanings, we may be falling into a very dangerous trap.

"Space" might be loosely defined as the realm of vacuum above Earth's atmosphere, extending unbounded out to the stars and beyond. And all "trans-atmospheric" activities would seem to deserve that heady and romance-filled epithet "spacefaring." But perhaps in our impatience to belong to "the final age," we are jumping the gun.

Recall the difference between intransitive and transitive verbs. In the former, the action is either reflexive upon the subject, or remains within the subject. Thus one per-forms, exercises, examines

oneself in a mirror. But in transitive verbs the action passes to or into an external object. One transforms something else outside oneself. So what sort of process is spacefaring? Now you might protest with annoyance that this is a stupid question! But alarmingly, a growing number of space advocates are blaring the horn for projects and programs that can be called "spacefaring" only in an intransitive, Earth-reflexive, "yoyo" sort of way.

Contrary to what would seem to be implied, in "Air & Space" we have not two theaters, but three. "Space," as intended by most of us in who come to the "space" movement from the enjoyment of Science Fiction and/or Astronomy, unequivocally refers to the realm of celestial bodies and the space "between" them. But to an increasing number of Latter Day Converts convinced by the technological, educational, and leadership benefits of space activities, "space" means no more than the "trans-atmospheric boundary layer" - supra-terrestrial Earth orbital space. It is the final peel in the onion of greater Earth above the surface. Everything else is but lights shining out there. It is as if we were back in pre-Copernican days.

The Space Station lies in this boundary layer, as do all our satellites, whatever function they perform. LEO and GEO belong to this boundary space. Actually the Moon does too, but as another shore beyond, it is seen as something else, outside the onion peel.

Most people have needed no conversion to see the benefits of intransitive space: Remote sensing Earth observation satellites, weather satellites, communications satellites, global positioning system satellites, and so on: all services consumers are willing to pay for.

So here is the problem. Many people are pro-space in the yoyo sense, but that's where the support stops. Sensing that here is where the greatest support for space activities lies, NASA has unrolled "Mission to Planet Earth", now a bandwagon gathering steam. NASA is becoming trapped in reflexive, intransitive boundary layer space. It gives it something to do, to keep its assets and employees working while we wait for a sea-change in public understanding. How pathetic!

Yes, Mission to Planet Earth is a space-connection through which we can woo the environmental movement. But we do so without getting the main message across. All we are doing is buying time. But that is pointless, if we are not also laying foundations for selling the reasons to go beyond.

We should not be surrendering to expedience. Intransitive yoyo orbital space programs are not what we were founded to pursue. What we need to get across is that the Moon too orbits Earth; pursuing its resource-potential makes as much sense as taking advantage of geo-stationary orbit. The Earth-centric econosphere is bound to expand to include the Moon. It's not science fiction. It's not far out. It's just extending common sense. We need to rehabilitate transitive space. This is nothing to be defensive about. **PK**

Vision without action is just a dream

Action without vision is just activity

Vision and Action together can change the world.

MMM #42 - February 1991

An Outbound Tabula Rasa- "LEO-RASA"

Those with other agendas have preempted the space station conceived by Wernher von Braun as a staging, assembly, and refueling depot for crewed deep space missions. It will be designed for totally unrelated purposes. NASA resistance to the recommendations of the Augustine Commission offers little hope of changing that. It has become clear that if we, as a species, are to move outward beyond low Earth orbit (LEO), we must devise mission scenarios that do not depend on any permanent orbital facility. We have to start with a clean slate, an empty blackboard or "tabula rasa." [Latin].

In the classic von Braun scenario out-lined in the early fifties series in Colliers, and illustrated by Chesley Bonestel, the grand lunar mission consisted of three great ships, each carrying a sizable crew and enough equipment to explore not only the chosen landing site but to mount a major overland ex-

ploratory expedition. It was to have been assembled in LEO from numerous elements brought up in separate 'shuttle' flights. The three ships would then be crewed, fueled and dispatched from the station.

His Mars plan was even more grandiose. Alas, it is now clear that station planning has already proceeded so far along an irrelevant dead-end path, that we must wistfully put the von Braun vision aside, and start from scratch.

It is whistling in the dark to expect Space Station Freedom to serve as "Shipyard & Depot" anytime within the next generation. One alternative, pioneered by Zubrin and Baker, is to design mission scenarios with multiple elements, each of which can be launched "surface-to-surface direct" (Earth to Moon, Earth to Mars) in pre-classic, pre-von Braun science fiction style. This approach combines two elements: larger Heavy lift Vehicles [HLV] from Earth and more compact elements to be delivered to the lunar or Martian surface.

Another approach, which would allow larger follow-up missions, is to design surface and/or Earth-return vehicles in two or three "quick-snap" [look, ma, no EVA!] subassemblies that could be delivered to orbit by HLVs that would rendezvous with one another rather than with an orbiting station whose support services would not be needed for the quick snap assembly. This is the gist of the LEO-RASA strategy, i.e. Rendezvous And Snap Assembly

By using proper design techniques and architectures, larger ready to use Moon or Mars surface structures and other mission elements could be assembled and checked out, ready for the trans-LEO boost, in a matter of a few hours, without risky and time-consuming EVA procedures. This may mean "back to the drawing board," but if we want to go within our lifetimes, there seems to be no other way than the "LEO-RASA" approach. PK

MMM #49 - October 1991

Biosphere II, and III, and IV and ...

On Thursday, September 29, 1991, the long-awaited and repeatedly delayed moment finally arrived for eight "Biospherians," four men and four women with genuine bravado, as they stepped across the threshold into what in effect is another world. That Biosphere II ("I" being Cradle Earth itself) is physically located on the planet's surface instead of some point removed, does not invalidate the heady claim. Excepting electrical power and telecommunications links, the umbilical cord to Earth is being broken for the first time, however tentatively, however experimentally.

Many pouting second guessers, not having had the foresight, ambition, inventiveness, and drive to have done something similar themselves, are faulting the project's design, specifically the complexity of the 5-biome (ecosystem) linkage and the ambitiously large number of plant and animal species included in this first test. Others, playing dirty hard-ball, attempt to find skeletons in the participant's closets. Have scientists now sunk to tthe pettiness level of politicians, or what? - that's scary! Our reaction is unprintable.

In simple point of fact, while most space development supporters (and societies) continue to invest their energies as if the lack of the lack of the needed space transportation infrastructure hardware is the only thing standing between us and our fondest dreams, we 'ain't' going anywhere in any real way until we've learned to set up autonomous biospheres that work.

And "work" is the operative word. We were angered by ABC's story subtitle "science or showmanship". They completely miss the point. While Biosphere II hopes to shed much light on a plethora of ecological and environ-mental questions, the whole point of this unprecedented exercise is not "know-what" but "know-how". In this sense, Biosphere II should be seen more as a biosystems engineering test than as a scientific experiment.

The odds are great that the eight colonists aboard this dry-docked ark will not be able to complete the full 2-year intended stay before their mini world becomes unbalanced in some way from which there will be no recovery without stop-test intervention. Does that mean failure? Hardly, The only engineering experiment that can be called a failure is one from which nothing is earned, a highly unlikely outcome.

That Biosphere II is being done with private money ("tainted" to many scientists used to the federal dole) and that marketable results will be proprietary (for sale or license) angers many. But it should cheer the most of us, for at last we see private enterprise and the profit motive beginning to apply its sleeping do-all might.

At the National Space Society Board of Directors annual meeting in San Antonio, May 26th, Directors were asked to suggest magazines in which NSS might advertise in the hopes of recruiting more members. Alas, the tired litany of suggestions – science, engineering, computing magazines – gave a discouraging impression that many board members still believe that hardware development and procurement is our principal, if not only concern. We finally got our two cents in, pointing out that we must live in viable mini-biospheres if our presence in space is to be truly enduring, and that therefore we ought to include publications in the fields of biology, botany, ecology, agriculture, and environment. We've made the point before, but except for a few like-minded spirits, we are still the dreaded 'fringe', not the mainstream of NSS thought.

What the Society needs to do, beyond the positive articles in Ad Astra on Biosphere III and related topics, is simple:

I. Actively recruit new members whose field is the life sciences, ending this stupid nuts and bolts chauvinism.

2. Go on record as encouraging and supporting entrepreneurial research and development of biosphere systems in general (it would not be appropriate to stand behind Bio-sphere II specifically, however much we all hope that this first test advances our bio-engineering knowhow).

3. Back this up by developing legislation that will give tax-breaks and/or shelters to each type endeavor.

Admittedly, this will be hard to formulate. Pointing out the potential payoffs to "Biosphere I" (as well as to prospective off-planet communities) will be the way to sell it. A tall order? Let's all keep in mind, nay, dwell on the fact of space life, that we're not going anywhere, except to picnic and come home once again, unless (or only to the extent that) we've mastered the complex challenges of establishing new mini-cradle-earths to support our multiple transplantations off-planet, be it in moon bases or space colonies. **PK**

MMM #54 - April 1992

MARS: Plenty of time to wait, But none to waste

Plenty of Time to Wait

Most of us in the National Space Society se the make-or-break importance of putting our expansion into space on a firm economic footing, and we view development of lunar resources as the first step to achieving that goal. Yet most of us also have a keen interest in Mars, its exploration by human crews, and its eventual settlement. While President Bush [the first] has espoused such a goal, economic realities are certain to putt off its achievement for decades, like it or not. Even a magnitude of order reduction (to 1/10th) in NASA's original cost estimate of $500B via Robert Zubrin's "Mars Direct" mission architecture still leaves human exploration of Mars an easily postponed luxury. Once the potential for off-planet resources from the Moon and elsewhere to substantially alleviate Earth's looming energy crisis is more widely realized, this will change, with retrieval of volatiles from Mars' moonlets, Phobos and Deimos, part of the scenario. Martian settlements will piggyback on that resource trade or will not occur at all.

[Snip]

No Time to Waste

Those who wait for transportation cost breakthroughs and do nothing else in the mean-time to help ensure the success of eventual Mars missions, work instead (in self-betrayal of their professed goals) to guarantee that when we finally do get there, we will see another "veni, vidi, nonvici" [Caesar's "I came, I saw, I (did not) conquer(ed)"] Apollo remake. In truth, there are a whole host of orphan projects that space enthusiasts can adopt and carry to conclusion, many of them less than romantic, that

will help prepare for the day when the traffic signal finally turns green. MMM has in past issues identified and outlined some of these – all still looking for sponsors willing to rerank their spare time priorities, roll up their sleeves, and to give the unknown a real try.

Engineering Projects (some mentioned in MMM)

Meteorburst Communications: Design lightweight equipment to be included on a Mars surface rover to attempt to relay signals to distant receivers over the horizon by bouncing them off meteorbursts in the high Martian atmosphere much as truck fleets now do on Earth. If successful, this would allow planetwide operations without the necessity of deploying and maintaining an expensive global array of communications satellites

Carmonox and Methanox engines: Develop, debug, and improve internal combustion engines (for vehicles and generators) that can run on Carbon Monoxide and Oxygen or on Methane and Oxygen in simulated Martian conditions. These fuels can easily be extracted from the local atmosphere and cached at handy points to bring real mobility to Martian operations. A pair of good projects for the automobile engine buffs amongst u s, or for school projects.

Skimmers: An Earth-style hovercraft will not work in the thinner Martian atmosphere unless a large portion of its standing weight (with or without fuel) is neutralized by lightweight hydrogen gas bladders. Maintaining stability in maneuvering, and maintaining ground clearance range as fuels are used up, will be a design challenge. If you have the capacity to tinker up a suit-able Mars skimmer and don't, don't cry when our people on Mars are dependent on tortu-ously slow walkers or crawlers when they could have been "making tracks."

Canals for Polar Melt water: One should never put all one's eggs in one basket. As permafrost may prove not to be an easily recoverable resource, we need to brainstorm how to access the much greater water reserves within the planet's polar caps. Do we truck quarried ice to distant bases and settlements? Or do we finally build the vaunted canals of Mars, once prematurely accepted as fact? If so, would these be pressurized conduits carrying melted ice water with periodic pumping stations and with measures to keep the water from re-freezing (such as solar heat-attracting and storing conduit side and top surfaces?)

Chemical Engineering Projects:

Igloo type shielding: Dinitorgen Pentoxide (N^2O^5) produced robotically from the surrounding atmosphere, would provide a substance that remains a powder throughout the full temperature range experienced on Mars. It could be used as a shielding material if contained by some sort of retaining wall or saddlebag system, for bases and settlement modules. The advantage would lie in not having to disturb the surrounding soil, which if in a permafrost condition, may be much harder to scoop up and redeploy than moondust. As this substance is listed as an unstable explosive, perhaps we have to look at an alternative also producible from Mars Air.

Climate Engineering by design: By now we know, having learned the hard way, that human industrial activity has a definite changing effect upon the terrestrial biosphere. While the effect of our presence and industrial activities on Mars will be miniscule at first, they will be real. On Mars the situation will be just the opposite that we face on Earth. We will want to maximize, not minimize, climate-effecting byproducts of our activities. But first we must decide what our "terraforming" goals are to be. Some of the potential pathways may be mutually exclusive. It will be important not to put in place operations that will commit us to temporary but unwanted "dead-end" greenhouse improvements. By the time we get to Mars, we will need well-thought-out **strategic exhaust gas policy.**

Agricultural Projects

Mars-hardened plants: At the present epoch, Mars Air is too cold, too thin, too dry, and too naked to raw ultraviolet solar rays to support any kind of plant life useful to settlers that we can easily imagine. Yet, condensed and warmed in moisture-tight greenhouses under UV-resistant glass, Mars' Carbon Dioxide – Nitrogen atmosphere (95% and 3% respectively) with a small amount of Oxygen added, should support agriculture easily enough. It's not too early to begin breeding and bioengineering (transplanting genes that promise success) plants that thrive" in such conditions, gradually hardening them to ever thinner, cooler, drier, less oxygen-rich conditions until one day, as human planetary engineering improves the climate on Mars, these evolved plants can establish themselves outdoors, and spread, creating the first (at least in a very, very long time) Martian ecosystems. Meanwhile, crops grown in such conditions will provide food, fiber, and feedstocks much more cheaply than those that have to be nursed to harvest in more Earthlike greenhouse conditions.

An important consideration in the above scenario is the choice of plants that are not dependent for pollination on insects or other animals that could not survive in such oxygen-starved conditions. Mars will have flora outside the greenhouse long before it will have fauna outside the zoo!

Probe Instrumentation Projects: If we are going to settle Mars, living off the land frontier-style, we must have in hand a much better picture of the nature and geographical extent and distribution of potential Martian resources. Our past probes, and those now in the works are aimed less at resource identify-cation and mapping than at the intellectual self-gratification of the principal investigators enlisted in the effort. This knowledge is not spurious. It does provide a foundation for further exploration. The point is that if we do not see to it that future probes are adequate to the job we who would settle Mars need them to do, we cannot sit idly by and leave the choice of instruments and the scope of missions to planetary scientists alone.

A Permafrost Explorer needs to be brainstormed. By first scouring over existing Landsat thematic imagery to find clues to Siberian, Alaskan, and Canadian permafrost – here on Earth where ground truth checks and calibration of instruments are an easy matter, a project team should be able to get a handle on how to design a Mars probe that would do the trick, outlining the extent and perhaps giving clues to the thickness of subsurface ice-laden soils on Mars. A spin-up precursor dedicated Earth Permafrost Explorer would be a funds-attracting possibility. The U.S., Canada, and Russia could provide funding.

A Carbonate Explorer: Orbiting thematic mappers might be optimized to expose calcium carbonates (limestone) in the soil as well a other depositories of carbon dioxide that could be used to re-thicken the atmosphere. It is even possible that there exist karst regions of long dead limestone caves preserved trough the disappearance of running water.

Of course, the discovery of calcium carbonates on Mars would mean that calcareous shelled animals once abounded in Mars' seas. So even those who could care less about the prospects of thickening the current atmosphere of Mars, but who are more interested in Mars' biological past, should be supportive of such an orbiter.

A Thermal Explorer: An orbiter could carry instruments to map the relative heating and cooling (post sunrise and post sunset) capacity of various areas and to reveal geologically active hotspots that could be trapped someday for geothermal power production.

Future topographic mappers could be made sensitive enough to reveal ancient shorelines and beaches, tiny headwater sources and eroded badlands. Chemical mappers might be made sensitive enough to reveal salt deposits, clays, and other rusted and hydrate-rich soils as well as hydrogen-depleted soils.

The Upshot

The implications of all this new know-ledge for base and settlement location, as well as for architecture, industry, and agriculture cannot be underestimated. Without such knowledge, we will founder about blindly, losing decades, with terrestrial financial support drying up as a result. We need to get the message to those with germane expertise to take a more progressive tack in planning the future of Mars precursor missions so that when we do go to Mars, we will have gone to stay, really!

These are just a few items of an ambitious homework agenda to make the waiting years anything but wasted ones. But the choice is up to us, as individuals because the various societies to which we belong seem disinterested in doing anything other than affecting public policy. If our dreams are important to us, leaving things to policy-makers is a stupid waste of time. **PK**

MMM #60 – November 1992

The Delta Clipper & Access to Space

Commentary by Peter Kokh

Alternative History can be so much fun. This is a literary genre, usually classified as a subcategory of Science Fiction, in which one tries to work out what today's world might have been like if only some pivotal key event had or had not happened. To many of us, especially those who consider them-

selves pro space, the name of William Proxmire, former U.S. Senator from Wisconsin, provokes almost as much shudder as does that of an earlier Wisconsin Senator, Joe McCarthy. Proxmire seemed to be the epitome of anti-space sentiment, a man totally blind to the unlimited possibilities of a future the rest of us saw and still see as self-evident.

Yet to some of us who tried to engage him in dialog, Proxmire began to emerge not as anti-space but anti-economic-nonsense, and yes, there is a difference. He was a harsh critic of the Space Shuttle, and in hindsight, most of his criticisms seem not to have been misguided broadsides but disturbingly right on target. Allow yourselves the unthinkable luxury, just for a moment, of imagining an alternative past in which he had been appointed NASA Administrator and had taken the job seriously. **We just might have ended up with a Space Transportation System that made economic sense,** one that indeed lived up to its pre-operational hype. How much more progress we might have made during the eighties and nineties to date!

While the shuttle is a sophisticated marvel, it has met its original design goals poorly. It is a farce to call something "reusable" when what we really have is something that must be all but "rebuilt" after every launch.

There was nothing wrong with our post-Apollo goals of reusability, fast turnaround time, and cheap access to orbit. There is something tragedy-begging about continuing to rely on a system which has failed to meet these goals. The culprits are easy to find:

√ design-by-committee compromises mismarrying civilian and military needs

√ design compromises forced by congressional and administration preference for lower up front savings no matter to what heights the operational and life-cycle costs might mushroom as a consequence; etc.

For years, rocket scientists have known of an alternative design approach promising one state or one stage plus capacity to orbit, inherent crew safety, low operational costs, and fast turnaround scheduling. But the trend has been to go with what we have, get the most out of a bad investment. **[Snip to end]**

The cure for boredom is curiosity. There is no cure for curiosity - Ellen Parr

MMM #61 - December 1992

NASA's new old Logo, and its new old Mission

Commentary by Peter Kokh

In 1975 a panel of graphic artists supervised by the National Endowment for the Arts helped NASA come up with a new streamlined logo, a 'minimalist' bit of lettering dubbed the "worm" with no pictorial allusions to anything at all. The old one, affectionately known as the "meatball," a circular blue field of stylized star patterns with a bold swashbuckling red arrow slash and an indeterminate something "in orbit" around the middle AS of NASA, suffered from two liabilities.

1) It suggested NASA might have a mission other than to pioneer technology at taxpayer expense (which it didn't have, thanks to Richard Nixon), and

2) It wasn't computer-drawn, in other words, it came off as a relic of a pre-technological past.

Now that Nixon had effectively emasculated the Agency's "ex" drive by purging it of anything more than token trans-orbital missions, the human zeal for the celestial frontier symbolized by the "meatball" needed to be discouraged and neutered. Instead NASA could find new respectability not only by disavowing any sense of cradle-break [as in jailbreak] intent, but by trying to make itself indistinguishable from any other "respectable" enterprise like IBM, K-Mart, or Amtrak.

Now, happy horrors, new NASA Administrator Dan Goldin, as of last May, has given orders to phase out the impotent sterile worm design and replace it with the original insignia as new items are ordered and built. Given this cost-effective transition by attrition, the switch-over will be gradual as befits the befits the gradual revitalization of the agency and the resurrection of its "Moon or Bust and Beyond!" spirit of yore. We hope Goldin and his quiet revolution will survive the transition to the new Clinton Administration. Letters of encouragement to this effect could not be more timely.

Big Budget Missions beyond the yo-yo space of Earth orbit are still out of favor, not so much because they evoke association in the scientifically illiterate with UFO's and ET's and Star Trek, but because we are going through a prolonged depression in national discretionary income - thanks to years of calculated neglect of investment in the nation's industrial underpinnings and its savings pantry for the sake of revengeful "re"-redistribution of wealth to the few. So wisely Goldin seeks now only to pave the way with low budget scout missions and critical R&D efforts. Then, when and if we can find a way to get the country back on a sounder economic footing than lights and mirrors statistics, we will be poised for real activity beyond "the orbitsphere".

It would seem that NASA's long years in limbo are limited, that there just may be daylight at the end of the tunnel, that we are cautiously taking tentative steps to put ourselves back on the right track. A renaissance in our space efforts now at least seems possible. Yet it is too early to pretend the bandwagon for the Final Frontier is now loading on track 3. Sorry to sound a discordant note out of tune with the rest of the space community but potentially the biggest delay is being reinforced by Goldin himself.

NASA's Mission to Pioneer New Technology

Let's get the offensive remarks out of the way at the outset. We view the overwhelming unquestioning endorsement on the part of space enthusiasts of NASA's stated co-mission to pioneer new high technology beyond the current state of the art, as a sad manifestation of vicious-circle dogma entrapment, that is, as our own sorry brand of "fundamentalism". Now that we have everyone angry, let's explain.

NASA was given its "Spin-Off" Mission, less out of logic demanded by the needs of its "Space Pioneering Mission" than by the needs of its "Space Pioneering Mission" than by the need to sell the program to those with more down to Earth preoccupations. One need not be interested in space to see how worthwhile is strong investment in NASA programs.

The consumer will be deluged in "trickle down technology."

NASA's Congressional mandate to preferentially develop "spin-off appropriate" technology has

1) Seriously and unnecessarily inflated the cost of many space programs, and

(2) Sometimes grossly distorted their definition, design, and execution.

This Congressional mandate to maximize missions and programs for their potential industrial, commercial, and consumer spin-offs, a mandate freshly re-endorsed by Goldin, has seriously inflated the cost of major space programs. This has worked powerfully and counterproductively to threaten the continued popular and congressional support needed for their realization. What is even more disturbing to us, the preference for developing and using technology options that promise kudos-wining spin-off perks has at the same time inevitably distorted the definition, design, execution, and relevance to long-term goals of many major projects.

The upshot is that while the cost of space programs balloon out of control, the consumer gets spin-off frosting for a fraction of what he/she ought to pay. Take industrial, commercial, university, and consumer directed cost-inflation out of the Space Budget (letting the consumer get only as many new toys as he/she is willing to pay for directly) and we could have either as much program for less and one better targeted to boot, or an expanded and more appropriately-directed program for as much as we now spend. That would be a win-win situation.

Technology transfer to industry and the consumer economy is, of course, something that NASA should continue to do. What is wrong is choosing, or tilting towards technology options solely or even partially on the basis of their spin-off potential rather than on their mission-related merits alone. That's quite an accusation. So let's illustrate.

Space enthusiasts worked hard to convince the Reagan Administration to start building a Space Station. Most of us, not all, did so because we saw the Station as a necessary building block in a permanent return to the Moon and real development of space resources, and with them the establishment of true frontier settlements beyond low Earth orbit. If the proposed station was to in fact serve this purpose, its design and even its construction technology choices ought to have been maximized to further

this goal. Instead we collectively played dead while NASA maximized the design and function of Freedom for quite other dead-end purposes, all for the sake of building a coalition of support among contingencies who could care less about our ultimate goals.

The upshot is that we have not learned lesson one about how to use non-terrestrial materials.

Lost were a number of opportunities to research and develop station construction materials and methodologies that could be repeated by frontier settlements that will have to rely on indigenous (lunar, asteroidal, Martian) materials if they are to have any hope of eventual economic autonomy. Instead of developing glass-glass composites and new metal alloys that could be duplicated with economically recoverable lunar ingredients, etc. (the list of forgone opportunities is dishearteningly long) the Agency chose instead from a list of sophisticated new materials and technologies on the "wish list" of Earth-bound industries, saving them the cost of doing it themselves. The upshot is that we have not learned lesson one about how to use non-terrestrial materials, either on the Moon or in space for the building of construction camps, solar power satellites, and space settlements. Freedom does advance Earth-bound industry. But it only inches us forward on the space frontier, when its design could have been maximized to give us a mighty boost in the direction we need to go.

While most of us wholeheartedly support Planetary Science Missions (though not the short-sighted budget-pie watchers who fail to realize that these "scouts" must go first if economic resource development is to follow). But we and/or our NSS agents have made no concerted effort to get NASA to maximize their design and instrumentation to uncover possible economically useful resources in addition to satisfying an idle curiosity wish list of those who could care less if mankind brought any of these new worlds into an expanding "econosphere." We have also stood by and let the Planetary Science community select the priority of targets for future probes.

Yes, unveiling of the exotic worlds of the Outer Solar System excites our curiosity. But the real nearer-term need is to "prospect" the Inner System for the underpinnings of a space-based economy on the Moon, Mars, the near-Earth asteroids, and handy dormant comets. If, individually and collectively we continue to look the other way, then will we not deserve the dream-crash that will inevitably befall us?

Daniel Goldin is surprisingly refreshing even to those who hated to see Admiral Truly depart from NASA's helm. But we have an historic tendency in this country to relax when a new leader takes over in a honeymoon climate. Goldin sees much that needs correction at NASA. But he does not see it all. It is put up or shut up time for space enthusiasts and for the National Space Society. Either we must we must stop being 'Don't worry, be happy" wimps or we'll get what we let happen.
PK

MMM #62 - February 1993

A Convincing Economic "Case for Mars" has yet to be made

Mission scenario development has continued to make progress towards the technical and logistic doability of limited engagement crewed exploratory excursions on Mars. Brain-storming of settlement scenarios, however, lags far, far behind.

The claims for the settle-worthiness of Mars have become unexamined rote recitations too many take for granted:

- √ Mars has marginal similarities to Earth: a day of similar length, four seasons, about the same area of land surface, and a gravity level intermediate between f Earth's and the Moon's.
- √ Mars, unlike the Moon, is not deficient in any of the elements needed to support life: nitrogen, carbon, and water-ice. Thus future Martians can both better provide for their own food production and other agricultural needs and locally process and manufacture a greater percentage of the various material goods they need or desire than can settlers on the Moon.
- √ Mars is the most "terraformable" surface venue in the Solar System with its higher gravity, initial air- & sea-stuffs, etc.

But - Lost in the above argument are some very brute economic facts. The Moon has abundant trade assets, namely Earth-deficient energy fuels and/or aids in producing them (solar power gathered on the lunar surface or in orbit and beamed to Earth; Helium-3, the ultimate fusion fuel) to trade for things it lacks and/or cannot yet self-manufacture, or for which it cannot yet realize locally-supported substitutes. This more than makes up for Mars' alleged "non-deficiencies" because it also promises enough of a surplus to support the costs of Lunar settlement itself.

Mars, in contrast, would seem to lack sufficient Earth-marketable assets. These will be needed in quantity to pay the costs of settler passage, settlement construction, and establishment of the needed capital industries to make the planet self-sufficient.

Yes, Mars' exotic scenery will surely draw ultra-affluent tourists and the occasional super-lottery winner. And as the gap between the rich and everyone else continues to widen obscenely on Earth, there is likely to be some tourism with trickle-down wealth sufficient to support a token Mars-side settlement necessary to cater to it. But unless transportation costs come down by more than even the most optimistic of us can today imagine, that traffic does not promise to be enough to pay for even those on site tourist facilities that budget travelers on Earth have long taken for granted, let alone trickle down to support a general settlement economy for those seeking a "fresh start" chance on this "New New World". Tourism of - not on Mars may really 'flourish' only as an armchair diversion for those remaining comfortably on Earth, vicariously immersing themselves in expensively gotten travelogues or real-scenery virtual reality personal explorations without long fortune-draining travel times to and fro.

This picture does not change even if the tabloids are right and there are gargantuan pyramids on Mars built by alien visitors from the stars (and if pigs begin to fly). Even such an unbeatable draw as that would be, would not alter or render moot the underlying economics of tourism. When and if there is some other kind of economic cake, tourism will provide the frosting. It cannot jump start the Martian economy all by itself.

On the Other Hand…

Phobos and Deimos, Mars two mini-moons, have as yet unconfirmed reserves of water-ice or water of hydration and carbon compounds that would be very attractive to Lunar settlements. "PhD" traffic to the Moon, perhaps in the form of refined liquid ammonia and methane, does offer one avenue of revenue to support activities on the Martian surface. But the amount of cost-defraying profit made here depends on how fast a trailblazing Lunar economy develops. Since the PhD gambit is an integral part of a Lunar "trickle down" scenario, the realized profits may at best be only enough to permit the Martian frontier to open slowly in comparison - especially if PhD does not have a corner on the market for "Lunar-deficients". And this could be the case depending how quickly alternative, potentially richer, asteroidal sources come on line.

What about…? Might early explorers find something already existing on Mars like a rare mineral valued for manufacture or perhaps prized for sculpture? Or might they stumble upon an inexhaustible lode of gemstones of unmatched quality or character?

Let's do a reality check here. The few elements that Earth needs in greater quantity than it has will be more economically sourceable on the Moon (Helium-3) or on Earth-approaching, even Main Belt, asteroids (strategic metals: platinum, cobalt, etc.). As to minerals and natural gemstones, elements in combination, these are produced by geological processes, and by all standards but one, Mars has been far less geologically active than Earth. As a result, the Martian repertoire of minerals is likely to be both less diverse and less abundant than Earth's, with little chance of something new, strange, or exotic enough to be marketable.

The exception is fixed-site volcanism. On Earth, crustal plates drift over fixed magma hot spots to create strings of volcanoes like the Hawaiian Islands. On Mars, with some spectacular crustal rifting (Valles Marineris) but no drifting plates subducting or overriding one another at their boundaries, similar magma hot spots have built up very high shield volcanoes over very long periods of time. This process is most unlikely to produce strategic mineral wealth galore, but just may have produced the ultimate "King Solomon's Mines." If so, is this the sort of wealth, which can finance a general opening of the Martian frontier? My guess is no.

Another possibility one can conjure up is that for some heaven-can-imagine-what reason, pressurized agricultural facilities on Mars will be able to produce unique fruits, grains, pharmaceuticals, dyes, or fibers that cannot be matched on Earth and which will be much in demand. One can think of

two Mars-special niche features, which might underpin such a development. The first is the 3/8ths Earth-normal gravity. It is hard to see where this could lead to a produce improvement that the 1/6th Earth-normal gravity on the Moon couldn't beat.

The second is the possibility of bioengineering unique "Mars-hardy" plant varieties that can establish a foothold and thrive "outdoors" on the surface in a thickened carbon dioxide atmosphere once "terra-forming" is already well underway. This is not at all implausible. Moreover, it is a scenario that can be "forced", in anticipation of such someday terraforming, in special greenhouses on Earth itself.

A variation on this theme is the far-fetched chance that something growable only on Mars would provide, at last, the fabled fountain of youth. Fat chance! If living on Mars should prove in any sense more healthful than living on Earth, there'll always be the negative tradeoffs of the dangers of relocating there in the first place - the long space voyage etc. No matter, for health is not exportable, not a cash crop.

In the meantime...

So how pessimistic should we be about establishing a plausible Economic Case for Opening the Martian Frontier? Pessimism is the refuge of those unwilling to do anything to change the odds. Those of us with a faith in the future of Mars, one that we refuse to surrender, have homework to do.

First, we must push hard for thorough geochemical exploration of Mars, and for the laying out of the planet's "economic geography" in thorough detail. Not only would this be necessary to plan the settlement of Mars in a rational manner to maximize earliest economic self-sufficiency, it is our only hope for finding any yet unknown elixir or manna or Klondike on Mars that might help pay the bills for pioneering it. Its not enough for us to trust that the ivory tower curiosity of planetary scientists will lead them to plan an adequate geo-chemical and resource exploration of the planet to do the job. Our pragmatic interests go well beyond their intellectual ones and we must pace them, not they us.

Second, we must work to pre-develop, debug, and miniaturize the capital equipment it will be necessary to bring to Mars to manufacture the bulk of the settlement's material needs.

Third we must support development of efficient agricultural production units suitable for Mars. Beyond that, we need to support an imaginative and vigorous program to identify potential "Mars-hardy" plant varieties and develop them by all means available into a pantry of species that will thrive in "enhanced" Martian conditions, i.e. in thickened CO2 Mars air.

While we may not uncover a miracle economic linch-pin, we will be lowering the formidable economic threshold for settlement. And while we may not be hastening the day when humans finally set foot on Mars, we will be doing something to make sure that that gambit, once finally played, is not another stalemate à la Apollo. For we will have done something towards making it possible extend and expand our presence there, in the direction of permanent settlement. And that's one hell of a lot more than will be achieved by those who merely push the politicos.

So why whimper? Suspend judgment on the eventual outcome and begin to whittle away the negative odds. Be the spiritual ancestors of Martians perhaps yet unborn. **PK**

MMM #64 - April 1994

We need a Pro-Space "Terrestrial Policy"

Most space advocates, if questioned, would probably agree that the only sort of viable Space-based Economy is one that is not only thoroughly integrated with our ever developing Terrestrial Economy but must actually grow out of it with an inexorable necessity. But if this is so obvious, our exclusive concentration on putting into place just the spacefaring components and elements of this projected integrated Earth-Space Economy is flabbergastingly stupid. For the directions in which the Terrestrial Economy develops and expands will involve choices of options, not always intelligently made. Some of these might provide less fertile ground, less bouncy a springboard for expansion into our planetary hinterspace.

If the Space Economy is to grow out of the Terrestrial one, then ought we not to be equally, even primarily concerned with "growing the terrestrial economy" in such a way that its dependency on space-based resources increases step by step so as to make "the rest of the story" unstoppable? Clearly, we as

a Society need to develop and adopt and pursue with all due vigor and attention, a pro-space "Terrestrial Policy". Having a well-thought-out "Space Policy" alone just makes no sense. Without the former, we could remain on a self-limiting, self-chosen, self-defeating course to nowhere.

Everyone will agree that a prerequisite for a friendly future is a greatly strengthened industrial and economic base. We must abandon the Republican notion that we do not need a U.S. "industrial policy" - the idea that an economy that is allowed to "drift naturally" towards a predominantly Serivce-Sector-heavy state can support a spacefaring civilization should be patently absurd. We ought to make noises with enough decibels to see to it that the favorable pre-election Clinton positions in this regard do not get lost in the shuffle.

The National Space Society has always been concerned about the state of education in this country. The Public space I.Q. is dangerously low. But our efforts to date, both to beef up school curricula on space and aerospace and to provide suitable support materials for this purpose, and to educate the public at large through the media and chapter-based outreach efforts, while all laudable, continues to build on sandy foundations. We need to naggingly promote improved science education in general, not for the few who might go on to be scientists and engineers, but for everyone so they can function more adequately as informed citizens.

In this regard, priority emphasis on Math and Physics is misplaced. The public needs to understand things on a more concrete level. Those without Solar System Astronomy 101, Chemistry 101, and Biosphere-Ecosystem-Environment 101, are ill-prepared to participate intelligently in the critical debates facing this country and the world. Those whose knowledge of these areas is largely erroneous - not just skimpy - can only be "tricked" into supporting space by offering them short-attention-span "Spin-off candies".

NASA's public outreach efforts, given prevailing widespread misconceptions and ignorance about the basic structure of the physical world and of Earth's trans-atmospheric neighborhood, is largely ineffective. Instead, the agency goes a long way to under-mine its outreach mission by its penchant for runaway acronym mania. NSS could marshal the educator segment of its membership to present NASA with an alternative to its mis-cherished jargonese. Give it priority!

Creating Vested Interests in Space-Based Energy

Most of us are agreed that our collective hopes for the future are tied to an eventual turn to space-based energy scenarios which would see the use of lunar materials for the construction either of many large solar power satellites in geosynch orbit or of vast arrays of solar collectors on the Moon's limbs, with Relay satellites in geosynch orbit - or large scale Helium-3 harvesting operations on the Moon to feed future fusion power plants on Earth. Most likely, some combination of these will arise.

But we largely fail to grasp that powerful vested interests in present energy supply modes and sources continue to operate to prevent timely R&D of the precursor technologies needed to make space-based energy delivery a practical and feasible and affordable option. Before this climate will change, a paradigm shift in production and use of energy must precede. Call it the Trojan Horse Gambit, if you will, but access to the door to space-based energy is blocked by a storm door with several locks. NSS must develop a strategic plan (our present long-term strategy committee is effetely bogged down in word games over the NSS Mission Statement) to support precursor energy developments that will radically alter the vested interests situation.

1. We should support any and all research that will help usher in a "hydrogen economy" - in which surplus electricity is used to electrolyze sea water into oxygen and hydrogen, and in which we have learned how to pipe and ship liquid hydrogen safely to both fixed and mobile use locations - power plants and vehicle engines. The game is not only to present King Oil with its first real challenger, but to force a major boost in electricity demand in its stead, to favor clean-burning LH^2 over dirty-burning oil, clean electricity over environmentally-taxing drilling and mining.

NASP, the National National AeroSpace Plane, would require major breakthroughs in our present limited ability to handle, store, and ship liquid hydrogen. While the Delta Clipper SSTO may seem like an acceptable alternative, its attractive use of existing technologies, makes it a consolation prize with a heavy price down the road. Cheap access to space, while the storm door to space-based power remains securely deadbolted, is a temporary fix. For Heaven's sake, let's be less short-sighted than that. Let's not give up support for NASP. Rather, let us intensify it. If we think we are going to get SPS without an LH^2 economy, we are self-deluded.

2. We must strongly support continued nuclear Fusion research. We joke about fusion being a technology "30 years in the future for the last 30 years". But there has been significant progress, and "breakeven" is tauntingly within reach. Dr. Jerry Kulcinski at the University of Wisconsin in Madison, pioneer of the Helium-3 Moon Mining concept, is confident that remaining engineering obstacles can fall within the next 10-15 years - with continued funding support. Once fusion is demonstrated with deuterium and tritium, the vastly more attractive Helium-3 fuel option will become a juggernaut.

3. We must also encourage R&D on precursor technologies needed for an SPS or Lunar Solar Array system built of lunar resources. The present honeymoon with germanium arsenide-based solar cells is a flirtation with a dead end. We cannot produce such items on the Moon. Rather we need to promote silicon technology breakthroughs. Our current infatuation with super high tech - at the expense of "lunar-appropriate tech" - is suicidal.

We must push precursor technologies at every point, outside NASA, where work can be done much more efficiently for near-term terrestrial profits. We should argue for increased R&D tax incentives across the board. Anything that helps the economy with more than smoke and mirrors, advances the cause of space development and the opening of the frontier.

In general we need to spend much more time and effort developing a pro-space "Terrestrial Policy". We haven't even thought about beginning to do so! We are not just building foundations with sand, but out of soap bubbles. **PK**

MMM #65 - May 1993

Career Choices in Spin-up Technologies

Okay, so it's going to be a while before we get into space big time, where lots of people are going spaceside for work or pleasure, even to live. So what do I do in the mean-time? Sit on my behind and watch Star Trek NG and DS9?

I want to earn my living in a way that helps realize my dreams. But aerospace employment opportunities are fast a-dwindling. So what do I do? Write science-fiction? Make toy laser guns and phasers?

For a bunch of people with sky-is-no-limit imaginations, when it comes to career choices, space-interested people consistently demonstrate very little imagination at all. For a population group with an especially high conviction and faith in the free enterprise system, when it comes to researching income-producing opportunities, space buffs seem to display all the entrepreneurial tropism of your average caterpillar.

The answers lie under our noses in the opportunities galore to make a "living" developing down-to-Earth solutions for down-to-Earth market needs that just happen to have high potential space applications. Last month we talked about the need to develop, adopt, and pursue a pro-space "Terrestrial Policy". But what is good for us as a group might just be good for some of us individually. When you look at a career choice or a potential mid-life career change, consider a pro-space "Terrestrial Policy" of your own, ways to make money here and now that may have the happy effect down the road of accelerating the development of the space frontier - once it is truly "open". Here are some ideas from past issues of MMM.

Glass Glass Composites:

Prior experience: glass, fiberglass, fiberglass-reinforced composites; **market opportunities:** initially, upscale furniture where price competition is not a factor (try colored fiberglass in clear matrix, try combing or graining the fibers; use a matrix glass formulation that can be duplicated on the Moon; explore fabrication methods and develop styles to showcase the unique qualities of the enhanced composite; after debugging the process and developing fabrication experience and market contacts, graduate to architectural elements, experiment with safety glass doors and windows, pipe and conduit, tanks for chemicals, etc. Further Reading: MMM # 16 "Glass Glass Composites"

Dry Mining and Processing Byproduct Uses:

Experience: chemical engineering; bulk handling systems, industrial ceramics, byproduct surplus exchange networks. **Market Opportunities:** A) Otherwise promising mining sites without adequate access to water supply; Experiment with dry or water-conserving methods of handling and treatment; B) Poor ores barely economically recoverable. Earn the crucial difference for your company by finding ways to produce a second element; or manufacture building materials from the tailings for special markets.) More: MMM #23 "Tailings".

INDUSTRIAL PARK SYSTEMS:

Prior Experience: Energy use and cogeneration systems, computer database waste and byproduct exchanges. **Market Opportunities:** Develop a winning sales pitch for your new Industrial Park and an irresistible draw for your urban area by researching industrial ecosystems - complexes of plants and industries that can use one another's waste heat in a logical cascade from those producing the most heat and at highest temperatures to those needing the least (involve the local electric and gas utilities); complexes of plants in which the byproduct of one is a needed raw material for another, alleviating transport and disposal problems and attendant income loss.

LIQUID AIRLOCKS:

Prior experience: materials handling systems; familiarity with gallium. **Market Opportunities:** Manufacturing operations requiring special separate or ultra-clean atmospheres. See MMM #17 "Liquid Airlocks."

DEVELOP NEXT GENERATION OF REMOTE SENSING EQUIPMENT:

Prior experience: electronics and physics and computers. **Market Opportunities:** deep reaching radar systems for subterranean archeology; oil, gas, and permafrost exploration; orbital prospecting systems; extreme environment probe technology (high pressure, high temperature, radioactive, corrosive, and unstable environments).

DEVELOP INDEPENDENT "CLOSED LOOP" WATER AND AIR SYSTEMS FOR INDUSTRIAL OPERATIONS:

Prior experience: Water and air conditioning systems. **Market Opportunities: e**nable once polluting industries to remain, even expand in areas becoming hostile to them.

INDUSTRIAL DESIGN OF "KOSHER" PRODUCTS THAT DO NOT BOND ORGANIC AND INORGANIC PARTS:

Prior experience: fabrication of organic and inorganic materials; industrial assembly design. **Market Opportunities:** Product development for companies that are required (the rule now in Europe) to take back their products for recycling, and hence highly motivated to develop new product lines using materials and manufacturing processes that make this legislated recycling burden much easier and more profitable.

In the Field of Agriculture

√ **WAYS TO ACCELERATE RECYCLING OF WASTE BIOMASS AND INEDIBLE PLANT MATERIALS AND/OR GROW OR PRODUCE MORE FOOD IN THE PROCESS**

√ **GENETIC ENGINEERING OF PLANTS WITH HIGHER PERCENTAGES OF EDIBLE MATTER,** or that yield better non-food byproducts; of bacterial or yeast cultures that can better "bioextract" trace elements present in soils in parts per thousand, million, and billion.

√ **EXPERIMENT WITH LED-GROWN CROPS** that save energy in winter greenhouses. Prior experience: experimental agriculture and food processing, organic chemistry. Market Opportunities: More food from dwindling acreage for hungry nations; export potential.

There must be a host of other products and processes awaiting the light of day that will be of great service on the space frontier and here on Earth. And one may be freer to make a contribution as an independent entrepreneur or inventor than as part of a corporate team. List your experience and aptitudes and interests, and we'll try to suggest some directions. **PK**

MMM #66 - June 1993

Towards a Definition of "Spacefaring"

Whatever the debate about space-spending, we have long since become a space-using and space-dependent civilization. In the past three plus decades, our way of life and economy has grown a second set of roots taping the fertility of space to complement the fertility of the soil. Communications satellites, weather satellites, remote sensing and thematic mapping satellites, global positioning satellites, search and rescue satellites, navigation satellites, etc. Not to forget a second layer of data relay satellites that tie them all together.

In addition to the various onion peel "-sphere" levels of the Earth itself, and of its hydrosphere, biosphere, and atmosphere, we have subtly become inextricably bound up with the "vantagesphere", orbital space from just above the atmosphere up to and including the Clarke orbit or geosynchronous orbit 22,300 miles up. In the past century, we have gone from a 2-dimensional surface-hugging civilization, to one increasingly dependent upon the lower atmosphere for travel, traffic and terror, to one systemically present in a volume several times that of our native niche.

Does all this make us "spacefaring"? Sometimes you do see this word in print as an epithet for the U.S., Europe, Japan, and the former Soviets. But most of us rightly suspect "we ain't there yet!" Let's look at the millennia-old parallel of our "intervolvement" with the Sea.

SEA far ing: adj. 1. traveling by sea.
2. following the sea as a trade, business, or calling.

To follow this precedent, we would not be a space-faring civilization until we routinely travel and do business "by space". And the implication is that we engage in such activities in person, not by robot proxies.

What have we now? Two space agencies that are capable of sending out crewed scouting missions of which only one all-too-hastily canceled series ventured so far as the first rock past the sheltered lee-space behind the Van Allen Belt breakwaters. Rather than spacefaring (on a par with open-water sailing) we are still timidly "coastal". We have a few lighthouses and buoys so to speak in our satellites.

Our mariners have only gone out on "scientific expeditions". We do not yet routinely travel "by space", not even We do not yet routinely travel "by space", not even timorously hugging the atmospheric shores. We will not reach that stage until transatmospheric aerospaceplanes begin first chartered, later scheduled, service between the continents.

The next, still "mommy-hugging" step would be permanently crewed outposts and then tourist facilities in sheltered coastal orbits. Yet when we reach these stages some 20-30 years hence, if we have progressed no further, we will still not have earned the right to call ourselves "spacefaring."

To follow our parallel we have only thought about "going deep-sea fishing" for food (read non-terrestrial materials and space-sourced energy). We have yet to set up a "contra-coastal" outpost on an opposite "shore" of any 'island' or 'continent' other than our 'homeland' coast. Not a cent or our trade in any commodity other than information is routed "by space". No tourists travel "by space" to "foreign" shores or even take "cruises" - on either side of the breakwater.

Much effort has gone into incessant debate over the Mission and Vision Statements of the National Space Society. The early consensus is first, that we will have become space-faring when appreciable numbers of people routinely live and work "in space". Those who imagine that this milestone is satisfied by the establishment of "working' outposts within the sheltered "breakwater" -- and there are many -- clearly do not share the core vision of the co-founding L5 Society. We have called for the establishment of communities beyond Earth. It is now high time to clarify that statement.

The "**coastal space**" of the vantageshphere is still
an intrinsic part of Planet Earth.

"**Beyond Earth**" means beyond geosynchronous orbit.

In addition to this qualification, we ought to state explicitly that we aim at the establishment of an Earth-Space Economy, in which "fishing at space" for energy, and resource development in the open "sea" or "on other shores" is begun in earnest and takes on an ever increasing importance. Only then will our civilization establish viable offshore pockets or colonies, and only then will be doing business, and some of us earning our livelihood, "at space".

This will all happen gradually. We have yet to do real prospecting on even the closest shore, that of the Moon. Once a decision is made to start accessing resources beyond the breakwater, our first outposts will be small, and contain only rotating crews who have volunteered for limited tours of duty.

We will then, and only then, first be on the verge of becoming a “spacefaring” species. When the first real settlement comprised of life-settlers and their families is established to pursue non-terrestrial resource development and proves itself viable and capable of providing for the bulk of it own material needs and able to trade profitably for the rest- then we will have crossed the threshold -- just.

Additional settlements and outposts, some lunar and planetary, others in free space, will follow. The range of our resource-gathering and foraging and of our industrial agriculture-based biospheres will slowly expand beyond the hinter-space of the Earth-Moon twin planet system. With our settling/ resource gathering and foraging and f our industrial agriculture-based biospheres will slowly expand beyond the hinterland of the Earth-Moon twin planet system. When our settling and resource gathering reach to Mars and the asteroids, we will graduate to being System-faring. Whether we will ever develop beyond that to fare the boundless interstellar spaces will be an open question, perhaps for centuries.

At any rate, it is clear that we have not yet begun. While the current winds are far from favorable, we can still busy ourselves with make-or-break precursor tasks.

Courage! Do! **PK**

MMM #70 - November 1993

Time for A Space Transportation System Sunset Act

In the immediate post-Apollo years when, despite the Neanderthal proclivities of the Nixon administration and the all-too-quickly jaded Media, we all expected so much, the early hype over the concept of a “reusable” space “shuttle” won us over easily and without healthy devil’s advocate criticism. Those who did take a second look at how the actual shuttle program was developing, and expressed reservations that in retrospect were more than totally justified - I think of much-maligned Senator William Proxmire (D-WI) - were summarily kangaroo-courted into the “archenemy” pigeonhole.

In general, the space advocate community has shown itself juvenile and immature in its rejection of criticism, being too youthfully self-assured to realize that, whether or not the “enemy’s” conclusions were acceptable or not, there may be more than a grain of truth in his/her/their objections that we absolutely need to consider if we are to end up proposing, designing, and building the kind of hardware or system or infrastructure that will truly serve our needs. Much as if we were some sect of religious fundamentalists, our emotional need to be 100% right did not allow us any doubts.

It is perhaps honest to say that even had we been more mature, more patient, more careful to encourage a shuttle program that was true to the original goals and vision, we might not have prevailed against the powerful forces of the ingrained Congressional mentality “nine stitches later rather than one stitch now” and the politically necessary cascade of incessant committee redesigns, equal to the Feats of Hercules. It is not possible for the political process to design anything “right” - that is not its purpose! And so long as the space activist community remains under the hypnotic control of the “Space as Public Policy” types long in control of the National Space Society and its predecessor and sister organizations, another outcome is hard to conceive as alternate history. Yet it is a Cosmic Law (upper case appropriate) that impatience must inevitably undermine one’s so strongly pursued goals. We assuredly deserve some of the blame for what has gone wrong.

However the blame should be assessed - there is a lot to go around - we are seemingly stuck with a Space Transportation System, aka “Shuttle”, that does not perform as intended or advertised and which indeed seems to have lived up to all of Senator Proxmire’s unwelcome characterizations. First, it is by no known definition of honesty “reusable”. It is in major part only “rebuildable” or at best ”overhaulable”. Witness the recent case when a mission had to be aborted after the main engines had fired but three seconds - with the result that these engines had to be “overhauled”, a six-week process, before another launch attempt could be made.

The fault here lies with the original decision to go with engines at the very edge of the limits of technology - for that little extra kick - even if it meant one plus orders of magnitude direct and indirect cost the limits of technology - for that “little extra” kick - even if it meant one plus orders of magnitude direct and indirect cost is that those of us who have refused to learn from history are fated to continue

Sisyphus-like in our hitherto unproductive patterns, ensuring only that our enemies will have been annoyed by us on their inevitable press to crushing victory.

Helpfully the former Bush Administration has already taken the first step, by its (admittedly reversible) decision not to fund any additional Shuttle Orbiters. Endeavor is to be the last. We must hold up this decision as our grounds for legitimacy and build upon it as a foundation, making it the opening "Whereas" in our proposed bill. Given Bush's gambit, it is the "STS Protectors," not us, who are out of step.

Writing the STS Sunset Act (STSSA)

Let's go beyond the "whereases", the subject of all the forgoing. Our STSSA should

1) Reaffirm by law the Bush Administration decision not to build additional Shuttle Orbites, but rather to get the most out of the existing fleet;
2) Set in place Budget and Program measures (both NASA and extra-NASA) to ensure that as the existing four Orbiters reach the end of their useful rebuildability and serviceability (or are lost in accidents or otherwise retired) new commercially operable, commercially viable, and commercially operated crew-worthy replacement systems are in place or coming on line;
3) Affirm the intention thereby to phase NASA out of the Operations role and concentrate the Agency's attention and efforts more single-mindedly on pathfinder technology development.

Let's pencil in some concrete specific suggestions to get the discussion in the space support community underway. BUDGET: 10% of the NASA STS Operations Budget - or alternately, 1/xth (x = number of actual shuttle flights in the previous fiscal year) times the previous year's NASA STS Operations Budget is to be pre-appropriated by law (not subject to annual budget review by OMB or Congressional Subcommittees but only by revision of the STSSA) for techno-logy development and demonstration of commercially-appropriate replacement systems defined as

> those having turnaround times and ground support requirements that promise one or two orders of magnitude improvement over those characteristic of STS operation.

Of this amount let's further suggest, as an opening for discussion, that 2/3rds must be spent on systems that have the potential to be per se crew-worthy, and 1/3rd must be spent on systems especially designed to move bulk (both pelletizable materials and integral oversize/overweight items) into orbit more cheaply. The effect will be to supply funding for R&D on:

- √ Delta Clipper and/or other SSTO and TSTO systems
- √ Launch guns and economic heavy lifters.

4) The STSSA would require that as commercially-viable alternatives come on line, NASA's STS manifest be allowed to shrink by attrition. At the same time, orbiter overhauls should be cutback or stretched out as appropriate for ground crews allowed to shrink by attrition and incentivized early retirement.
5) Since NASA would not only be gradually weaned of Shuttle in the specific but eased out of the STS Operations role in general, the STSSA would provide funds for the establishment of a Space Academy for commercial crews. Where use of existing NASA astronaut training facilities makes economic sense, i.e. where greater savings are not to be made by building new facilities, these NASA facilities can be turnkeyed to the Commercial Space Academy authority.

Our goal will to be to write a piece of legislation that provides a fully compensated transition between the NASA STS and replacement systems that encourages and incentivizes commercial development of alternative vehicles and at the same time helps NASA to adjust to the new shift in emphasis and "come back home" to its originally mandated role and inspiration.

While the above transition is being and then gradually realized, we will have a lengthy "meanwhile" period and it will be important for our STSSA to address this in depth. E.g. "meanwhile"

6) NASA should not fly the limited life-time Orbiters without reason i.e. put an end to some of the "trivial (scientific) curiosity missions" now being flown for lack of something better to do being budgeted (fighting words to some, but we have no intention of taking them back). Plus
7) NASA should not fly missions with less than full crews but use open seats for scientific observers, journalists, teachers, writers, lottery winners, getaway special mission payload attendants etc.
8) NASA should not fly without enough to keep a full crew busy.
9) NASA should not fly missions shorter than the full mission duration of which the Orbiter being used is capable.

Also, meanwhile,

10) NASA should allow its own astronaut corps to shrink by attrition. It should preferentially fly those who have signed on to join the Commercial Astronaut Corps in order to build up a pool of pre-experienced personnel. If extra crew are needed by NASA in the interim, the Agency should in turn hire-for-the-mission astronauts and qualified crew being graduated by the Commercial Space Academy, provding them with Orbiter- and Mission-specific additional training as needed.

People - Payload - Purpose; these are the keys to a proper use of shrinking NASA resources and of the growing Commercial resources in the transition period established by the STSSA. By careful attention to the transition provisions of the act, the "sunset" of the Shuttle Orbiters can be a pain-free and happy one of justly deserved gradual retirement with full honors for the yeoman work they will have done through the 80s, 90s, and early oughts in keeping alive and expanding the role of manned activity in space.

By providing for an honorable and orderly transition to a new generation of vehicles, vehicle operations, and vehicle operators, the STSSA will be a vital element in moving from an era of elitist, token, proxy human presence in space to the era of genuine opening of space as a "Human Frontier", not just a technological and scientific frontier. But first we must write and debug the law and build a strong coalition of support for its introduction and eventual passage in Congress - over the dead bodies of "the BAU Crowd" (i.e. business-as-usual) if necessary, but hopefully by winning them over to interests at stake other than those of turf protection now in full play.

Our first task is to gather comment and to continue to circulate this proposal and put together a team to write the actual language of STSSA prior to trying to find introductory sponsors in both houses. This is where y'all come in! **PK**

MMM #72 - February 1994

Escape from the "Retreat from the Moon"

Springs of Demoralization

In the space movement, a wavefront of demoralization and passivity has come ashore in recent years and is continuing to sweep inland over our collective spirits. There is a growing, still not fully admitted, cynicism about the real chances of a Return to the Moon's surface and progress towards permanent incorporation of its "magnificently desolate" horizons within an expanded human "world" or ecumene.

Some of this diffidence is our own fault. We are, and have always been, intimidated by the vast scope of the Apollo Project and of the CO$T of Projects à la NASA in general. This awe paralyzes our potential alternative efforts before we can even conceptualize them. We too timidly affirm that there is a faster, cheaper, better way of doing things.

But in part our worry is well grounded. The "times" have unalterably changed. The 1990s are not the 1960s: we have collectively side-slipped into a time-dimension of diminished personal, institutional, and national expectations; the end of affluence for the middle class and its calculated decimation. In the '80s a devil-take-the-hindmost philosophy was officially promoted as we knowingly risked an aggravated polarization of society and undermined joint endeavor agendas in a lurid glorification of unchecked personal self-interest.

It is not just that we are no longer interested in grand collective goals. The innocent notion of Perpetual Prosperity and Progress which long nourished a proud national generosity with our expected "National Discretionary Income" has been shattered beyond recovery. Those who think The Spirit of Apollo can be rekindled by a similar National Metaprogram, are detached by this delusion from the national experience. Worthiness and desirability do not make blips on the National Budgetary Radar Screen. Intangibles don't rate any more. In this age when most Americans have had to tighten our belts drastically and have had to do without an increasing number of things we once took for granted, the

spectacle of ostrich-like space advocates dangling before us yet-to-be-identified future spin-off goodies comes across as a clearly contemptible insult to common o common intelligence.

First we must face these realities. Then we must learn to work with the grain of the Current Context, not against it. Finally, we have to blaze an altogether different path back to the Moon, and our past experience will not be much help.

The Choir has No Clothes

The current discussion whether indeed "NASA has no clothes" and is a bankrupt institution, or whether at last the Agency is on a painful obstacle-strewn road to recovery under new leadership - is really irrelevant. Even a revitalized NASA cannot lead us back to the Moon under the current national conditions which are likely to prevail well into the foreseeable future. We are now trapped in the paradigm of the Zero Sum Game. We have grown collectively fatalistic. The "Escape Key" to get us out of this dead end routine can only be pushed by those who can find it on the keyboard of action opportunities. For those trapped in Retreat Mood Mode, the routine escape key remains well hidden; and only hopelessly inappropriate or inadequate exit ploys suggest themselves.

Space advocates who remain mired in the outmoded thought and action ways of the past, cannot forge the future. The plea that we "not preach to the choir" has no force. For the choir has no clothes as well. On the one hand, in the search of almighty numbers, the ranks of the choir have been deliberately swelled with "fellow travelers" who have never shared "the vision" of humanity leaving its cradle world in non-token numbers. On the other hand, most of those, who have shared "the vision", can only think of means and methods that had a very limited "window of applicability" during the 1960s. Can such self-aged old dogs learn new tricks?

Illustrating the point, we collectively display far too narrow a concept of what is space-relevant. When we think about space enterprise, we think mainly of satellite and probe manufacturers, Earth orbital applications, and newfangled launch vehicles. For a group which boasts of being forward thinking, we have almost no real imagination at all.

We need to be busy less with renewed plodding along the traditional ruts of media and political activism, than with the industrious laying of innovative concrete "space-enabling" technology and enterprise foundations. Within that rubric we need to be much less exclusively preoccupied with promoting improved Space Access and more inclusively preoccupied with promoting improved Space Resource Utilization Technologies and Precursor Profit-Generating Terrestrial "Spin-Up" Enterprises to debug them. We need to do this in preparation not for the return of better times but for the dawn of yet unforeseen opportunities that may lie outside the range of historic molds.

Space Education in a Vacuum is Wasted Effort

Education is indeed one part of space advocacy that continues to be valid - but, only under the condition that what we teach is relevant. In this day and age when most people have a hopelessly inadequate sense of both World and U.S. geography (location and relative size of states; for example, Milwaukee is not now, nor never has been, in Minnesota) popular ideas about the Solar System offer even less hope of rational understanding of the choices facing humanity.

And it is hard to see how anyone can contribute to the national debate, let alone lead it as an elected representative, who lacks basic notions of the elemental and chemical structure of matter. Basic early high school level chemistry, physics, geography, geology, and astronomy should not be electives. It is pointless to huckster space to those without such rudiments.

Where such basic education is offered, we need to push inclusion of the "Economic Geography of the Solar System". But none of the so-called "space curriculum" text materials I have seen takes this plunge. If the public is to support and help fashion intelligent national policy, it has to be primed with the necessary background information. Space Education today is by and large but a Quixotic tilting at windmills.

Starting Afresh, Taking Ownership

1) INDIVIDUAL ACTON: Those willing to take real responsibility for our future (rather than abandon it to the potluck of government) have more potential clout than most dare realize. But our efforts are too easily thwarted, on three main fronts.

a) We have significant others unsympathetic to our agenda.

b) We cannot find non-token discretionary personal funds

c) We cannot free up useful time in our busy daily schedules.

We must start soliciting, collecting, and sharing any helpful hints from those not so trapped.

a) Those of us still, or newly single, ought to be true enough to ourselves and our own dreams to make sharing a World View that includes human expansion into expansion into space a litmus test. We do not marry just individual warm bodies - we marry our own personal world to that of the other. If these are not compatible worlds, one or both must be compromised seriously if the union is to be maintained. If his/her world is incompatible with mine, then he/she is not holistically compatible with me, no matter what the physical chemistry. If we can't be this honest, then we should stop hypocritically proclaiming our interest in space. That leaves us with the question: is the time not ripe for a Spacebound Computer Matchmaking Service?

b) Many of us are caught in a truly challenging no- fun game of repeated belt-tightening as our real incomes continue to shrink. For us the only way to find discretionary funds is to eliminate some budget items in favor of others.

But for those fortunate enough to be still enjoying an upswing in their personal economic fortunes, there is a plan that makes sense - that is, if space is an honest "top priority". This is the **Income Growth Tithing plan.** It involves a personal relatively painless but dramatically effective pledge to tithe (take 10%) of all future raises, gifts, winnings, and other windfalls and put it towards supporting some space frontier door-opening project of choice, or Mutual Fund. Money so isolated will be small at first, but, as and if personal prosperity continues, snowball amazingly over time. The plan is flexible. No growth, no additional tithe. If income drops, tithing can be retrenched. The plan can be extended to the disposition of one's final estate, as a recommended option.

c) Free time is not entirely a matter beyond our control, at least not to the extent we all make excuses. It is a question of priorities, of identifying forms of procrastination, time-treading, and time-dissipation. It is a question of "fencing off" personal time as "sacred from intrusion by others". Above all, it is a question of honest priorities. We are all able to make time, somehow, for what we really have put at the top of our list.

2) EDUCATION: We need to take ownership of space education's Lessons, ending the stress on bare science that draws no connection to the really significant commercial and industrial applications and opportunities of space:

√ space is a place to no connection to the really significant commercial and economic applications and opportunities of space: where we've been in space is only of interest as a prelude to where we're going.

√ space is a place to find fresh beginnings in culture, in economics, in social and political organization.

√ space is a place to put some of our Human and Gaian "eggs" outside of our fragile solitary "birth basket"

√ space is a place that will allow the human mind and spirit and body to realize new capabilities and possibilities and thereby reflect even greater glory upon the Force(s) that brought us into being. We need the unfamiliar challenges of space and raw new world settings to more fully develop the full range and depth of human talent potential, i.e. "to be all that we can be", collectively.

3) RULES OF "THE POLITICS GAME": We need to snap out of the "culture" of fatalistic acceptance of the way the Politics Game is played in Congress, instead accepting real responsibility for what those rules are. "Rational" space policy cannot directly flow from the political process engaged under current rules. We must cease confusing democracy with rabbleocracy, which in fact, through pork barrelitis, is what we now "enjoy". It is time to work to change the rules of the game.

√ We must change the turf map for budget discussions, ending the lumping of NASA with HUD etc.

√ We must separate "spending" from "investment" in discussions of Deficit Control measures

√ We must wean Congress' hands off the steering wheel, allowing it the "high" of its foot on the throttle, i.e. getting it out of micro-management mode

√ We must seek establishment of an independent authority* with dedicated focused mission responsibility, not for space exploration, (leaving that to NASA) but for space-based energy and resource recovery, endowed with real independent revenue authority.

[* **SPEAR**, **SP**ace Energy **A**nd **R**esource **A**uthority is a name suggestion. This can be set up as an independent corporation with access to germane revenues, for example, by authority to levy a surcharge, within a set range, on all residential, commercial, and industrial electric bills.]

4) APPROACH TO POLITICAL ACTION: First we must cease this silly nonsense of trying to get the whole country to see it our way and deliver us our realized special interest agenda on a silver platter. This nation is a society and government of "those who intend to stay behind". Ultimately, would it not make more sense for us to organize ourselves, and operate, as a Society and Government in Exile of "those who want to go"?

In the meantime, we must continue the switch in emphasis from advocacy of traditional "government space programs" and missions to advocacy of "Commercial Space" legislation that will √ facilitate, √ leverage and √ incentivize with seed and reward money a greatly accelerated comerciali-zation of space activities. This is the only way to wean aero-space **contractors** from secure government "spacefare". And it is the only way to increase the size of the space business "pie".

Currently, the National Space Society, SpaceCause, the Space Access Society, and the Space Frontier Foundation are all moving strongly in this direction. We need to seriously brainstorm the full range and natural sequence of legislative opportunities in this regard. We must put intra-movement rivalries on hold and increase our serious networking. **PK**

MMM #75 - May 1994

Successive World Views: Space as a "Face, Race, Base, Place"

By successive, we are referring to the logical order. In point of fact disciples of all three "immature" worldviews are to be found in all populations. Again in point of fact, only a small percentage of literate adults, a minority even among space advocates have made the final jump. That jump still requires the proverbial "Leap of Faith".

"SPACE IS A FACE" — for many, even in "literate", "educated", "advanced" societies, space remains misidentified as the abode of God and the Angels. Heaven is imagined to be in the Heavens. The stars are but meaningless pretty points of light, their mythical patterns blamed for happenings that defy individual control or presumptions of justice. Consistent with "space as a face" is the false Aristotelian distinction between the terrestrial world of change and the celestial world of immutability, a notion which was not fully shattered until the spectroscope revealed the stars to be made of the same chemical elements as the Earth.

The strength and persistence of this worldview is reinforced by the discontinuity of the horizons below with those imagined above — until recently when entry was earned for a token proxy few representatives of our species. "We can't get there from here", is still true for the overwhelming majority of us. Space continues to appear as neither real nor relevant. That satellite communications and weather nets affect our daily lives these days changes nothing, really, for their orbit-confined abode is just the near-space boundary layer that belongs more to Earth than to the heavens. "Yo-yo space" and interplanetary-interstellar space have only quasi-vacuum in common. It is easy to accept activity in one, and disapprove of it in the other as "unnatural".

"SPACE AS A RACE" is something rather new. With the dawn of German rocketry, Hitler began to see the Moon as the "high ground" from which his missiles could hold the world hostage to his Third Reich for a thousand years.

It is perceived military advantage that started the race to space, even if the overt drivers were national prestige and a new fountainhead of technological superiority. So Space became a Race between America and the Soviet Union: Sputnik vs. Vanguard; Vostok vs. Mercury; Soyuz vs. Gemini and Apollo. The protagonists were first just satellites, then manned orbiting capsules, then Lunar landing expeditions.

The setting was the Cold War. Even after the U.S. "won" the race (as defined by Kennedy) hands down, and the urgency declined, a majority of space supporters still saw the importance of space

activity through the filter of "the Race". Might not Kennedy's seemingly bold vision have misidentified a key milestone as the goal, turning us all into hares much too willing to quit prematurely?

"SPACE AS A BASE" may seem to be a new worldview. Yet its roots lie in Konstantin Tsiolkovsky, Dandridge Cole and other visionaries. "Basers" see space as another challenging and hostile frontier, another Antarctica perhaps — a place for exploration and scientific outposts.

This "Base" worldview struggled for supremacy over the "Race" in the Post Apollo Retreat. Our battle litany was Orbit Base (Space Station), Moon Base, Mars Base. For these people, perhaps for some of you, space remains a suite of horizons unsuitable for human settlement and acculturation, but open to outposts - yes, like Antarctica. It is hard to argue with them/you actually. If space is so attractive for human expansion that the government ought to spare no expense to open the frontiers to prospective waves of eager homesteaders, where are the hordes banging on the door of Antarctica, a far friendlier place than the Moon or Mars or the naked unimproved vacuum of L5?

To Space Base advocates, Exploration and Science are the Holy Grail, not Scouting, Prospecting, Reclamation, and Settlement. To them, the old Space is a Face worldview still rings true. There is Earth and there are the Heavens. The one is for humans, the other best left to angels and priestly emmisaries called astronauts or cosmonauts or spacionauts who intermediate between the forbidden sanctuary of the gods and us lowlier mortals who ought to accept our consignment to Earth, and not question the age old equation: World = Earth. While, if asked, no self-respecting space advocacy organization would admit to being a prisoner of this worldview, the old saying about ducks and quacks holds true. Look at what an organization fights for: Orbit Base, Moon Base, Mars Base - or an open frontier for human outmigration, i.e. Cradlebreak!

"SPACE IS A PLACE" is worldview at the end of the maturation process, as we see it. Yet it is not really "new". "Heretical" thinkers for centuries imagined the planets and even the Sun and Stars to be worlds in their own right, peopled with beings designed by the Creator to fit in with their strange environments. Then came the wave of science fiction writers. H.G. Wells in his "First Men on the Moon" portrayed the Moon as a "world" for its inhabitants, the Selenites. Heinlein and Clarke nurtured many of us, instilling in us the vision of a universe with both already inhabited planets and virgin worlds waiting patiently for a husbanding humanity. To those whose imaginations were expanded and nourished by science fiction, that space is a place has never been in doubt. We have been the true believers.

To this preexisting base Dr. Gerry O'Neill brought in a whole new infusion of fresh blood, people newly converted by carefully reasoned speculation grounded in economics, energy, and technology. The earlier advocates "knew" that space was a place. The recent arrivals plotted to transform the hostile realms they beheld into a horizon of places friendly to life.

The vision statement of the National Space Society mentions "Human Communities Beyond Earth." To what worldview does it belong? Make no mistake! This is a formula for "strange bedfellowing. The statement is carefully chosen to mean one thing to Base people, another to Place people. NSS has never gotten off the fence. Seeking the power of numbers, it has forged, and operates as a strained detente of those who share quite distinct, and ultimately incompatible World Views.

For "Space is a Place" means a place not just for bases, outposts, garrisons, and other caricatures of humanity (much like McMurdo Sound and all other Antarctic stations contain only cartoon communities) but for people willing to turn their backs on the "Old World" and embrace raw new frontiers as their own, finding ways to tame them and make them over as expressions of their cultural and technological creativity, bringing these sterile barrens to life with seeds and seedlings and creatures from Earth. For us Space Placers, space is not just an annexable fringe of Earth, a place to put satellites and probes that make life below easier. It is virgin territory, new shores. Space to us is as the continents were to life emerging from the seas. LEO is not a destination, just an interface, like the shore, from which we can step into a whole new suite of horizons for the full range of human activities, an endless frontier of untouched places in which we can find new ways to be fully human and thus new ways to give glory to the (C)(c)reative (F)(f)orce that spawned us.

Our agenda is not per se an Orbit Base, a Moon Base, a Mars Base. It is rather a whole set of tools that will open the frontier to those willing to call it home, and that will allow them to survive there and eventually even to thrive. It would have been unthinkable to our African progenitors that we should one day roam the deserts, live in igloos along treeless arctic coasts, in stilt houses in shallow waters, in the rarefied air of the high Andes altiplano, or sprawled across far flung island chains in the Pacific.

These would all have been extreme environments to them, just as space now seems to the bulk of our kind.

The Leap of Faith behind the Space is a Place World-view is not so irrational or unprecedented after all. "**Homo est animal omni-adaptibile**." Man is the animal capable of adapting to anything. The momentum of all human history is behind our faith, and underlying that is the epic momentum of Gaian life in general, from tidal pool to ocean to land to sky to subterranean caves to sea bottom thermal vents and on and on.

It is not that humanity in general is destined to move off planet. New niches, in fact, have never been colonized by the most successful members of a population. These do just fine where they are. It is the misfits, the capable but not quite coping, those forced out of the favored cozy homelands that are forced to pioneer new surroundings to call upon new talents, new technologies, new accommodations to nature -- commodations to nature - under severe penalty of perishing if they do not. Blessed are the Second Best. It is the "Second Bes"t who lead every new tentative wave of niche colonization since the dawn of life.

If this is so, it is absurd for us to imagine that we can, or ought to, try to convince everyone that the new world horizons are the promised land. Those of us who, as honestly comfortable as we are on Earth, still yearn for the challenge that only pioneering an untamed frontier can bring, have a drive that the majority of humankind can never understand. To convince the government-of-those-determined-to-stay-behind to open the frontier for the rest of us is a feat not equaled since Moses convinced the Pharaoh that the Israelites were a pest that were best let go to foolishly fend for themselves in the un-forgiving wilderness of the Sinai. Don't imagine for a moment that we can trick history into repeating itself. We must find the way ourselves, leveraging and piggybacking on the very limited set of space technology initiatives that are convincingly in the best interests of the Earth-content.

The Space Placers are perhaps a minority of space advocates. The marriage of convenience with Space Basers and Space Racers is fated to be unproductive. It will not give birth to the Open Frontier. And even among Space Placers, perhaps the majority are overly romantic. It will be a long time before Mars is as hospitable as Antarctica, and no one is lining up to be the first to pioneer that unassimilated corner of the Earth. O'Neillian Sunflower Colonies are generations off. The frontier will begin humbly, quite ramshackle fashion, offering bare subsistence as the fruit of much toil, accompanied by few perks and lots of rough edges. The faint of heart need not apply. The frontier is for those to whom real risk pales in comparison to the rewards of challenges met and bested, to the freedom to find new forms of technical, artistic, and social expression, to the rewards of turning utterly unearthly scapes into human-scapes.

We watch Star Trek or Babylon 5 and imagine space to be the ultimate Los Angeles (before the quakes, fires, riots, etc., of course). Someday, perhaps. But the frontier is a place that makes all finger-nails dirty. In the second half of the 19th century, those who wanted the best that life could offer, the most sophisticated and advanced of creature comforts, headed not for Dodge City. No, they stayed in Baltimore.

We need to set aside the misleading artwork that severely overhyped the O'Neillian vision. We need instead to put out a siren call like that which Shackleton placed in the London Times back in 1905: (paraphrased from memory.)

"Wanted: a hundred strong rugged men for a dangerous expedition to the South Antarctic seas.
Poor pay, certain sickness, assured danger, chances of returning home alive shaky."

Five thousand eager men answered that ad! Are those with such "right stuff" a vanishing breed? Has our society become so risk averse that no one will answer a no punches pulled call to pioneer the fron-tier? I think not. Forget the Earth-lullabied majority. Blessed are we the second best - those of us who are restless despite everything life in these times can offer us, who sense we don't quite fit in, who yearn for a chance to start fresh, those of us willing to make space a place - it is up to us.

And that, dear friends, is the ultimate synthesis.
Space is not a place. We have to make it one! PK

MMM #86 - June 1995

"NEO" Strategy Touches Tabloid Nerve

Ever since we received the Jan/Feb '95 issue of SSI Update and read the lead story, this editorial has been a must write. Now it is June, and perhaps this essay, delayed for a number of reasons none having anything to do with the topic, seems less than timely. But a mistake is at issue, one which will not go away if we remain silent, one which threatens the credibility and respectability of one of the most prestigious and honored of all non-governmental space interest institutions.

We are talking about a decision of the Space Studies Institute Board of Directors to adopt a "bold" new core strategy policy. For some time even before Gerard O'Neill's death two years ago, there were signs of deep malaise being expressed, sometimes quietly, sometimes openly, by a number of long time SSI Senior Associates that SSI seemed to be adrift, and had lost sight of its original purpose to guarantee the conduct of government-neglected "critical path" research that would pave the way to the future about which O'Neill wrote and spoke so forcefully, recruiting a wide following. We were not party to these misgivings but listened and observed intently.

The Institute had quietly put out feelers seeking input on its "research agenda for the next 5, 10, and 20 years". We know the contents of only one such report, our own, but there must have been more.

The outcome is "bold" all right, almost "bold" enough that we are a little surprised it hasn't been picked up by the National Enquirer. Forget the Moon! We didn't really want to go there anyway and put people down on a traditional surface! The asteroids can and will supply all the materials we want to build the artificial island surfaces of what were once called space colonies, but are now referred to, in skittishly silly deference to political correctness, Space Settlements.

We do know more now than did O'Neill about the availability and accessibility of the near Earth asteroids the majority of those known having been discovered since O'Neill's seminal paper was published in the seventies. There are, to be sure, some serious tradeoffs that asteroid buffs find convenient to ignore - these will be discussed in a follow-on editorial on page 3 of this issue. [This piece is included in the Asteroids theme issue, pp. 39-40 - you can download this at:

http://www.moonsociety.org/publications/mmm_themes/

The point which raises our eyebrows in alarm is not this selective embrace of the "new realities". It is SSI's decision to get involved in public advocacy by pointing out that a Near Earth Object (NEO) strategy kills two birds with one stone.

(A) It nets us handy asteroidal resources with which to build space settlements for our benefit and solar power satellites for Earth's benefit.

(B) In the process it rids near Earth space of doomsday objects capable of consigning humanity to the same oblivion long enjoyed by the dinosaurs.

The point is, that while such a danger is a positive finite reality, the chances of it happening within some future commensurate in length to our racial memory (6-8 thousand years at best) is as remote as one person winning the Power Ball Lottery jackpot twice in a row.

Consider the doomsday warnings of Jeremy Rifkin, the well known outspoken opponent of recombinant DNA research and genetic engineering. Few educated people have much respect for him an him an him and alarmism. Yet the downsides and risks he warns of have a far greater chance of becoming harsh reality in the near term than do the born-again Chicken Little disciples now taking charge of SSI's helm.

Yes, an asteroid could wipe us out. But look at the list of known impact craters published on pages 4-5 of this issue, courtesy of an email post by Bryce Walden of Oregon Moon-base. Look at the ages, and the frequency. Then sober up.

Any attempt by SSI to further its legitimate agenda, much of it receiving our support, by inculcating public hysteria and fear is bound to backfire as the public learns how remote the chances are. Consider how many Californians knowingly live astride the San Andreas Fault, a definite near term disaster waiting to happen. Ask how much they care.

Consider how ill at ease are the Canadians, the Scandinavians and other northern Europeans, and the inhabi-tants of our northern Midwest about the certainty that glaciers will wipe clean the slate of their homeland turf within the next 10-20 thousand years. I haven't heard of anyone losing a night's

sleep over the prospect. Have you? Has Canada, or the U.S. for that matter, named a government commission to look into how we might avert such a disaster? It's too remote!

Now ask yourselves how seriously the public will take the idea that sometime in the next hundred million years, life on Earth may be called upon to start over. If you think that will motivate politicians to spend as much as a penny, you have more faith in public credulity and gullibility than do I.

It also bothers us that with this new NEO strategy announcement, SSI has apparently abandoned its deliberate indifference to the public space policy debates, to join the ranks of those who misguidedly believe that the sure road to space is to get the government to do our work for us and deliver an opened frontier to us on a silver platter. How do we do this? By tricking the public and their representatives into believing that our agendas are in their best interest. For shame!

We do not deny that opening the space frontier will work to the enormous benefit of Earth and those billions who choose to remain behind. But the way to accomplish this goal is by profit-driven fait accompli. The role of the government is that of enabler and facilitator and supportive partner, not doer. We must be the agent and do the doing. Not try, as Yoda would say, but do! Yes it's not easy. But then if it wasn't difficult, it probably wouldn't be much worth doing!

Spectators will stay butt-glued to their couches. It's up to the rest of us. **PK**

"...The innovator has for enemies all
those who have done well under the old conditions."
- condensed from Machiavelli

Be a Doer, not a Watcher!
The watcher is likely to be disappointed.
The doer has the comfort of knowing that
He has tried, and perhaps laid foundations,
For others who follow, and may reach the goal.

MMM #87 - July 1995

Apollo 13 and Risk Acceptance, an endangered American Virtue

We love a story with heroes. The new movie release, Apollo 13, amply brings this home. We are a nation starved for heroes. Why? Because we have collectively turned off every hero-making mechanism we can find.

We have fast become a nation of pusillanimous sissies in blatant repudiation of our past. Yet while we publicly and privately reject voluntary risk acceptance, we remain rapt and awed by examples of those who rose to the occasion of threats to life and limb that we ourselves would avoid at all cost. It is as if we know there ought to be a better side to us, as if occasional heroes collectively absolve us of our self-indulgent cowardice. In our repressed guilt, we are a nation desperately looking for heroes, but not willing to be heroes ourselves. We want to tell ourselves we still have the right stuff. We want to glory in heroism, but only by unplanned proxy.

At the same time we reject any official policy that puts people at risk, even military personnel. We absolve ourselves by insisting that everyone follow our own yellow-backed trails. We need heroes, but they must emerge despite our best efforts to make heroism unnecessary.

We have often said that the point that government has deeper pockets than private enterprise is irrelevant when it comes to a discussion of which is better able to open the space frontier. Money is powerless when you don't have the guts, and the government, as the embodiment of a neurotically risk-averse society, simply does not have the ability to do what it takes - end of argument!

Industries too have become intensely risk averse, unwilling to gamble on profits beyond the next quarter or two. It comes down to the individual or the enterprise dominated by an individual to push the envelope beyond the safe cozy rut.

The globe circling non-refueling flight of Voyager illustrates the point. Burt Rutan, asked how he succeeded when by the books, this mission was impossible, replied simply

'We decided to throw away the books,
and to violate accepted safety practices,
and to accept calculated risks'.

Of Course, the two pilots were in full accord. Some-times you have to deliberately go out on a limb and gamble. Voyager illustrates the path needed to open space. In space, as with this craft, weight reduction is of the essence. When to provide redundancy and margin, weight and/or cost is inflated to the point of making the mission an economic failure, then it is time to accept a certain triage of risks. Some risks are cheap both in weight penalty and dollar costs to guard against, and so we guard against them. Others are marginal in penalty and cost and we prioritize them according to risk assessment analysis and do what we can and still keep the mission lean and slim. And the other risks, those whose hedging compromises the mission unduly and out of proportion, these we must accept. The Shuttle is an economic white elephant for several reasons, but failure to do any sort of risk-triage is certainly one of them.

Space advocates in many cases illustrate the adage that the apple does not fall far from the tree. In the seventies, many jumped on the Space Colony bandwagon because the vision of engineered environments promised to obviate the need to continue adapting to strange environments. Mankind's history is one long epic of one adaptation after another, and like the citizenry in "The Shape of Things to Come", we have grown collectively weary of all this adapting - and its risks! Space oases neatly avoid the risks of adaptation to unfamiliar and seemingly hostile environments, other gravities, other climates, other atmospheres, etc. Of course, we don't admit this motive. Instead we seize on other justifiers: unlimited real estate; room for far more people, etc. Nor do we wish to give the impression that space oases are not legitimate or that we don't need them in any full-flushed space development scenario. They are, and we do. But let us be honest about the real source of our suspiciously overdone enthusiasm!

Space advocates by and large continue to look on the government as the one who will lead us to the Promised Land - for that conviction gives individuals blanket absolution of accepting the risks of entrepreneurial alternatives. Major established aerospace contractors, like all established businesses, have become roots-denyingly conservative and risk-averse. The time for risk acceptance is youth, when we have nothing to lose and we think we are immortal anyway. This goes for personal and corporate youth.

Corporate youth means lean and small businesses still close to their roots and founding inspirations. It means finding K.I.S.S. (keep it simple, stupid!) solutions and not falling into the trap of cutting edge financial quagmires. It means accepting risk triage as a guiding philosophy.

"Blessed are the second best" is perhaps the (omitted) beatitude which most aptly sums up the course of natural evolution. Those best at adapting to an environment stay put; those who can't compete at that game get pushed out into new habitats, or simply fall by the wayside. Among those being pushed out, the ones who still have enough of the right stuff to deep-adapt to new environments succeed, and often go on to greater success than the stay-at-home dominants. Blessed are the second best! Individuals and young entrepreneurial outfits cannot compete on the high-priced turf of government and major aerospace contractor activity. But those who, undaunted, pioneer alternative simpler, cheaper means are the ones poised to make the breakthroughs on which the entire future will be built. Blessed are the second best. Accepting risk is the name of the game. As in any kind of investment, the safer the move, the smaller the possible profit, and vice versa.

Personal involvement and commitment are instances of major risk-taking. We stand to have spent major portions of discretionary free time, even discretionary income, pursuing initiatives calculated to advance the opening of the space frontier that in the end turn out to be no more than marginally effective at best, real failures at worst. Most will not accept that degree of personal risk. And of those who do, most will be discouraged by the first real or imagined setback. Far safer to just "belong" and give "moral support", maybe even money, to some faceless organization with a committee-brokered plan. Far, far safer to limit all personal involvement beyond that level to cheering from the sidelines of the couch, or from the pages of some science fiction novel. God forbid! our lives are short enough that we should risk wasting precious free time doing something that stands a chance of not

working or being ineffective! Heaven knows we don't make enough money to make ends meet as it is without risking any funds unwisely!

The space frontier will either remain forever closed except to a proxy elite feeding voyeur-addicts, or it will be burst wide open by individuals and the enterprises they start. To the degree space is a collective effort, it will be a success story of a collection of individuals, not a collection of stand-in agencies. Can it happen? It's up to a vote, and most people will be voting with their buttocks. Risk is not for everyone. But as always, history will once again be carried by the individual, the individual with the courage to embrace risk. PK

MMM #88 - September 1995

Lessons for the Space Station from the film "Apollo 13"

The Ron Howard movie, "Apollo 13" with Tom Hanks, Kevin Bacon, Gary Sinese, and Ed Harris, was the first feature film (i.e. excepting IMAX documentaries) shot in real zero-G with all onboard shots being tediously pieced together from must have seemed an endless series of multi-second Vomit Comet KC-135 flights. Can't do that in computer simulation!

Three lessons from the tale jumped out at us.

1) It wasn't planned backup and standby hardware equipment or extra margin capacities that saved the day, it was NASA's greatest assets, **brains and determination of people determined to beat clearly overwhelming negative odds.** In the process, parts of hardware and system sequences got put together in new combinations never intended nod nor foreseen in a daring make-do creativity born of sheer do-or-die necessity.

2) One of the major hurdles was the inadequacy of the Lunar Excursion Module [LEM or LM] Aquarius' CO2 scrubbers to handle three crewmen instead of just two. They had to find a way to patch in a scrubber from the Odyssey Command Module - the hitch being that one was square, the other round. The lesson is clear.

All critical parts and their components of all ships, modules, nodes etc. should be standardized and interchangeable.

That does not mean that progress must be frozen. Improved versions can and should be built whenever and wherever possible, but they should fit the existing interfaces. Without knowing what in fact the situation is, we'd be willing to bet a life income that this is not the case with the various components of the International Space Station being built by the U.S., Europe, Japan, Canada, and Russia. Possibly not even between components built by the several U.S. contractors: Boeing, McDonnell Douglas, Rockwell International, Lockheed Martin, and others.

Interchangeability of all critical systems components and commonality of spare parts station-wide would go a long way towards preventing future crises in orbit from being worse than they have to be. Right now we've only taken the first step, because we had no choice, i.e. to devise compatible docking systems.

Some hardware development is undoubtedly already too advanced to meet this proposed new design constraint. But many systems and parts still exist principally on paper, and it is not too late to bring all the international partner teams together to insure commonality and interchangeability. It is very cheap insurance.

3) **Having a duplicate facility on the ground** in which problems in flying hardware can be troubleshot live in simulation, is clearly important. If Ken Mattingly had not had access to a Command Module Simulator, the returning Apollo 13 crewman would clearly have died trying to reenter Earth's atmosphere. The lesson is clear.

We ought to have a duplicate space station (or moon base) on the ground, module for module, system for system. During any emergencies in orbit, backup crews on Earth could help find work-around solutions by simulations with verisimilitude.

Expensive?

1st, **the cost to build duplicates would only be marginal.**

2nd, **such a facility would be ideal for training crew and payload specialists, even for pre-orienting media and VIP visitors.**

3rd, during non emergency situations, such a facility would be **an unbeatable public education tool**.

4th, some of the brighter, more creative, and enterprising **people touring the facility might be challenged to build new and better commercial stations in orbit.**

5th, **if need be, parts of the duplicate hardware on the ground could be flown in space**.

6th, **something that could eventually be taken apart, shipped, and put back together to be displayed in the Smithsonian**, would be assured.

Now probably each parts/module manufacturer will have a duplicate for just such simulation purposes. But what is the point of having such simulators scattered all over the globe? They should be gathered all in one place, with standby teams os on hand or able to be flown in at a moment's notice.

The problem with such an idea is, of course, that it will cost extra money up front, i.e. it is a cutable budget item. In this era where the "right stuff" is quickly becoming but a dim racial memory, we are not optimistic.

The above lessons need to be applied to future Moon and Mars bases as well, and to the spacecraft that will carry crews and pioneers – wherever.

(I) A pool of talented, trained personnel needs to be maintained, not only to serve as background crew for each pioneering mission, but also to handle live simulations for real-time crisis problem solving in the same item for item faithful simulation facilities on the ground that serve for training flight crews.

(II) The outcome of many an unplanned emergency and or rescue, in orbit, in deep space or on some planetary surface, may hinge on the availability of interchangeable common parts for critical systems and their interfaces. There ought to be some **interagency working group** set up to ensure such a development. A stitch in time saves nine. Yet, strange as it may seem, planning ahead, really ahead, has never been a strong suit of any of the world's space agencies. Had it been otherwise, we would not, for example, have a space debris problem of anywhere near the magnitude now before us.

(III) Simulation facilities will remain vital for outposts on planetary surfaces ass well. And the fringe benefits in each case, helping justify the cost, Will be the same as those outlined for the "shadow" station proposed above. **PK**

MMM #93 – March 1996

Mars will Require a Hardier Breed of Pioneers

Many people envision with enthusiasm an eventual wholesale settlement and colonization of Mars, and I number myself among them. In doing so, we carry forward what has become a racial dream of our species throughout this century. And we have done so, stubbornly, through revolution after revolution in our perceptions about the Red Planet. Banished to the realm of myth are the Mars of Edgar Rice Burroughs, populated by green men and princesses and thoats, and the Mars of Percival Lowell, crisscrossed with canals feeding green strips of irrigated vegetation, defying the creeping desiccation of the Planet. But gone too is the glimpse of a moonlike Mars that we read into the photos from early Mariner orbiters.

We know now that Mars was once warmer, wet with ocean, rains, and rivers, and lakes, and possibly in early stages of greening. We are all but certain that much of that watery endowment yet remains, locked up in permafrost layers of soil in lower lying basin lands. There may even be liquid sub-

terranean lakes if there are near-surface geothermal pockets still simmering here and there, but we do not know. As to the polar caps, we now know that under a few inches of carbon dioxide frost seasonally chilled out of the atmosphere, there are vast polar ice sheets hundreds of meters thick, at least in the north.

How much water is there? That is, how extensive and patchy are the permafrost deposits? How thick are they? How fresh or brinish? All these questions must be answered to a first approximation accurate to an order of magnitude before any brainstorming schemes of "terraforming" (or, as we would prefer, of "rejuvenaissance" i.e. not making Mars like Earth, but bringing it back to the more encradling Mars-state it once enjoyed) can be much more than an exercise in "garbage in, garbage out." Which is why MMM has never gotten into such schemes. It is far too premature an exercise.

What does remain is the promise of a world that is more thoroughly endowed with prerequisites to support human and Earth life than is our own bonds-world, the Moon. Mars would seem to have far more appeal as a homesteading destination for those with enough of the right stuff to be willing to forever forsake the Green Hills of Earth.

But we can indulge in these fantasies, these declarations of willingness to go, only because the need to take a second look has not been thrust upon us by any immanent opportunity to open this frontier. That point of truth is still over the time horizon by an unknown number of years.

When that time does come and those who've thought themselves ready to go are faced with the decision to "put up or shut up", we think that many, even most, will get cold feet.

For despite Mars' life-supportive endowments, the challenges and obstacles to the establishment of a long-term human population capable of first enduring, then of thrivingly coming into its own, are daunting. And they are daunting from many points of view: engineering, logistical, biospheric, but above all and most critically, personal.

It is this last but ultimately most make-or-break class of challenges that we want to discuss here.

POINT: Mars is farther from Earth than the Moon, much farther. And the implications are compounded.

Size: (Earth) Moon Mars	Dist. from Earth (Mn=1)	Dist. from Sun (E=1)	Heat & Power from Sun (E=1)	Launch Window Resupply Frequency	One way transit times
	1	1	1	daily	1-3 days
	150 to 1,060×	1.38 min 1.67 max	52% max 36% min	every 25 months	6-9 months

Resupply, reinforcement, relief, and rescue are always from 6 months to 25 months away. This will mean a reliance on a strategic "egg yolk" policy, as opposed to maintenance of "umbilical" style logistics. On site repair and fabrication shops as well as hospitals, both as to equipment and personnel expertise will need to be very much more complete. **Triage** in medical emergencies will have to be accepted by all as a potential personal consequence before leaving Earth.

It will mean that the personal commitment to the Mars frontier of each pioneer recruit must be individually that much deeper, more "final", that much less open to reconsideration down the line. It will be much more expensive to return to Earth, and the delay time before such a repatriation can be affected will be much, much longer. Only the hardiest, most self-reliant, and resilient personalities should tempt such odds.

Felt isolation from the mainstream of human civilization will be much deeper. Electronic communication with Earth involve response delays of 6-44 minutes, not the 2 plus seconds Lunans will experience. While, in all but live radio communications, those delays can be edited out, the edited conversations will flow jerkily and clumsily. The new "Martians" will tend to turn inward culturally and socially, and go their own way.

POINT: The Sun is not only further, dimmer, and much less warming, it is noticeably so to the naked eye. Not all of that is bad, of course. On Earth, full sunlight is uncomfortably intense. On Mars

the softer light will be still plenty bright enough, and welcome, much as the softly sunny November skies in the northern United States and Canada.

But the smaller Sun [see artwork on page 48] will be a constant reminder of the relief-less cycle of very cool and bitterly cold seasons. Martian summers are but caricatures of our own temperate zone warm seasons, not even quite on a thermal par with the patchy thaws of our Antarctic summers.

The new Martians will learn to cope and grow to find much pleasure and satisfaction in the accommodations they need to make to acculturate themselves to this new world. But only those with the inner strength and drive to make the enormous adjustments had better set out on such a venture.

It can best be summed up so. Only a tiny fraction of the numbers who say they would go to Mars had they but the chance to do so, would also be as willing to commit to pioneering the relatively far friendlier fringes of our own Antarctica, with its vast fresh water supplies, breathable sweet air, and surrounding oceans teaming with life and food. That has to tell us something. We are all too romantic about Mars!

Yet as long as the moment of truth reality check is yet far off, we can afford to indulge our Martian illusions. And perhaps that is good in the long run. For it carries forth the dream, and with it the ongoing brainstorming exercises that will one day overcome the daunting odds. **PK**

MMM #94 - April 1996

"Alien Shores" - We've been this way before!

In this issue, we take a look at the "environment" of the Moon in so far as it will deeply affect the paths taken by future development, settlement, and outgrowth of a uniquely Lunan culture. It is a global setting that seems utterly barren, sterile, and hostile — in a word "alien" to everything we consider within the widest range of suitability, within the collective limits of human experience.

Indeed, is this not the popular objection to off-Earth colonization we hear most frequently and spontaneously expressed? "These are alien and hostile places, where we clearly do not belong! We should stay on our home planet!"

But Earth, globally speaking, was not always home. Our progenitors, according to current consensus, evolved on the East African savannas. If so, we are native to a relatively small subset of what is a very great range of diverse terrestrial habitats and climes. Once upon that time, much of the rest of Earth was effectively as "alien and hostile" to these early men as the Moon and Mars are now to us.

Out of this relatively narrow and specialized home-land, we have spread to rain forest and jungle and swamp and desert and mountain fastness and coasts. In each case, we left behind things with which we dealt comfortably, and faced new material, new climate, plant and animal resources and challenges that we could only learn to use by trial and error.

Yes, we've been through this before, collectively as a species, time and time again. In each case, what was once totally "alien" to all our previous experience became absorbed. We learned how to cope. Dangers and risks were tamed with "second nature" habits and new local common wisdoms that dealt with them effectively.

We learned to clothe ourselves, not once, but many times in ever more resourceful ways. The same holds true with our need to provide shelter. And, of course, food! It is this difference in the set of challenges facing different peoples in diverse new habitats that is the wellspring of different non-hereditary cultures. It is too this failure to flinch before the apparently "alien and hostile" that that may have prioritized the development of language, by which "show" became "show and tell", a much more capable tool of tutelage.

Think for a moment of how "worlds apart" are those early East African grasslands and the Siberian Taiga, the Peruvian-Bolivian-Chilean Altiplano, and the North Polar eskimo-lands. Was not the conquest of the latter by native peoples the "remember the Alamo" equivalent that we find ourselves called upon now to follow?

Was the challenge of endless shifting ice flows, of permafrost tundra slopes barren of all but lowly lichens, of severely cold seasonal temperatures, not just as relatively intimidating as the raw ex-

posure we find on the Moon to cosmic rays, solar flares and ultraviolet rays and the incessant micrometeorite rain, all in near vacuum among utterly sterile, barren, and water-virginal soils? No, we've been through all this before, collectively as man, time after time.

We could go back further. Pre-human life before us is the culmination of an eons long march out of the "First World", the Sea. We ourselves must see our yearning for new worlds beyond orbit in this perspective. And then we must remind others (for have we not collectively forgotten?) that this is not a wholly new thing on which we would embark. It is but a pendulum swing back to a cyclic theme that has been part of life for four billion years. And, more than a cyclic theme! A cyclic imperative!

But here we must be very careful. For this is an imperative that has never been wide-felt. When conquest of the land became ripe, most life was more than content to remain in the Sea. It felt no such challenge. Similarly with the plant, animal, and eventually human conquest of one new terrestrial habitat after another. There never was an overall imperative. In every case, all but the few thrived content enough where they had always been, within memory.

Colonization has never been the task of the most successfully adapted. Rather it has fallen always to what we might call "the second best" - those capable of resourcefulness but incapable of competing with the dominant sectors of their own populations. They had to either push out to new and by the old standards less favorable habitats, or remain downtrodden where they were, if not perish altogether.

No "whole" population, structured by government or not, has ever set out to transplant itself except in the case of total environmental and eco-system collapse within its home-land (e.g. the Anasazi). Colonization has always been a rather disorganized and spontaneous activity of "second best" individuals. If you want a "Beatitude" especially appropriate for the space frontier, it is this: "Blessed are the second best".

Yes, the Russian Empire set out to force-settle the Siberian steppes and Taiga (with what it considered the dregs of its own population). Yet these were not empty lands but areas already spontaneously settled by native peoples.

Yes the American and Australian governments deliberately undertook to settle their respective Wests. But in each case, in all honestly, the government but supported and facilitated a popular movement of resourceful frontier-minded individuals in an effort that would have collapsed without them.

Indeed, the only all-government effort to create a presence in a previously unoccupied land has resulted in no more than a caricature of settlement. We speak of course, of Antarctica, presently closed by treaty to pioneering individuals and their families. Despite the onus of this legal precedent, space activists, even anti-Moon Treaty diehards, have been asleep on the wheel, protesting not a whimper when the the Antarctic Treaty was renewed recently for another thirty years.

If, when all is said and done and written, humankind fails to establish secured footholds beyond Earth, it will be the fault not of governments, but of the collapse and disappearance of the resourceful frontier-minded pioneer spirit among individuals. No amount of unlikely government support can ever make up for such a vacuum.

"These are" by our all too frequent, all too whining complaints, "not the best of times". But they are good enough to drug most of us into contentment with life on Earth, whether we'll personally admit it to be good life or not. Many are those of us who want to see the space frontier open, but few there are of us who would personally venture out there. Certainly not while the frontier is full of rough edges and beset with growing pains. We'll wait until things become science-fiction sophisticated, until the Kansas Cities of the Moon, Mars and free space are as genteel as the Baltimores of yore.

Yes sir, we've been this way before, to alien shores. But will we ever go again! I don't know, but proceed as if we will, because I hope what has been in the "second best" in life from the outset, is still there. It all depends on whether those of us with the right stuff are collectively numerous enough to form a critical mass of talent, resources, and determination.

Meanwhile, all too many of us lay the task not at our own doorsteps, but let-George-do-it like, at the doorstep of our governments. That, my friends, is pathetically wasted time and energy. Government will follow where the people lead, not vice versa.

But I fear we may have institutionalized this mistaken stratagem. The moment we did so is ever so clear. It was in the vote that two-thirds of us chose as our name, "The National Space Society", eloquent witness to our belief that opening the space frontier is properly government policy. The other

choice offered, “The Space Frontier Society”, denotes instead a free association of people, undefined by national status, determined to open space “by any means possible”, including, but not limited to, government facilitation and critical support.

"Oh, you beat a dead horse!" I hope not. Because if the horse is dead, so is the dream! The name choice is now an eight year old fait accompli. But that will never make it wise. We have in so choosing set before ourselves our greatest obstacle, our own failure to take ultimate responsibility for the dream. Of such stuff are tragedies oft’ made. **PK**

"We're at our best when we're given our biggest challenges."

- Rick N. Tumlinson

MMM #102 - February 1997

Yesterday, Today, Tomorrow, and Space

This is not an essay in history (Yesterday), analysis (Today), and prophecy (Tomorrow). Rather it attempts to be a discussion of make-or-break attitudes. Attitudes are more than an issue of semantics, as the recent electioneering (Dole’s “Bridge to the Past” vs. Clinton’s “Bridge to the Future”) should attest. If you don’t believe attitudes are important, then you must be a fatalist /determinist, and have a hard time explaining our own national history.

“Philosophy” (pronounced with a sneer and a spit) is scorned by pragmatists as irrelevant, ineffective nonsense. But whether is is good philosophy or bad philosophy, expressed or implicit, philosophical attitudes - yours, mine, those of groups and peoples - are the real engines that drive events. Inappropriate self-hamstringing attitudes are the single biggest reason that most, the overwhelming majority, of “space-interested people” end up doing nothing effective to make their preferred future become real.

The “genes” of Tomorrow, if you will, have like most everything else two contributing parents: an “egg” - all the factors and determinants rooted in Yesterday (the Past, everything leading up to the moment), and “a” “sperm” - whatever is contributed Today. To carry our metaphor further, what Today contributes is somewhat open. Among many options (i.e. many sperm), one - by effort or by neglect will “win the race” to co-determine the Future.

There are many ways to get across the same point. “The best way to predict the Future, is to [co-] invent it.” To try to forecast the Future only by making deductions and extrapolations from the Past ignores the ingredient that Today - one Today after another after another after another - can infold into the batter. The Past embodies a tremendous amount of inertia, but it’s mass is not infinite, and its course can be deflected by mid-course (i.e. Today) “corrections”. This is certainly not to say that we need pay no attention to what has happened in the Past, or what is in place as we begin “Today’s game.” A very good understanding - both wide and deep - of Yesterday is of enormous assistance in making decisions about the most effective type of corrective input Today. Space history, the history of institutions, and the history of public policy in analogous pioneering and frontier situations as we inherit them from Yesterday are all vital. But at the same time it must be insisted that the precedents of the Past do not limit the options of Today. We are free to take altered, even radically different paths - to make “midcourse corrections”, to apply deflecting force, acceleration, or deceleration.

Frequently it is said that the Past is the Past, and Today is the only thing we can do anything about. That is a [half-]truism. There are many, many events and factors and developments in the Past that bear upon Today’s actions and decisions, all juggling for position to have the most influence on Today’s Production. The net effect of the Past can only be presumptive. Any analysis of the “meaning” or “lesson” of the Past can only be tentative. The Past, as it constrains Today’s choices and actions, is not a done deal in that sense. Indeed,

“Today is Yesterday’s Second Chance.”

As long as there are fresh Todays, as long as we wake up to “a brand new day that has never been touched” (Barbara Stanwick in some movie the title of which I cannot recall), there will continue to be “fresh chances for Yesterday,” This is a very forgiving point of view, both for events on the large

public scale, and for events in our own personal lives. Take this attitude, and watch your prospects and horizons suddenly transform forever.

We have spoken before of the pathetic absurdity of both “Pessimism” and “Optimism”, and of “Meliorism” (a word coined by turn-of-the-century American philosopher William James) as the only posture that can be effective. We can translate that into the terms under discussion. Pessimism comes down to the implicit unstated belief that the Future is totally determined by the Past. Optimism comes down to the implicit unstated belief that the Past has no bearing at all. Meliorism accepts the contribution of the Past as an unfinished one, as only half a full set of “genes”, and undertakes to add the best corrective co-determinant it can - at the moment of Today, then more the next Today, one Today after the other.

As James put it, it all comes down to one’s personal temperament. If you insist on being either a Pessimist or an Optimist, even though you should have learned by now how absurdly self-crippling such tantrum postures are, then indeed you have nothing to contribute. Go back to daydreaming or science fiction. This discussion is for those of us who want to be more effective in the pursuit of our preferred Futures.

Today is the only leverage we have to apply to the momentum of Yesterday.

If we have informed ourselves well enough of Yesterday to find the right fulcrum, we will be able to “move” the mountain of precedent and inertia that it embodies.

There are two main excuse categories why over 90% of “space-interested” people do nothing but “watch”. One category is personal: no time, no relevant talent, no left over energy, etc. We’ll talk about that another time.

The other is philosophical. The Optimists feel that Space Development, the opening of the Space Frontier, the utilization of Space Resources, the establishment of viable pockets of humanity beyond Earth’s Biosphere, are all inevitable. Watching, spectating, cheering - that’s all one need do. The Pessimists, on the other hand, have adopted a “defense mechanism” against disappointment, a deep seated skepticism, even a cynicism, that the forces of the Past are overwhelming. This gives them advance absolution for doing nothing.

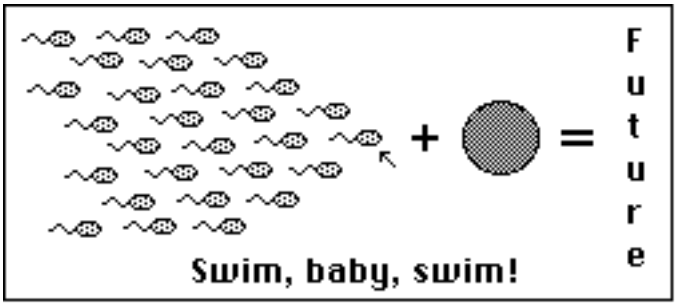
There are lessens here not just for each of us as individuals, but for our pro-space organizations and their leaderships and “Directors”. Appropriate action requires a healthy philosophy, purposefully pursued for maximum effectiveness. Most pro-space leaders would not be such if they did not implicitly sense most of this. But almost everyone’s effectiveness could be bear improvement by honing what implicit philosophical tools they have. For leaders and for those of us in “assisting positions” or ready and willing to self-enlist ourselves, a lot hangs in the balance - Tomorrow.

If you will allow a fresh try at a definition, (mine, not a quote)

A sapient species is one whose individuals are able to use Time as a Tool, not just live in it.

Yes, we are a “tool-using” species, but TIME not the stick in its various forms, is THE TOOL that takes us beyond the plane of animal existence and makes us radically different from them, however close our physiological genetic makeup. **We can live outside the Present.**

And yes, we are “dreaming animals.” But what is it to dream than to imagine a Future beyond the precedent of the Past and find in ourselves the capacity to make it real? If consciously or unconsciously you have a poorly- or mis-developed philosophical Time Tool, you cannot help being less a sapient than you were born with the potential to be.



Ours is the role of the sperm. We are in a race to codetermine the shape of Tomorrow. Make no mistake about it. There WILL BE A Tomorrow. But WHICH Tomorrow? That depends on which sperm (which

possible contribution of Today) wins the race. And the outcome of the race can as easily be affected by neglect as by effort, and vice versa.

Yesterday is but the setting for what we do, or do not do Today.

So "swim, baby, swim!" **PK**

MMM #103 - March 1997

The Moon's Role in the "Opening" of Mars

It is time to respond to a worrisome recent off-center shift in the traditional posture of the National Space Society leadership on the question of the Moon "and/or" Mars. While member sentiment has run the whole spectrum of opinion, including outright disinterest in either option, the consensus, if you could call it that, was that we want to do both, but that both logistics and the economic realities of terracing our outbound steps so that one builds upon the other implied that we should concentrate on opening the Moon first.

Granted, not everyone sees the same future for the Moon. Some would be satisfied with a scientific outpost or two, perhaps including a lunar Farside astronomical observatory. But the mainstream vision has been of one of substantial export-producing resource-using development, in the service of very real needs on Earth.

Mars, as much as many of us dream of going there, even settling there, has always seemed more elusive. It lies more than a hundred times further out into the void, and takes a much longer time to reach it, with launch windows every two years or so, not "open all the time." For those plotting economic development scenarios, Mars for all its scenic appeal and for all its abundance of life-needed elements critically deficient on the Moon, unlike the latter seemed to offer no bill-paying export potential. The economic case for Mars had yet to be made.

Enter Dr. Robert Zubrin, formerly of Martin Marietta, a brilliant and charismatic visionary. He showed us how to put together a Mars mission that did not presuppose a large infrastructure in Earth orbit, nor on the Moon. "Mars Direct" was possible by not taking along the fuel needed for the return to Earth trip – that would have been processed on Mars itself, using the ingredients of its atmosphere. The process involved has now been demonstrated to everyone's satisfaction and delight.

Zubrin did not rest here. In his recent book "The Case for Mars", he goes on to develop his recent theme that Mars is the ultimate "frontier" in our solar system, and begins to make an economic case by pointing out a number of export possibilities.

Then he goes too far. Trapped, as many of us seem to be, in a "foregone conclusion" that we can afford to do only one or the other, he attacks lunar industrialization straw man plans, calling the Moon "a dead end siren call to nowhere." We utterly reject the 'either-or' presumption, the mainstream belief that only governments can do space. Yes we agree, only governments can do Mars. There are, at best, severely insufficient opportunities to develop or produce early exports on a scale that could pay for the development of the Martian frontier. Mars has nothing to sell Earth but scenery for billionaire tourists, and a safety valve frontier for those so dissident that they'd embrace a world where no life can exist in the open, where it is almost always and everywhere cold beyond bitter.

Mars principal and logical market, alas, is a senior industrial frontier on the Moon, to which it might ship volatiles like methane and ammonia, processed not on the planet itself, but on its moonlets, Deimos and Phobos. Should Lunar Prospector find more extensive ice deposits than has Clementine, the Moon's need for importing volatiles will be reduced and/or delayed. Mars "might" produce some strategic metals, insufficiently concentrated on the Moon, such (e.g. copper, silver, platinum, gold). But that there are ores on Mars, where hydro-tectonic processes working to concentrate elements in veins had much less time to work than on Earth, is still hypothetical.

The Moon's lack of concentrated ores and its deficiency by both terrestrial and Martian standards in life-needed volatiles, would seems to make it an unpromising place to set up a frontier civilization. A similar comparative lack of resources and raw materials did not stop Japan's rise as an indus-

trial supergiant. Japan got what it needed by trade. Just as counter-intuitively, the Moon's critical deficiencies will prove its greatest asset, The Moon will be compelled, to secure both growth and survival, to open the rest of the solar system: asteroids, comets, the moons of Mars, then Mars itself, and so on.

Indeed, it is Mars, not the Moon, that stands to be the dead end siren. It has everything it needs long term to cradle a thriving human exclave of some eventually considerable size. Mars will have no need to open markets among the asteroids and comets nor anywhere else,. If there is anything for sure, it is that Martians will be the ultimate isolationists.

Yes, if we are talking about an initial expedition to Mars only, doing the Moon first is a detour. BUT, if we would open Mars as a frontier for settlement, we must already be developing the lunar frontier. Both will grow together. Eventually, Mars will boast the greater population. But just as Plymouth and Jamestown had to come before Chicago and Los Angeles, so must Luna City come before Mars City.

Let the government(s) choose to go to Mars. Let space activists who see their role only as government gadflies concentrate on Mars too. But first, set the game rules aright, so that international private enterprise can open the Moon. If we don't have both, in this fashion, in this order, we'll only win another tragicomic "flags and footprints" dead end. **PK**

MMM #104 - April 1997

ICE on the Moon: Strategic Reserve, Strategic Choices

Most articles and commentaries dealing with the Clementine bistatic radar experiment evidence of "a" field of water-ice deposits in a south polar permanently shaded crater point to the significance of the find as a resource to be tapped for making cryogenic rocket fuel - specifically liquid hydrogen since liquid oxygen can be produced from lunar soil at virtu-ally any site. A few such reports add as a footnote that water could be useful for life support.

Distinctions have to be made: life support is impossible without water for food production and vegetation-based biospheres, drinking and hygiene. This use is largely recyclable, waste water filtered or treated to the point it can be used for plants; the plants transpiring humidity into the air; dehumidifiers drawing absolutely pure and potable drinking water out of that air to restart the cycle. Water can also be recycled in most industrial uses, even though, on Earth, it all too frequently is not.

Disassociated by electrolysis or solar power into oxygen and hydrogen for rocket fuel, however, it is used once, and forever lost. Fortunately, there are substitutes: anhydrous fuel combinations like liquid oxygen and powdered metal fuels (iron, aluminum, magnesium, calcium are all theoretical possibilities, with powdered iron by far the easiest to produce in an upstart outpost operation.); and hydrogen extenders: for example silicon, in the methane analog liquid "silane", SiH^4.

So the question arises, if these ice deposits are rather skimpy, should they not be reserved for uses for which there are no substitutes? The rocket jocks (spade-calling time), many of whom (if the shoe fits ...) give no more than lip service to eventual resource development and the establishment of real settlements to support them (not confident that the economic rationale exists to make it happen) tend to be protective of the extravagant one-time use for rocket fuel to support admittedly more exciting and more near term space exploration type activities. They argue that the hydrogen, even if all used up in this fling, can be replaced with volatiles harvested from comets, as if, even though true, this were easy and cheap to do. "Hydrogen is the most powerful fuel" - true on paper, not necessarily in practice, as it is the least dense of all fuels, needing very large, proportionately heavy tanks, out of which it loves to leak (why shuttle external tanks are not fueled until just prior to departure time). We do need all that lift to boost heavy payloads out of Earth's deep gravity well. We may need it to boost payloads out of Earth orbit, even from the vicinity of the Moon, destined for the outer solar system. We certainly do not need that kind of oomph to lift payloads off the Moon, bound for Earth, low Earth orbit or geosynchronous orbit or for the L4 or L5 lunar co-orbital Lagrangian fields.

These various points made, tempering reason is needed in several doses:

- At this time, we have NO idea just how extensive in area or in total cubic meters or kilometers the lunar polar permashade ice deposits are.

- We don't know how easy/difficult mining it will be.
- By the same token, we have also yet to demonstrate the economical production of silane on the Moon to use as a hydrogen extender, and liquid oxygen/ powdered metal fuel combinations have flown only on paper. There is one heck of a lot of engineering to do. No one is doing it, because no one is willing to commit to the future - certainly not Congress, nor its NASA tail (NASA has certainly wanted to do such research, but when Congress says no, NASA has never had the gumption to insist).
- That lunar resources are sufficiently valuable to fully and even profitably support lunar settlements and biospheres is a faith fanatically held by some (including myself) and doubted by others.

This said, we reject the claim that we have "no right to decide what future lunar settlers will want us to have done" with this unique resource in this, their prehistory. "They might" want us to blow it all on exploring the solar system, willing to go fetch ice from occasionally passing comets and asteroids when they need a drink, or a bath, or their plants are drying up. Without intending to introduce the same polarizing emotion that attends the abortion debate, we must protest, that if we don't speak for the unborn - in this case the lunar settlements - who will?

Our recommendation is this. We are not yet in a position to use the lunar ice in any way. **So:**

- **Now is the time to gather more information,** and not get prematurely polarized over the issue.
- **Let's take silane and powdered metal rocket technology out of the orphanage and find out just what is involved in engineering real and reliable rockets using such fuels**. We cannot demand their use instead of pure hydrogen if they exist only on paper. How do we fund such research? One way is the spin-up route whereby we brainstorm a terrestrial application promising near-term profits and then go ahead and develop the technology with that incentive - with or without a Congressional assist.
- When the probes and engineers have done all their homework then we can return to the debate. How you think it will all turn out depends upon your temperament - mine lies with the settlers and their biospheres. But until all the homework is done, I'll respect your beg-to-differs. **PK**

MMM #105 - May 1997

The "Man in the Mirror" Strategy for Opening Space

When it comes to popular music, melody and rhythm catch my attention much more readily than do lyrics. But one relatively recent number whose words really did catch my attention was Michael Jackson's "**Man in the Mirror**." **The message is prime cosmic insight.** "The man in the mirror," of course, is the one looking - you - yourself. **The one real lever you have to affect the World's unfolding is yourself**. **Change yourself, and you begin to change the World.** We must each start with "the man in the mirror."

Development and cultivation of one's talents and aptitudes is everything. These are the raw tools we are born with, and most of us under-develop at least some of them. it is through these very personal tools that we can most effectively affect the world around us. Our excuses? Not enough free time (but we have only one life to live and every moment spent not being up to par is a moment whose potential we waste; not enough money (but more often than not, by neglecting talents or their development, we suppress our full income potential).

We have always rejected the "party line" that the space activist is the one who is involved politically in the promotion of the government public space program. That is a drum to whose beat not all of us are comfortable marching.

The true space activist is any person who strives to effectively use whatever mix of talents and aptitudes he or she has to promote the earliest realization of an open space frontier. Each of us works most effectively doing what comes naturally, working with the grain of who we are, according to our talents and aptitudes. Forced or cajoled into another mold by others, we can scarcely do our best. **Don't ever let anyone reduce you to such a common denominator (phone dialer, letter writer, wallet opener). You may have much more to give than that.**

Individually, we need to prioritize those hobbies, and/or types of income-earning activities that exercise our talents — over those activities that contribute nothing to personal development but only serve to pay bills. Doing so, may come at least temporary cost, reduced earnings. But the rewards of self-fulfillment, and our effectiveness in interfacing with the world at large are a priceless perk. Again, we only live once.

E**ach of us has only one chance to be the person our talents and abilities would have us be.**

For some of us, a rededication to developing our talents and aptitudes may affect only the way we budget our spare time, that is, our hobby activities. For others, a more difficult eventual occupation or career change may be in order. The sooner we start, whatever our age, the better, the more we have to gain and contribute by changing the man in the mirror. **If you think making such changes in how you use your time and energies is difficult, consider how much more difficult it will be to change the world, without so changing yourself first!**

Take stock. What do you 'know how' to do fairly well? What things have you always felt you might have it in you to do, but never got around to pursuing? (you got waylaid by life and family and job and their demands first)? What abilities have you let atrophy? Not sure? Take a professional aptitude test. Ask to see results of tests you have taken already at school or work. Identify areas that have not received enough attention. Make a practical plan to do something about at least one of them. A start! **Talent development, is a life long process.** We need the habit of self-improvement. We can't get up to talent-par by some facile abracadabra. It takes time, patience, determination, and overcoming many setbacks.

Time management will make or break your project. Look at your day (work, home), your week, your month. **Be frankly honest in writing down all the ways you (find to) waste time** – we all waste time, but the list of ways we do it differs for each of us. This is time that could be given to talent/aptitude improvement. We only live once. **Inertia is the enemy.**

You may have to **demand sanctuary both in terms of physical space and hours on the clock for self-development.**

This does not cheat your family. Indeed, not to do so in the long run down-the-road cheats your family more. You will be the best you can be for them, only if you take care to become the best you can be in yourself. It's a matter of patience, on your part, and on the part of those with whom you share your life. They owe you that. Insist on it!

Just as not everyone in the army carries a rifle, "the army for space" will be its strongest, when each of its very individual soldiers has taken every effort to see that he or she "be all that we can be." False generals would reduce us all to trigger pullers!

The realization of mankind's future in space proceeds on many tracks in as multiversal a fashion as has the development of "World One" since time began. All of history's legislators, leaders, and politicians would have gotten us nowhere without countless unsung farmers, scientists, educators, artists, craftsmen, tradesmen, entertainers, writers, poets, and others, even lawyers. Many less direct, less prestigious, less obvious roles and contributions to the breakout from Cradle Earth are waiting to be made. There is a role that is unique to you and your own identity, one that will build your identity further. **Start with "the man in the mirror." PK**

MMM #106 – June 1997

Failures are the Stuff Out of Which Success is Made

At the Lunar Reclamation Society (NSS) chapter meeting in Milwaukee this month (May), we were discussing various plans for ISDC '98 which will be held at the Hyatt Regency Milwaukee next spring. One of the special things the committee wants to do is a "poster session" entitled "Space Entrepreneurs Hall of Fame". Groups and individuals will be invited to "nominate" individuals they feel have contributed to (or to the prospects for) the commercialization of space. Some nominees are obvious, like Arthur C. Clarke, with his prediction of communications satellites. The nominating group or individual will prepare a storyboard and short paper about the nominee (criteria and format under discussion) as an

entry in ISDC 98's "SEHOF." We'd want the display items to be sufficiently durable so that SEHOF could be a traveling, and growing exhibit available to future ISDC's.

During the discussion, one chapter member objected that there are no space entrepreneurs yet, especially if you add the qualifier "profit-making". "So far," he said, "there have only been grandiose plans and lots of failures." We think that's a very narrow view, and also implies an unnecessarily restricted view of what kind of enterprise can be called "space related". Be that as it may, a more important point has been brought up: the tendency to disvalue and dismiss failure.

Someone (I do not recall who) has said, aptly, "show me the man who has never failed, and I'll show you a man who has never tried." Many persons in fact justify "not trying" by fear of failure. Indeed, in any envelop-expanding ground-breaking effort, the probabilities of failure are demonstrably greater than those of success. This has not stopped the scientific process nor the inventive tinkering which has led to the tremendous, ever quickening, and ongoing crescendo of technological culture tracing back to the discover of sticks, stones, and fire.

When someone succeeds brilliantly, he or she might make a gesture of humility by pointing to the "shoulders of others" on which he or she stood. But it is not only the wave crest of past successes we ride, it is also the much deeper tide of past failures. For failures help define the limits of the possible, whether technological, financial, cultural, or political — and by doing so, reduce the odds of success against the next brave spirit to rise to the challenge. Past failures help define and illuminate the route that eventually leads to success. Because of this humble but vital service performed by all those who try but fail, no one should be ashamed of having not achieved a "goal". It may take some humility, but in that case, it is the humble who enable final glory.

This is so not only of those who invent new doodads or processes, but also of those who "brainstorm" in general. Attempting "to creatively foresee" future pathways is just as risky an endeavor as attempting to pioneer them. But if one's error, however wide of the mark, is the triggering occasion of another's finding a better way, then the service of that error is a happy one. As the Christian liturgy says of Adam's "sin", "Oh happy fault" (because it created the need for a savior and redemption).

Thus in western culture there is a long tradition of recognizing the service of those who have failed and yet contributed all the same — often precisely because they have failed, or because of how they have done so. That we classify our bunglings as "learning experiences" testifies, in self-deprecating humor, to this positive value, To succeed means to have risked failure and won.

In his classic "The Moon is a Harsh Mistress", Robert A. Heinlein coined the epithet "tanstaafl", actually an acronym of "There Ain't No Such Thing As A Free Lunch." Tanstaafl applies to success as to anything else that is desirable. In the end, we have to pay for it. And the coin is not only hard work and careful research and preparation and talent honing etc. The coin is frequently prior failures.

Putting in place the various paving blocks of the road to space is no different from any other endeavor. But in that the task is very complex, inter-involved, and largely beyond currently pedestrian technology, we can expect the failure to success ratio to be higher than most other avenues of endeavor.

Elements required have to be tackled in the order of "prerequisites" - they have to be terraced. We can't expect to create an all-new space-based solar power satellite energy system before we have enhanced present energy systems with power relay satellites, creating a world energy grid. And so on.

Getting us into space, commercially, is a cat-lived pursuit - many failures already to our credit as dues paid. Otrag, Amrock, Connestoga, the list goes on and on. But with each failure we learn and success becomes that much less improbable for those with enough optimism to pick up the pieces and follow.

Organizations too, have had a moment in the Sun, only to "fail": L5 (which has an afterlife of sorts in NSS), LDC (Lunar Development Council), LBO (Lady Base One), etc. This record must not discourage us.

That we persist, we who would have the stars, despite all these battle failures, is testimony to our credentials - we have the right stuff. We know how to turn failure into success. We will win the war.
PK

MMM #108 - September 1997

The Moon? "Been there, done that!" — Not!!!

That the media and a poorly educated public should take the view that "we've done the Moon, now let's move on" is understandable if discouraging. That one hears the same sentiment echoed by many space advocates is much more of a problem.

Perhaps any/everyone's estimate of "what needs to be done next" is colored more by the drum-beat to which they march than by cool, clear, hard reasoning. Turn of the century American philosopher William James showed in great depth just how much temperament predisposes "reason". Without at-tempting to be exhaustive, a first effort to list some of the different siren call drums we space-interested "hear" might be: Explorer, Tourist, Settler, Businessman.

Myself, I have an ear for all of these drums, each of them raising a surge in my spirits. But it would be dishonest of me not to admit that my spiritual home base is as settler. The great variety of topics about which we have written in MMM over these last eleven years are testimony enough to that.

Others do not hear that drum so clearly, or it raises much lower tides in their spirits. Unsuspect-ing just how much remains to be discovered and wondered at on the Moon, the explorers and tourists among us, will naturally want to move on. Some would-be settlers, and many businessmen will want to consolidate our toehold on the Moon first, pointing out the greater logistic base such development will afford for further deeper exploration of the rest of the Solar System.

It is always useless to argue against temperament. The universe is vast and it needs all of us. We must be wise enough to admit that and respect one another. I understand the lure of Mars, of Eu-ropa, of Titan. I too would be a Martian, a Europan, a Titanite.

That said, it must be pointed out that in any non-superficial sense, we have **ye**t to do the Moon!

We did not get enough rocks and dust! Our samples from six scattered areas, a college effort, are far from representative enough. Nor are they enough in total quantity. Enough perhaps to let us un-cover "what the Moon is made of", orders of magnitude too little to let us discover "what we can make out of what the Moon is made of." That deficiency has set NASA up as high priest over the samples, hoarding them so tightly, least we never go back for more, that we are prevented from learning what we need to know to give us confidence that we can return to stay, self-sufficiently.

We are forced to rely solely on ivory tower "research" too heavily based on crucially inadequate simulants. That in turn slows us down in developing a viable suite of feasible and serviceable lunar-derived building materials and alloys.

We have explored none of the literally thou-sands of linear miles of lavatubes which geological clues and photo-graphic tell-tale signs give us a very high level of confidence we'll find - cosmic weather sheltered, dust-free hidden valleys many thousands of square miles in aggregate area. We have sampled no central peaks (composed of upthrust mantle material), no polar permashade "cold hole" ice fields, no unflooded great impact basins (the farside thalassoids). We still do not know enough to piece together the real origin of the Moon, the presently in vogue Velikhovskyesque scenario notwithstanding.

We have yet to take advantage of the unique platform the Moon offers optic and radio astron-omy both - vantage points of which the Hubble people can only dream. We have yet to visit to the "Peek-a-boos" lands of the lunar limb, much less explore the first square mile of the lunar farside ex-cept from orbit.

The Moon is a gift we've "anticipointedly" unwrapped and discarded in a boredom revealing not its shallowness, but our own lack of depth, after playing with it for just a few moments. But after all, back then our mindset was "moonandback" one word.

QUESTION: Can those so easily and quickly bored with the Moon, totally unable to imagine beneath and beyond appearances, quite incapable of recognizing opportunities staring us in the face, be trusted to be any more insightful when they lead us to Mars? Or - might we need new leaders, with proven track records in uncovering real possibilities and opportunities for "**reclamation**", i.e., for "finding resourceful ways to take 'a barren wasteland' and turn into a fruitful, productive oasis in which transplanted hu-mans can take root, thrive, and pursue happiness". How many of these been-there-done-that people have wasteland reclamation experience, or even reclamation brain-storming, in their resumes? These very same people will find on Mars, alas, only more "rocks and dust", more endless expanses of "bor-

ing", not-quite-as-hyped scenery, "unrelieved" frigid cold, and - and this is the bottom line - "no reason to return".

What we are sure to get out of entrusting them with our leadership is another long "40 years wandering in the desert (of incapacity to imagine)" post-Apollo like retreat before these same people or their intellectual successors succeed in getting significant press for their "on to Europa" fad-charge.

In comparison to the general public, the space-disinterested, WE space-interested people are supposedly extra-imaginative, extra-creative, extra-resourceful, extra-attentive to hidden opportunities and possibilities. Guess what, folks? Not!!! **PK**

MMM #109 - October 1997

We need an "X-Prize" For In-Orbit Artificial Gravity

By Peter Kokh

When the Reagan government committed in '84 to building a Space Station, perhaps many of us conjured up the vision of Von Braun's "wheel" as depicted so well in the epic Kubrick/Clarke film; "2001: A Space Odyssey". Alas, neither NASA nor its contract-seeking aerospace has ever entertained the idea of realizing an artificial gravity platform in space. No allusion is ever made to Von Braun's dream, and the whole idea lies buried in an unmentioned limbo in an unspoken conspiracy of silence. Instead, throughout the long rocky road to Freedom, Fred, Fried, er ... ISSA, what we see instead is the pursuit of validating the medical-physiological-mental feasibility of year(s)-long duration "micro"-gravity to demonstrate the possibility of an eventual exploratory science picnic strike at Mars.

NASA has not been without opportunity to experiment with artificial gravity. All it takes is two shuttles or two modules or other roughly comparable masses co-rotating around a common center of gravity via adjoined tether. But we suggest that there is a reason, a rather insidious one from our own shared point of view as would be settlers of the solar system, why we have seen no such efforts, not even so much as official paper studies (!!) to date.

The reason is this: demonstrating the engineering and physiological feasibility and validity of artificial gravity would be tantamount to a storming of the Bastille, to the sudden realization that mankind might be on the verge of Cradlebreak! For with artificial gravity, we could travel to and from Mars and points more distant with relative ease, arriving with the strength necessary to tackle the scouting, the exploration, the experimentation, the outpost building - whatever - upon reaching our destination without having to waste precious time in bed rest reacclimatizing ourselves to gravity.

Artificial Gravity opens the way for O'Neill type construction shacks, Bernal Spheres, Torus settlements and giant Sunflower worldlets. It would open the way to serious industry in space, to space settlement. Rotating habitats would allow asteroid miners as well to work healthfully, safely, productively, and be able to come home, if and when they so decided. Abracadabra, artificial gravity would open the Solar System at large as a humanizable domain. For the government, wanting to keep the space program "tamed and domesticated", innocuously contained within Earth-orbit "fringe-space", the potential financial commitment such a Cradle-breakout technology might encourage is sure to send cryogenic chills down the spins of any public official, not just the grim dream-reapers of the OMB.

Whether the infamous Roswell incident involves a government conspiracy or not, pales into insignificance long-term with the virtual conspiracy against even basic and rudimentary experimentation with artificial gravity. As much as we need Cheap Access to Space, as much as we need space nuclear propulsion, nothing stands to blow the lid off of the limits to human dreams like the realization of artificial gravity. We ain't going anywhere without it, not beyond the Moon in any significant way. Yes, we may do a self-limiting Mars sortie or two without it, but we'll get no further than that before bogging to a whimpering halt, reaching an invisible, unnamed, unidentified ceiling the public will soon accept.

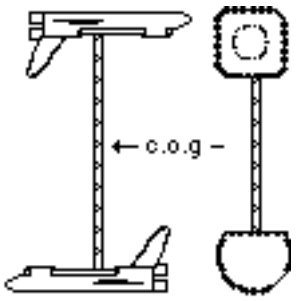
Congress would no more let NASA doodle with rotating environments than it will let the Agency plan a lunar outpost or Mars expedition. Our manned aspirations have to be kept in check, satisfied with more affordable low Earth orbital tricks and trivia.

How do we make an end run around this conspiracy? The answer is clear. We must encourage commercial demonstration of artificial gravity. After all, even in Earth-fringe space, the ultimate economic bonanza stands to come from Tourism, and orbitels offering artificial gravity, of whatever level, will be much more popular than those that do not.

Meanwhile, there is strong enthusiasm among space-activists and government station supporters alike for allowing commercial activity at Alpha, much as the Space Frontier Foundation's if-you-can't-beat-'em-join-'em "Alpha Town" proposal has outlined. Such an Open Station policy might see the incorporation of commercially financed and operated laboratories, habitats, even compact picture studios and hotel modules in and around Alpha. Here too there is room for an independent co-orbital manned rotating facility flying in formation with Alpha. Or, such a facility could be put up in its own, perhaps more equatorial orbit, serving commercially run industrial laboratories, tourism, or both.

Instead of leaving such developments to chance, however, space activists ought to begin now to brainstorm how we could put together an attractive enough "X-prize" purse to ensure that the realization of the first such facility comes sooner rather than latter. The stakes are high. The demonstration of physiologically acceptable artificial gravity stands to blow the lid off human aspirations, which media Science Fiction popularity notwithstanding, is at an effectively contraceptive low. **PK**

Simple ways to demonstrate artificial G



MMM #113 - March 1998

In one word - Marsandback, No! Marstostay, Yes!

We've all heard it: "those who do not heed history are condemned to repeat it". Yet, evidently, for many, if not most of us, it is a quote that has gone in one ear and out the other.

It is now more than 25 years since the last human set foot on the Moon. But what did we expect? The Apollo program was explicitly aimed at putting a human crew on the Moon and bringing them back safely. Period. Moonandback. One word. Period. Those of us who knew there should be more, kept fooling ourselves into thinking that there would be more. Right building. Wrong foundation.

Many of us have also for a long time realized that Mars would eventually be the most populated world in the Solar System, Earth itself, of course, excluded. To us few old timers there are welcome legions of reinforcements as the brilliant work of breakthrough mission architectures such as Robert Zubrin's "Mars Direct" wins new converts.

Yet there is plenty to worry about. No, we don't refer to the shallow media or the myopic Congress or administrations who follow the masses rather than lead them. I refer to a far more insidious faction, we ourselves. Seemingly oblivious of the need to pick means that are suited to the goal, we who inwardly sing the mantra Marstostay, outwardly lead the public and its demagogs in a sing-along "Marsandback!" "Marsandback!" "Marsandback!"

So we urge the government to adopt the goal of manned exploration of Mars. Have we not learned that Congress does not budget open-ended programs? To Congress, manned Mars exploration is at best a limited set of missions - flags, footprints, enough token science to quiet the protesters. The End†.

Have we learned nothing? Why should we expect Marsandback to be any more pregnant with the future than Moonandback? Human presence on the Moon must now literally rise from the ashes. Twenty-five years and counting! We don't know how much longer it will be. Those who expect the government to do the Phoenix trick may find that the tradition of postponement is the path of least resistance. Economics alone will open the Moon.

So why do we now chant in zombie unison "Mars-andback!" "Marsandback!" "Marsandback!" ?? There is a need, caution some, to sell the ladder one rung at a time. The public won't swallow the Martian frontier. We have to get them over the anxiety of putting that first toe in the water. We have to sell them on a human expedition to Mars. Once they have accepted that, once that mission is successful, then we sell them the next rung, then the one after that, and so on. To this learned advice we say, "balderdash!" Remember the Moon! "Those who do not heed history are condemned to repeat it."

If we get our sorry way, all we'll earn is another hiatus, this time one guaranteed to be longer and deeper - there are no more attractive worlds than Mars to get things started again in a different theater. And the stand down from the Moon is not the only ominous portent from the pages of history. Look at how our leadership (the individuals change, but somehow the anthem remains the same) has succeeded in bringing about the era of L5 colonies in space and solar power satellites, etc.

We decided on the strategy of selling our goal, one rung at a time. And where are we now? About to get a space station which is not a stepping-stone back to the Moon to retrieve lunar resources to use in building space settlements and solar power satellites. No, we have a "station" (same word, different meaning, much like the cold war semantics of "peace"), a station that is not a depot to anywhere, not a staging point, not a construction yard. It has been sold on other points, none of them germane to our goals. Yet we officially continue to boost the station and even to boast of the irrelevant things it will accomplish.

We cannot, and must not try to sell space one rung at a time.
We have to sell the whole ladder.

If we do otherwise we will end up with rungs that do not fit together as steps, and thus are not rungs at all, just cul de sacs. Alas, cul de sacs achieve one thing very surely, they preemptively tie up discretionary money achieving something with no real relationship to our original goals. Yet we do not learn our lesson. The players, even the teams, on the NSS Board come and go, but the holy Game of selling space one rung at a time is never challenged. Everyone, even declared mutual enemies, accepts the Game as transcendental.

Well that simply means that if someday Mars is settled, we do return to the Moon to stay, there are real human communities beyond Earth - all this will have come despite the National Space Society and its timid Game, not because of it.

So let's cut this talk of human exploration of Mars! Let's start pushing the "settlement of the Martian frontier", and picking means that lead to this end. Logically, it is a simple thing to do. Not to use the right means to the end, is to play into the hands of those who will be only to happy to see our efforts come to naught. We have to stop being our own worst enemy through our carefully organized and compulsively pursued clutzery.

After the lead-thud finality of the termination of the Apollo Program set in, we told ourselves that the fatal flaw was the Saturn V. Too expensive an infrastructure to maintain. Yet now like bush league baseball fans wildly cheering every foul ball, we seem prepared to uncritically swallow the government's virtual Mars Program, that is, the Mars Program the government will end up approving based on the inappropriate elements now in place.

With chemical rockets pushed to their design limits taking many months for a Marginal journey, offering little shielding to their cavalier occupants, and without artificial gravity to keep them in shape for the taxing job ahead, we will succeed in getting brave round-trippers to Mars. But this is a transportation infrastructure that cannot support an organized effort to "open" the Martian Frontier.

We need faster nuclear thermal rockets that in cruise mode will separate into tether-bound rotating sections. By providing Mars-like gravity for the transit, we assure that when the crew arrives, they will be fit to work immediately, without wasting precious oh-so-expensively-purchased surface time in unproductive bed rest.

We need rockets that do the job with comfortable ease, rockets that become marginal both in performance and in crew protection only far deeper into the outer Solar System.

We must bite the bullet as well on biologically assisted life support, especially in modules destined to become Mars surface habitats. We need to begin food and fiber production right of the bat.

Well before leaving Earth, we will need to successfully fly a suite of precursor robotic probes that will show us where the resources and assets are, so we can site our outpost where it can best continue to grow into a thriving settlement.

We'll need surface vehicles able to range swiftly and widely over the whole planet, not ploddingly, tentatively within some shy base perimeter.

Our goal should be to set down on Mars "the first Martians"
not yet another batch of"returning heroes".

But the number one thing we need to bring along is people with the real right stuff. Dare we say it? We need to limit Mars crews to true, deeply committed Marstostay people, not Marsandback people. Our goal should not be to produce returning heroes! It should rather be to send the first new Martians! Radical? If you can't buy this, you're lost to us. You counter that we must crawl before we run? Well, we squelch that by reminding you that we did it your way on the Moon.

To those who will say, and they surely will, that we have to learn how to stay on Mars before we dare send anyone to stay, we reply that there is no way to learn except by doing. There is no way around it. We must take the plunge from the outset - or we are dead. The End. †

Marstostay does not segue from Marsandback.
Marstostay must be pursued instead of Marsandback.

Not enough, we need also to set our brave new worlders down on a site with the resources necessary for them to succeed over the long haul - not on a site picked for its "great geological interest". If we are on Mars for good, we will get to explore the whole planet, in due course, and thoroughly. We must not sacrifice the odds of success to the impatient idle scientific curiosity of those who have no interest in whether or not a Martian frontier is opened. We will learn far, far more in the end, if we go to stay. So the "Mars scientist" supporting Marsandback instead of Marstostay is a pathetic hypocrite. If the shoe fits ...

There is a long list of hardware development, propulsion breakthroughs and all around general brainstorming homework ahead of us before we will be ready to go to Mars to stay. Nothing less than such preparation will do. There is no point in going before we are ready to do it right. To hurry, to set a target date by which we "will" go to Mars, only ensures that we will go before we are ready - that we will go in order to return, not in order to stay. Jumping the gun may satisfy our impatience in the short run, but will produce a devastating disappointment in the end, as a similar sadly still much admired crash program did on the Moon.

Alas, the only trick we seem to know is trying to get the government to do things for us, thereby entrusting the insanity of the political process with the proper conduct of affairs for which we should not be so ready to abdicate such a serious responsibility.

We leave you with this paraphrase of a modern proverb: If it looks like a Marsandback, quacks like a Marsandback, and waddles like a Marsandback, it probably is a Marsandback. If I have embarrassed anyone, it is because I support the emergence of the real Marstostay you inside. Search for it, nourish it, and become a spiritual ancestor of the Martian pioneers. **PK**

MMM #114 - April 1998

Earthday 28: Lessons that will Only be learned in Space

We Earthlings have been down on ourselves for sometime when it comes to our environmental conscience. It seems we may have inherited from our common ancestors a bad habit legendary among our Primate relatives: we are quite content to foul our own nest.

Primates cannot be housebroken.

And some times it seems certain that we humans can't be planetbroken.

We are quite content as pigs in mud befouling our one and only "habitable planet."

A big part of the problem, something that must not be overlooked as it bears on any ultimate solution, is that thanks to gravity, water rolls down hill, carrying waterborne pollutants and garbage out of our own tribal territory into that of our neighbors while, thanks to the Sun-driven winds, what-ever we belch into the once fresh air is likewise dispersed "somewhere else"

Those who feel humans should not go into space lest we trash every other place we come to as we have our home-world, overlook one radically different characteristic of all potential human town-steads out there. There are no biospheres to pollute, we must make mini-biospheres of our own to shelter and reencradle ourselves, and within their very finite limits, there is "no place else for our un-treated discharges to flow downstream, to blow downwind". Future Lunans, future Martians, future as-teroid belters, future space settlement citizens will all do something no human has ever done before. They'll live immediately downwind and downstream of themselves. As such, their environmental sins, should they be so foolish to commit them, will haunt not their neighbors, nor their grandchildren, but themselves - not a couple of generations hence, but right away - that very morrow if not that same day

We are used to living in a transcendentally planet-wide biosphere. We see no ready distinction between planet and its air and water envelopes that sustain life everywhere, so easily. Everywhere, even in superheated, sulfur-saturated deep ocean waters near sea bottom volcanic vents. Everywhere even in the boiling mud lakes of Yellowstone Park. Every-where even in the oxygen-deprived methane soaked oozes of the ocean bottom. Everywhere, even under the ice shelves off Antarctica. I once recall, while en route from Milwaukee to the '88 ISDC in Denver, driving into NE Colorado through endless rolling hills of nothing but scrub brush and tumble-weed, saying to my car mates, "how godforsakenly desolate this place is!" Then, suddenly realizing my mistake, "how silly of me. On the Moon, this would be a lushly verdant National Park, a planetary treasure!"

Indeed, there is no life out there. We must take it with us. It is not just humans who would live in extraplanetary exclaves. but humans reencradled in the very Gaian Earth Life that encradles us now. Our existence is a symbiotic one, and it is a matter of emphasis whether we're taking representative terres-trial flora and fauna out there with us, or whether we are just the gonads of Gaia, pubescent with tech-nology, the sole means by which Earth life can spread to worlds once barren and virginal, letting them glory in the joys of motherhood for all time previously denied them, motherhood of and to life.

Out there, humans must survive in a radically new situation, a situation turned on its head, in mini-biospheres close-coupled with nature, with nowhere to throw anything away - "immediately down wind and downstream of ourselves." It will be sink or swim time, from the gitgo, from then on forever so long as humans shall survive beyond Earth. Failure is radically intolerable. We must get it right, get it right all the time without fail, things we've never got right before - because we did not have to get it right!

Biosphere II's was a bold daring mission. Nothing less than learning how to live in harmony with nature. It was an expensive project, funded by a wealthy individual - hardly an economically duplicable experiment. We did learn some-thing. But this is not the way to learn more. We just won't spend the money, we will not take the pains, all for the same simple reason. We don't have to. The penalty for failure is too remote, too postponable. We can be bothered to inconvenience ourselves trying only so long before we shrug our shoulders. And there are many other oases of environmental inspiration about the globe from Lindisfarne to Bloomington, Indiana. Valiant efforts that in the end tilt against the wind-mill of postponed punishment for failure.

True, many of us are moved to pursue space development in search of ultra clean space-based energy schemes promising inexhaustible pure energy for Earth, relieving this planet of the single most dirty activity of all, in its gross effect, producing energy, by damming rivers and ruining valleys, by min-ing and burning coal and oil and uranium. With clean energy we dream of bringing Earth's unprivileged billions to the table of cornucopia, with enough reserves for all to share the good life in a sustainable way.

Important as these possibilities are, they come at a high upfront price and hence themselves beg to be postponed. And what politician can resist? But there is another environmental benefit from the near term establishment of viable human communities on the extreme and unforgiving shores of the barren sister worlds of our solar hinterland. This is a benefit that is not so easily given a dollar value, a benefit that cannot be traded on the stock exchanges of the world's financial centers. It is the benefit of knowledge, of know-how, of "having learned how, at long last, to live fully at peace with nature, trans-planted life within our hull-contained mini-biospheres, on acres "reclaimed" from the lifeless waste-

lands of cosmic ray-washed shores. Lessons learned because we had to learn them, had to or die. We have to get it right, right the first time, or our beachhead will become another in an already long list of human ruins and ghost towns buried in the sands of time.

Spin offs are available from any high technology initiative. Asteroidal wealth may never come. Inexhaustible supplies of space solar power, of lunar and Uranian Helium-3 may take generations to tap. No benefit is so certain and so powerful as that without which none of the others can be attained. Getting our symbiosis with nature right - for the first time. Not even in the idyllic pastoral times of the mythical past did we do it right. Now it will be different. We will succeed because we have to. And this knowledge, more than all the energy in space, more than all the technological spin-offs, more than all the asteroidal wealth, this wisdom will save our beloved Earth. - **PK**

MMM #115 - May 1998

"Spin-Offs": the most impotent of all arguments for Space

Perhaps most of us have never examined just what it is that interests us about the outer universe of Space and our potential future beyond the atmosphere. There are so many aspects to the greater universe and thus many points of appeal and interest. What grabs one, will not catch another. Never having put our finger on what makes ourselves tick, we find it difficult to explain our passion to others, much less to infect others with it. That is too bad, because there is nothing that one call sell so convincingly and sincerely as precisely what enthuses oneself.

In absence of such personal testimony, we are prone to rely on "stock" tidbits of "witnessing" that we have heard from others. Foremost of these is the so-called "spin-off" argument. But if we are honest, while instances of beneficial spin-off from space research and development programs add frosting to the cake, without the cake, they are so much insipid sugar that neither wins new converts nor succeeds in disarming old enemies.

The reason this is so is that any high tech R&D program will produce technological spin-offs in new and improved consumer products or medical paraphernalia. Or at least, any high technology "crash" program can be maximized to do so. I recall during Jimmy Carter's unsuccessful run for reelection, his son was explaining that a vigorous space program was not necessary to produce desirable technological spinoffs. "Our plan is to pursue an aggressive program to produce major breakthroughs in solar power and other alternative energy sources in such a way that positive spin-offs will flow from them, much as they have from the space program up to now." For me, this was a thunderbolt, because he was right! Spinoffs are not an argument for space because there are other equipotent sources.

We do appreciate the gizmos we've gotten used to. but it is very easy for us to dismiss hypothetical ones we don't yet enjoy and on which we are not yet hooked. Thanks, but no thanks, is the all too easy, all too appropriate answer,

Why do we still hear the spin-off argument? It is a blatantly obvious "excuse", a shameless way to get across the unintended message that we don't have a compelling "real reason", or, at least we haven't taken the time to examine what drives ourselves, what passion we experience, with which to infect others. "Know thyself!" This is the first rule of any approach to an active role in the world. I have heard people say that "spin offs" are what interested them in space. But it is a lie. A Pity.

Turning to the spin-off argument is a case of monkey hear, monkey cry - hey, if the banana fits, peel it! Canned frosting type arguments only earn the contemptuous "So?" that they deserve.

Not only do we not convince the public by this tactic, we may actually harden opposition to space programs, space exploration, space research, and space development.

By using this impotent argument, we encourage the suspicion in others that we have no "real reasons" why space is good.

The spin-off argument is a knee-jerk defense mechanism. We use it in the same situations where we might say "my big brother can beat the tar out of your big brother."

So what arguments should we use? The best is to try to understand **what first interested YOU in space?**

- Looking at the stars and wondering?
- Studying astronomy?
- Reading science fiction?
- Hearing some visionary tell about his vision of the future?

1. **Go back to your roots**. Look at not your present understanding of the opportunities and possibilities, but
   at what first got you hooked.
2. **Read up on those aspects of space.** You will always be more convincing affecting others with your virtual vision than with the vision of others. Other visions you can add as frosting, to draw people in. But start with your own passion.
3. **Listen to the other person**, and try to determine what his/her passions are.
   - Robotics? • Electronics? • Arm chair astronomy?
   - Social utopias and experiments?
   - A yearning for the lost frontier?
   - Environmental concerns about Earth?
   - Concern for the desperate poverty in the Third World and a lack of ready solutions?
   - Concern for the survival of the human race with all our eggs in the one basket-Earth?
   - A desire to see the wondrous adaptability and creativity and resourcefulness of humankind reach even greater heights through new challenges?
   - A desire to see and experience and explore new, strange, even alien surroundings and landscapes?
   - A feeling that all the important roles are taken, and that there is no opportunity to get in on the ground floor of anything meaningful?
   - Some undefined feeling that the answer to whether or not "we are alone" is to start other separate human worlds?

There are lots of possible hooks if you are talking to anyone who is not totally shallow. (You will meet such people. Don't even try. Nothing is to be gained.) Above all, listen first, and listen patiently and at depth. You cannot convert someone if you haven't taken the pains to learn what buttons to push. If you just talk, you will talk past the other, not to him/her.

If you listen, and hear - it will take practice! - you will find the right approach. Just remember, "spin-offs" are not it! Or if you find someone who miraculously does fall for that argument, you will have found a truly shallow person. **PK**

MMM #119 - October 1998

The Search for Life is Now "the" Hot Public Space Policy Button

Except for Lunar Prospector, which NASA had adopted ready-designed as one of its Discovery Mission "Turn-Key" opportunities, the Agency, and the U.S. government, administration and Congress alike, have remain turned off by the Lunar Frontier. All attention has remained on the Space Station, on future transportation systems, and on ongoing deep space missions.

After the finding of the life-sign Martian meteorite in Antarctica (prematurely debunked by disbelievers, it seems), **Mars** is once again a respectable topic.

√ We are excited by what we don't know about Mars,

√ but not about what we don't know about the Moon.

The reason is simple:

√ in the Moon's case our ignorance concerns only mineral resources.

√ In the case of Mars, independently originated Life, capital "L."

At the same time, the darling of the outer solar system continues to be **Europa**, the near lunar sized moon of Jupiter that long since dethroned its sibling, Io, at the center of our attention. Europa, doubting Thomases aside, shows every evidence of having a sizable global ocean under its ice crust.

In the context of deep ocean thermal vent based eco-systems found and explored on Earth in recent decades, it is impossible to rule out that Europa too, may harbor at least primitive life forms - another possible independent Life start, again, capital "L."

There are many reasons why water alone may not be enough. We need a usable energy source, plus other elements: carbon, nitrogen, phosphorous. But "the human solitude", given the failure to date of our modern beginners' league efforts to eavesdrop on intelligent radio signals from other civilizations, has become metaphysical. This solitude now characterizes the human condition.

Finding irrefutable evidence of independent "Life-starts" elsewhere in the solar system would provide reassurance that we are not, after all, some meaningless cosmic joke.

E.T., aliens if you will, are still an off-limits topic, the brunt of jokes among shallow congressmen. And so, S.E.T.I. type radio searches for intelligent life are still not "respect-able". But should future sample return missions or human expeditions to Mars and/or Europa turn up convincing evidence, even of now-extinct life, you can bet that the attitude towards the "E.T. Question" will change.

Only then will the Moon regain public attention, via the back door so to speak, as "the" ideal platform for an advanced all-out radio search for intelligent radio signals, from the lunar farside. Working in favor of the new evangelical zeal at NASA for "the Search for Life" is that continued studies of terrestrial climatology and of the evolution of life on and under the benthic ocean floor dovetails neatly in the instrumentation required with prospective life-search missions to Mars and Europa. For NASA, it is a long sought marriage "made in heaven" and, for us would be expatriates of Earth, unlike the purely environ-mental Mission Earth emphasis of recent times, Mission Life has a deep space vector. At last NASA has found a reason to move beyond Earth orbit, and do so aggressively.

I recently received a telling letter from NASA in response to email to the White House 6/6/98.

"One area of particular focus is solar system exploration and the quest to understand the origin of life. The recent discoveries of evidence for ancient life in meteorites that originated on Mars have enabled us to refine both our questions and our approaches to the Red Planet.

"Our strategy for exploring Mars focuses on three broad scientific areas.

First and foremost is the question of life: Did life arise on Mars? Is so, what happened to it? Might there be life on Mars today?

Second is climate change: What caused the great, global, climate change that appears to have occurred on Mars between its ancient past and the present? What can this example of climate change tell us about climate change on Earth?

Third is resources: What resources are accessible on Mars for robotic and human exploration? Where are those resources and how may we lean to use them? How has the interior of the planet evolved to produce those resources?

"**The thread connecting these three scientific areas is water.** Water is essential for life. It is also a principal factor establishing climate, as well as a resource in itself and a factor in determining the availability of other resources."

The letter goes on for two plus additional pages, focusing on future Mars missions. But at the same time as Galileo makes successive flyby rendezvous with Europa, one can feel the excitement build within NASA and the brainstorm sessions at JPL and even private Europa groups (e.g. IcePIC) build to fever pitch.

Again the threads are the same: water and the possibility of life. Now we've witnessed the long overdue birth of the Mars Society, the Planetary Society serving as somewhat of a precursor. Can the birth of a Europa Society be far behind? We think not - it could come within this millennium.

But now we've found water on the Moon! Not quite, only water-ice. There is no indication that water in liquid form has every exited on the Moon except momentarily in minute amounts. The rest of the ingredients are not there. The Moon's history does not seem to shed light on Earth's past, present, or future. Hey, don't cry! One man's trash is another man's treasure and we can rejoice that the other man, the government, has lost interest. If there is not now and never has been life on the Moon, there is no argument that it does not belong to mankind by default.

The Space Frontier Foundation has it right:

√ **Let the government** abandon Near Earth Space and concentrate on the great expeditions of discovery to the rest of the Solar System.
√ **Let business**, commerce, trade, industry and, above all, people develop low Earth orbit and the Moon. This is as it should be. Each sector does what it does best.

A dynamic connection?

The question arises: will the private sector benefit in its development of low Earth orbit and the Moon from infrastructure and technologies developed by the government(s) in their push to explore the past and present of Mars and Europa? That is the hope. That is the expectation.

But perhaps we should counsel lowered expectations. Has the private sector found the infrastructure developed for the Apollo Missions useful? Not at all. And infrastructure developed for limited government initiatives to Mars and Europa may be no more useful for those who would go to open the Martian frontier to pioneers bent on making it a second human homeworld.

Those of us interested in opening the Moon, and those of us interested in opening up Mars - there is more overlap than some suspect because of natural inter dependencies - should start relying on themselves. By waiting, rather than developing our own talents, we rust, and are left with nothing when we find to our stupid surprise that the government has not delivered. It is now nearly 30 years since Apollo 8's first trip out to the Moon. Where are we? If we wait for government built hardware to take pioneers to Mars, the Mars science expeditions will have come and gone and we will still be pouting and whining about our lost chance to pioneer the Red Planet fifty years hence.

Yes, make use of government science!
But let's not depend upon government infrastructure.

The exciting things on the lunar front are not about exotic life, but about expanding greater Earth through captive resources - water at the poles. lavatubes, radio quiet in a deep farside minimagnetosphere, the possibility of a thorium-uranium nuclear fuel industry along the south Imbrium rim, nitrogen and carbon outgassing traced by radon, etc.

Yes developing the Moon is about Life also,
a future exclave for Earth Life. PK

Only those who risk going too far can possibly find out how far one can go."
- T. S. Eliot

MMM #120 - December 1998

Essence of the Frontier: a Readiness to Reinvent Everything

Throughout human history, whenever groups of people endeavored to pioneer new territory, unoccupied or not, they have had to adjust to different conditions than those they were familiar with in their traditional homeland. When there was a choice of prospective new territories, they would, of course, naturally select those that seemed most similar to the one left behind, at least in those respects that mattered most. Steppe peoples favored other steps. River delta people, other river deltas. They would have to make some adjustments, but hopefully not wholesale ones. But nowhere could they expect to find a new home just like the old one in every way. Whether the stress was on finding a new life setting, or on getting out of the old one, except in the case of unwilling refugees, the movers were a group self-selected according to their willingness to start over, their acceptance of the need to "reinvent" many of the givens of daily life to fit the character and available assets of the new home.

Mineral resources, wildlife, vegetation, and climate all affect what the pioneers can make and the methods they might use. On hand manufacturing and craft stuffs will affect home and building styles and construction methods, furnishings, clothing. Sports, games and amusements, even cuisine, will show major or minor adjustment to the new realities.

Those who liked their lives as they were and were willing to change little, stayed behind. Those who left would naturally change as little as possible, but were willing to change and adapt and make do whenever and wherever necessary.

As we move into space locations, we are very unlikely to find any places reminiscent of Earth except in trivial ways (the Arizonesque scenery and similar day/night cycle of Mars). Those not ready to make major and wholesale adaptations will chicken out once they take off their rose-colored glasses. Sure, we've all seen the very Earthlike concave landscapes painted by artist dreamers trying to sell the L5 vision. But if ever such places are built, it may be long after the youngest of us is dead that the extremely high economic thresholds involved are reached. Nearer term, whether on or under the lunar or Martian surface, or in the primitive shielded construction shack space settlements that we might be able to build in coming generations, the frontier's most Earthlike aspect will be ourselves, the plants and animals we bring along, and our characteristic "we can do it" attitude.

Those who find they have to leave behind too many "favorite things" and lack confidence that they can find/make satisfying substitute "favorite things" will choose to remain behind. Never has there been a frontier, or set of them, so challenging, so demanding of our readiness to reinvent everything. It is a task that daunts us, whether we'd go to the Moon, to Mars, to the asteroids, or pioneer the first crude space settlements. There will be a premium on adaptability and attitude. The tasks involved should frighten anyone taking a real look.

Yet there are ways to adapt, to do without, to make happy substitutions. There are ways to hone the rough edges off the early frontier. Taking a look at them, one by one, is just what MM**M** is all about. That is what the third "**M**" is all about. A brash, brazen **MANIFESTO** that shouts: "look, we can do it, and these are some of the things we might try to make ourselves 'at home' in our new setting."

If we remain displaced Earthers, we will have failed. We will need to redefine ourselves as fully settled-in Lunans, Martians, L5ers, asteroid 'Belters' and so on. We can only do this if we leave Earth behind in our psychological rear view mirrors, and forge unreserved new attachments to our new homes. We need a no-holds-barred readiness to reinvent everything. Sure, some material, cultural, and social aspects of our lives will translate readily enough. But others will require major changes, reinvention, replacement, or sublimation.

If the Frontier is a place where we are forced to start anew, it is also a place where we will have a chance to get in on the ground floor, a greater chance to play a significant life role, where we can leave behind the baggage of examples, customs, habits, and strictures accumulated on Earth. The space frontier will be a rugged place where the status quo, the way we do things, is not a given, but something to be created afresh with our input. And all this is a plus. It is this gain in the potential value and significance of our individual struggles that will make all the sacrifices worthwhile. It is this promise, the chance to start over when the old life has been found wanting or become unbearable, that has been the beacon, the siren, the beatific vision pulling many a person and family to pioneer in the past.

The deep logistical mutual quarantine of the various space frontier sites will offer unparalleled opportunities for social, political, cultural, religious experimentation without attrition to and erosion by a dominant and overwhelming mainstream culture.

It is not only political, cultural and economic anarchists and utopians that will be drawn outwards, but many individuals with more concrete, more personal problems with their current life situations. The frontier will be an unparalleled scene of renaissance and creativity and fulfillment. - PK

MMM

MMM #121 - December 1998

Required Beyond Mars: "Cryosynthetic Materials"

With the growing crescendo of interest in Galileo's ongoing flyby probes of the ice-crusted ocean moon, Europa, NASA and others are already brainstorming Europa orbiters and ice-crust penetrators. Suddenly human horizons have expanded well beyond Mars. Whether we find Europa fertile with primitive life forms, or barren but ready for fertilization, the prospect for human expeditions out to Ju-

piter's realm looms strong. It is a challenge that we cannot now meet with present technologies, no matter that several movies have depicted such exploits, notably Arthur C. Clarke's 2001 and 2010.

Already we realize that chemical rockets are marginal for Mars. They will get us there and back, but with barely acceptable long flight times to and from, exposed to cosmic rays and solar flares. Continued Mars exploration and outpost support will require faster fleets of nuclear powered ships.

Nor does the prospect of spending so much time in zero-G only to arrive too weak to explore or work make sense. The engineering problems of artificial gravity may scare NASA into a conspiracy of silence on the topic, but the bullet must be bit. We have to start experimenting with artificial gravity spacecraft architectures, off the drawing boards! On past Mars to Jupiter's moons, and to Saturn's, these technologies are absolutely essential.

As we go further out, we will encounter a quite opposite materials-availability situation from that which challenges us on the Moon. Instead of the volatile-impoverished regolith soils, we will more and more be finding metal- and silicate- (rock) poor volatile-rich icy crusts. Where in the inner system, ice-rich asteroids and comet-hulks will be the prize, in the outer system, bodies, large or small, with economically mineable deposits of rocky materials will be the prime target of the claimstakers.

As a hedge, we should be experimenting with synthetic materials that can be processed from outer system-rich water-ice and abundant carbon and nitrogen compounds to make "cryoplastics" that will not be too brittle to be serviceable in the very low temperatures that prevail well out beyond Mars. We will need to live off the "ice" out there, even as we need to live off the "land" nearer to home.

Let's get on with this vital research! --- PK

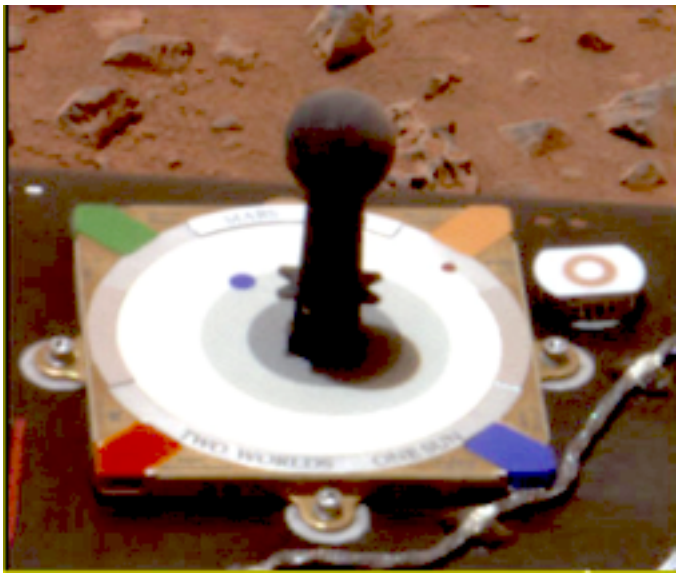
MMM #125 - May 1999

Sundials on Mars & Other Hitchhiker Goodies

Bill Nye had an elegant idea. The popular "Science Guy" of PBS fame looked at drawings of the proposed Mars Surveyor 2001 Lander. **A small square and post used as a kind of test pattern to calibrate the craft's color panoramic camera** caught his eye. His imagination saw it transformed to do double duty **as a "sundial".** A Cornell graduate, Nye contacted University of Washington (Seattle) Prof. Woodruff Sullivan who was instantly interested.

Over the next eight months, with NASA/JPL blessing, Nye and Sullivan put together a team that included artist Jon Lomberg, a creative consultant to the Mauna Kea Center for Astronomy Education, Hawaii; Tyler Nordgren, artist-astronomer at the U.S. Naval Observatory in Flagstaff, AZ; Louis Friedman, executive directory of the Planetary Society; and Cornell University astronomers Steven Squires and Jim Bell.

The brilliant results of their brainstorming were announced at a recent press conference at Cornell. The new "Martian Standard Time Zone" takes effect in January 2002, when the 3 inch square sundial, designed and assembled at U-Washington, lands on Mars. The redesigned test pattern-sundial will be visible to all of us, thanks to the Internet.The Mars Sundial will hardly advance Mars Science, and will surely not demonstrate technologies vital to the establishment of a human settlement on Mars. But it will, as did the Mars Pathfinder rover, and as will the Mars Airplane Kitty Hawk, help fix the attention of the public on Mars, and give concrete detail to not quite believable visions of the eventual transformation of Mars to a human world.



The cost will be minimal, both in dollars and in extra payload mass (2 oz.). That's the elegance of the idea. Take equipment that must make the trip anyway, and at nominal expense transform it into something that will serve another function with payback in the priceless currency of public support.

This is not the first example of a payload sent into space aimed at seizing public imagination. The plaques on the Apollo Lunar Landers and the Voyager spacecraft are early examples.

Given Nye's shining example, should we not attempt to make what he did a deliberate and regular process? We can't leave it to the mission scientists and investigators whose attention is properly riveted on scientific investigation. Nor can we leave it to those on the other end of the talent spectrum, who have no understanding of what goes into a payload package. The whole idea, you see, is to look at - and under-stand - a piece of scientific equipment or a spacecraft part, and be able to envision it performing quite other functions with minimal alterations non-prejudicial to the original purpose of the item. Fortunately, we are blessed with a healthy percentage of technical people who also have strong aptitudes in other areas: art, craft, enterprise, advertising, etc. etc.

But does the Mars Sundial exhaust the list of possibilities? Is it a unique opportunity unlikely to come up again? It would be defeatist to assume so. So let's assume the opposite, that there are additional opportunities awaiting the spark of creative genius.

How do we attempt this brainstorming as a regular extra-mission team oversight? We could put together a team of science popularizers, like Nye, who it would seem would have the "right stuff." They would pour over plans for spacecraft, especially planetary landers that are in the early design process and together or separately use their creative x-ray vision to expose unsuspected opportunities to non-interferingly trans-form this or that into something that will catch the public imagination.

Or, the organizers of individual missions could run design competitions, picking equipment where function does not specify every detail of form. They would be under no obligation to go with a best entry. Nothing suitable might emerge.

The idea is to maximize "hitchhiker options" for imagination-seizing payloads at nominal cost. If it pays off in public support that may translate to more and bigger missions, or missions on a faster more frequent pace. The real hope, of course, is that it will pay off for support of future manned missions to follow in the footsteps of our robotic scouts.

Both the Moon and Mars are currently barren worlds of magnificent but discouraging desolation. Anything we can put there that opens the door to the vision of these worlds transformed as theaters of human life takes on heroic value. The Mars Sundial and other familiar human artifacts make strange worlds seem less so, and helps our collective feeble vision take the next giant step.

Do we have any suggestions for similar hitchhiker artifacts? We've talked about the PR value of setting down on the Moon a Beacon visible to the naked eye, and of small electronic message billboards on the Moon viewable on the Internet. But we didn't cast them as redesigns of equipment that would be making the trip anyway. So we can't take credit for similar ideas. Instead, we put the idea, the spark, the

challenge, out to all our readers and to the public in general. Hopefully, the Mars Sundial will not be the end of the line. **PK**

MMM #126 - July 1999

"Disinterest-Proofing" is Long Term "Task One"

In last month's editorial about the "Mars Sundial", we spoke of "the priceless currency of public support". That support is vital for science and exploratory missions, whether robotic or human crewed. These ventures are undertaken entirely for intangible values: knowledge and scientific insight. We cannot do them than except at public expense.

When it comes to space development, accessing and using the vast resources of space as an integral vector of an expanded human economy, we have the opportunity to pay our own way, to invest in pursuit of legitimate earnings. The "expansion of Earth's economy through off-planet resources" is definitely in the interests of future generations of Earth citizens. Yet it is a hard sell to those preoccupied with today and the immediate future. If those of us with the vision want to see such developments happen, we have to pursue them in a way that is fully "disinterest-proofed." As we proceed, the public will sometimes pay attention, momentarily fascinated with this or that bit of progress. But, as we learned with Apollo, the public and the media's attention span is "unusably short".

<u>To build a space development plan on public support is suicide, a case of "building foundations on sand"</u>

Ah! What about space tourism? What about attempts to install a first commercial moon base paid for largely by entertainment monies? As to space tourism, clearly ticket sales are essential. But even here, developers of vehicles intended to take paying individuals to space had best hedge their bets by looking at other markets such as cargo delivery.

For more ambitious schemes, such as the Artemis Project™, it would be most wise to maximize revenues earned by taking along experiment and demonstration equipment for on site tending. After all, the establishment of an industrial resource-using settlement is an Artemis Society vision item. Such income would hedge the bet that public interest in movies or live pay-per-view telecasts of the event would bring in the needed monies. In planning this mission, this area needs at least equal attention. Indeed, if there is to be a sequel mission, and many of them as hoped, then it is only realistic to expect that the "free ride" from public interest will be a rapidly diminishing supporting factor.

We need to "disinterest-proof" our mission plans! In the National Space Society, major emphasis is given to both public and media outreach. This is vital at the current "precursor mission" stage of the ballgame/game plan. We need more missions of scientific discovery, more missions of resource prospecting. These are conducted on the strength of "speculation" about the often intangible value of their findings. Government must play a major role, in many cases, The major role. Even in the case of Lunar Prospector, conceived and designed without major government help, a government-paid launch via the Discovery Program proved necessary.

At the same time, it is vital that space enthusiasts realize that the government ride can only take us so far. From there, we are on our own. We should have learned from the Apollo Anticlimax that public interest is a fickle partner. It is good for a "kick start". Notice the period at the end of the last sentence. Take it literally!

"One product" missions make about as much sense as "one product" economies or "one store" malls. If the "one" fails to deliver as advertised, the whole enterprise is shot, ruined, caput, bankrupt. Viability comes from a diversified portfolio in each of these instances. "Public interest", even if strong enough to elicit individual contributions and "ticket sales", should be but one stock in the portfolio. Each mission must be designed to be still doable should usually irreversible public apathy set in. It's the old adage (to MMM readers) of taking responsibility for our own dreams, of not entrusting their realization to those who do not share them.

Today's breed of commercial space initiative planners seem to understand this. Applied Space Resources Lunar Retriever mission is a case in point. The goal is to fly a "commercial sample return mission" to Mare Nectaris, about 400 miles SE of the Apollo 11 landing site. Samples will be sold to re-

cover mission costs and other commercial opportunities are under study. But for crucial up front funds, ASR is developing a negligible weight "hitch-hiker", the Millennial Archives, a nano-engraved record expected to remain intact for many thousands of years, consisting of many individual "archives" purchased by individuals interested in memorializing their memories. ASR is busy "diversifying" its "cargo" in ways that complement the original mission without prejudicing its success. Solid common sense. Public interest is a player, but not the only one.

NEAP, Near Earth Asteroid Prospector, to be sent to the asteroid Nereus, is a fully commercial venture, again with a diversified customer base. These are patterns to which other space resource prospecting & development (P&D) mission planners should look at for inspiration.

The bottom line is that if we want it to happen we have to stop depending on those who do not share our priorities That's "Disinterest-Proofing." **PK**

MMM #130 - November 1999

The Lunar Rock Pile: Behind "Door #1," "Door #2," "Door #3," etc.

The "in" Team of Aldrin, Goldin, and Zubrin would have us all chant along with their refrain "Been there, done that," to the Moon Putdown Blues. It is easy to see why. From a first blush quick superficial look, that's all the attention most people give anything, the Moon is quite obviously a monotonously gray rock strewn desert of unspeakable barrenness.

"The Moon is obviously a Rock Pile.
We found that out. Let's move on."

But guess what? Like the backdrop of the classic TV hit show "Let's Make a Deal!", the Moon's façade is only an apparent global dead end. It has unseen "doors" behind which lie a world of unsuspected potential.

Behind Door #1: The "location" and "outline" of the first "door" to the hidden potential of the Moon was hinted at in the Apollo moondust and moon rock samplings and their analysis. An abundance of oxygen, silicon, and calcium, plus an abundance of the three major "engineering metals": iron, aluminum, magnesium, titanium. We've but to look through the door's peephole.

The key to open this door lies in homework we can do on Earth. We need to know how to isolate or "produce" these elements out of the mineral complexes in which they are combined, more inconveniently than we'd like. Except for iron, a considerable amount of which is available unoxidized, in pure metal fines, in the "pre-mined" upper regolith, a "blanket of dust" pre-pulverized by eons of micrometeorite bombardment. We need only a magnet to harvest this resource. But otherwise, largely because the Moon did not undergo tectonic processing of its crust in the presence of water (hydrotectonic processing), it has no ore veins of concentrated metals in simple mineral combinations. The Moon's mineral wealth is not to be gotten so easily. But it is there.

We need to do processing experiments, using simulant soils superior to those we have toyed with to date. They must resemble moondust not just in the percentages of the elements represented, but in the chemical mineral combinations to be found on the Moon, as well. We have no, or little, experience extracting elements from such minerals. Yes, we have done some work on figuring out how to extract oxygen. But to paraphrase a well known proverb, "settlers do not live by oxygen alone."

Nor is it enough to do "lab" experiments. Techniques suitable on so small a scale are often unsuitable for scaling up to "production-batches". "Chemical Engineers" need to be involved -- the guys who can design factory-scale chemical processing.

Nor are the raw engineering metals enough. We need to develop ways to extract and isolate many elements present in lesser abundances as alloy ingredients, color pigments, as ingredients for glass, glass composites, ceramics, cement and manufacturing stuffs and building products in general. The dance card of the chemical engineers is quite full.

How can we do this homework without federal funds? We brainstorm profitable terrestrial applications of the techniques and processes we are developing for the lunar frontier. That way we make

money now and at the same time put "on the shelf" the technologies we need once we get there, paid for out of the profits of terrestrial applications, not taxes. This is the "spin-up" route.

Many still look to the rocket scientists to deliver the Promised Land. But as much as we need them to figure out how to realize "cheap access to space", it is the chemical engineers who will be able to tell us how to access space resources. (And without the agricultural and biosphere engineers and the human factors engineers, there won't be any "we" out there to do any thing with these resources.

If you in search of a career that will put you at the forefront of opening the space frontier, one of the options just listed may be for you. Space is a place. Transportation just gets us there. After we arrive, we need to have opened these "doors" if we aren't just going to sit there "stranded".

Behind Door #2: The location of this "door" lay in two clues: the Moon's axis is nearly perpendicular to the plane of the Earth-Moon system's orbit around the Sun. So the Moon has no seasons. As the Moon is not a perfectly smooth sphere, there must be places near both poles, in craters at least (crevasses are not a lunar feature), in which "the Sun never shines." These "permashade areas" are stable "cold traps", very frigid places where volatile elements (relatively high boiling points, with the vapor or gas easily dispersed by the incessant solar wind) might have accumulated over **millions and billions of years.**

NASA planned a Moon Observer, equipped to answer the question of whether or not any cometary volatiles, dispersed in nighttime impacts with the Moon, might have reached the polar cold traps before the Sun arose over the horizon to disperse them. But this probe was a "phantom mission". The craft was to be the "backup Mars Observer". Congress, as superficial as most everyone else, convinced that there was nothing useful to learn from further Moon missions, and in an effort to rein in Mars Observer program costs, canceled the backup craft. Almost end of story!

Scientists and space activists knew the "ice question" was important, deserving an answer. To our collective credit, Lunar Prospector was born and designed outside NASA. LP was available as a Discovery Mission project when the opportunity finally arose. The rest is history. Lunar Prospector's instruments found several times as much hydrogen at the poles in permashade polar cold traps as exists elsewhere (per unit area). Unlike the hydrogen to be found globally, embedded in surface soils by Solar Wind buffeting over billions of years, the polar hydrogen signal data are best explained as coming from water ice, rather than excess concentrations of Solar Wind protons. The Moon, it seems, "behind Door #2", has major reserves of water ice at both poles.

As an elegant afterthought, as the "Little probe that Could" wound down its extended mission at low altitude, it was aimed "blind" towards a crash landing into a polar crater expected to contain layers of water ice. The hope was that the impact would throw clouds of dust and tell-tale water vapor, high up enough above the rim of the Moon to be detected by Earth-based instruments as well as by Hubble.

It didn't happen. But to look at the media headlines, "Lunar Prospector fails to find water," some of these headlines echoed in pro-space publications (for shame!), you would think that all the data LP had gathered in the past eighteen months was somehow now suspect!

Balderdash. Even if the selected crater does have a bottom-filling ice layer, several things could have prevented a splash-out: the craft, impacting at low angle, did not penetrate all the way through a surface layer of dust expected to cover the ice layer. The craft may have haplessly impacted the side of a large boulder or rock outcrop that was ice-free (seem's reasonable enough!) The water vapor may have reacted with the soil as it accumulated, producing cement cakes rather than ice. We need to have a ground truth probe to find out. But perhaps the Powers That Be are happy not to have a "positive finding" lest they be derailed from their preoccupation with Mars. (We need to explore and settle both worlds!)

Those who want to access what lies "Behind Door # 2" need to put together a segue discovery mission, this time to land at one of the poles and do a ground truth search and a quantitative and qualitative assay of whatever reserves it finds. Lunar Polar Lander, like the "lunar polar probe" later renamed Lunar Prospector, will almost certainly be up to us. The most we can expect is that NASA will pay the costs as a Discovery Mission opportunity if we can keep those costs down to a bare minimum, and if the craft is as capably instrumented as it needs to be to get the job done.

Water is essential for life support, agriculture and the biosphere in general as well as closed-loop industrial uses. It is NOT essential for rocket fuel. Liquid hydrogen IS invaluable for getting us out of the deep throat of Earth's gravity well. We can do well enough with less potent substitutes once we are in orbit and beyond. To burn up an irreplaceable resource to get our rockets off - all in a one-time

non-recyclable impatient exercise makes no sense. If this polar hydrogen resource is in the form of cement hydrates instead of free water ice, it will be harder to access. That may prove a blessing, as it will work to discourage the pillagers more than the settlements.

Behind Door #3: Lunar Prospector mapped the lunar globe by tracking a number of elements. One of these was the radioactive element thorium. There are apparently appreciable reserves of this element in various areas of the Moon. Thorium is transmuted into fissionable Uranium 233 in a fast breeder reactor. Thus the Moon apparently has the wherewithal for a major nuclear fuels industry.

Thorium and Uranium 233 are nuclear fission fuels. They produce energy by the splitting of heavy atoms. The atomic bomb and all current nuclear plants operate on the fission principle. But the hydrogen bomb and nuclear plants built to operate on the same principle, produce energy by combining lightweight atoms (hydrogen, deuterium, tritium, helium-3). Now it turns out that the same solar wind, which has put a considerable amount of hydrogen protons into the lunar topsoil or regolith, has also endowed that layer with a wealth of Helium-3, the ideal fuel for fusion reactors, if we can overcome the engineering hurdles in making such plants a reality. Helium-3 could be the long term cure for Earth's stubborn energy and environmental problems.

As to the fissionable Th/U233 resource, this too may be an invaluable export. Fringe environmentalists could conceivably succeed in banning the transport of all nuclear fuels through Earth's atmosphere. While chemical rockets can support Mars exploratory expeditions of trained and dedicated crews, that real settlement, migration to Mars is most unlikely unless we have fleets of nuclear ships able to make the trip in much less time and over extended launch windows. Two plus two = .. . You guessed it! In that not improbable scenario, Lunar Thorium could fuel the opening of the Mars Frontier.

Behind Door #4: It would seem that the entire surface of the Moon is exposed to the wind and waves of cosmic weather. Micrometeorites rain down incessantly everywhere. The intense raw solar ultraviolet washes everything. There is no shelter anywhere from the fury of Solar Flares and cosmic rays. The Moon's surface is an unending, unbroken desolation that is as deadly as it is magnificent.

The first hint that this was not the whole story came with the Apollo 15 landing mission alongside Hadley Rille, a winding "sinuous" valley. Upon examination, the valley did not seem to be "carved out" by either water or lava. Instead it is the relic of a subsurface lava tube, what is left of it after the roof collapsed on top of its floor, creating the trench above. From orbit, we've looked at similar "sinuous rilles" elsewhere on the Moon. They are a feature to be found only in the congealed lava flow "seas" called maria, usually near the "coasts" where the highlands begin or end. And lava sheets, formed by runny lava (like the kind that forms shield volca snoes) are just the sort of environment in which lavatubes form. Indeed, lavatubes are the principal means by which these sheets advance over the terrain they end up burying.

It would seem that to protect ourselves, we must build outposts on this storm-washed surface, then pile up a healthy layer of moondust on top, to serve as a solid protective blanket in the same way as Earth's atmosphere provides a gaseous blanket to offer us the same protections.

Have all lunar lavatubes collapsed? Do they only exist as relics? as natural ruins? Apparently not! Some such rille valleys are discontinuous. They consist of a number of sections separated by "interruptions" of apparently normal looking flat surface continuous with the surrounding host terrain. These natural bridges can only be interpreted as surfaces hiding intact lavatube sections. And where we have partially intact lavatubes it is reasonable to expect we will find some that are both wholly intact and not flood-filled by subsequent flows. Other evidence comes from rows of "collapse pits", rimless craters that are a sure sign of caverns below.

The maria may be ridden with these tubes, and not just in the surface layer. As the mare [MAH ray] sheets built up layer by layer, tubes would have formed in each, some to be later flooded, some not. And wherever the surface-ceiling cover exceeded 40 meters or so, cave-ins and overall collapses will have been unlikely except in case of a direct hit by a sizable asteroid tidbit.

These lavatubes, of immensely larger scale than those we find on Earth, thanks to appreciably lower lunar gravity, and, immensely more ancient (billions rather than thousands of years old), provide hidden but real anchorage, safe harbors not only from the cosmic elements and solar weather, but also from the extremes of surface dayspan heat and night-span cold -- and from the mischievous moondust that is otherwise everywhere.

We need to map these subsurface features, something that has yet to be attempted. Tom Billings of the Oregon L5 Society has brainstormed a two-part sleeve/core "radar flashbulb" probe design.

Aimed at promising sites, the probe would be aimed to impact the surface, forcing the outer sleeve to telescope over the inner core and thus generate an electromagnetic signal at just the right frequency to illuminate any "voids" within say 8 kilometers of the impact area. The signals reflecting off the hidden voids will be readable by either a wide-array of radar telescopes on Earth, or a dedicated space radar array in near-Moon space.

Designing the probe and proving the concept is one thing. Picking the right targets is another. The plan is to use special computer software to pour over the voluminous Clementine high sun angle photographic data, looking for tell-tale shadows of "skylight" and "terminal" entrances to tubes. This search will take both time (possibly 18 months of run time) and money. An Application to the FINDS Foundation in July, '99 has generated no response as yet. Your donation, large or small, to the Oregon L5 Society Lunar Lavatube Locator project will help us open "Door # 4". Lunar Prospector took ten years to become real. The longer we delay the LLL project, the longer we delay a real opening of the Lunar Frontier. Your donations can help save us all time.

A successful mission or series of missions, possibly flown as Discovery opportunities, will forever change how people look at the Moon. It will be suddenly more than a monotonous rock pile. It will become, in the public awareness, a real world with real safe harbors and protected hidden valleys.

There are other hidden doorways to the Moon of "unsuspected world-potential", and it has been MMM's guiding mission to uncover the possibilities one by one.

The Next time you hear someone say
"The Moon? Been there, done that!"
You will know that you at least are able now
To see behind the rock pile face
To the "real Moon inside" -
A rock that can become a world,
If we only open all the right doors. PK

MMM #132 - February 2000

"Spinning-up" Frontier Enterprises Profitable for both Earth & Space

The outlook for Space Enterprise would seem to be grim in the wake of the Motorola Iridium bankruptcy. We beg to differ. Yes, investors will be wary of big space enterprise proposals after this major collapse. But how, in truth, would the success of Motorola's effort or of any similar effort help open the space frontier? It would have helped build the market for small payload launchers. Our point is that small satellites and small payload launchers, while they may make money for individuals who may also happen to be interested in opening space as a human frontier, do not in any direct way remove any of the considerable hurdles confronting those who would open space to human beings on any truly non-vicarious, non-virtual level. Small payload CATS, certainly good in itself, is probably not much more than an energy-sucking detour.

We need cheap access to the threshold of space, LEO, for large payloads and for people. AND we need cheap, fast transit "in" space itself. AND, once we can get cheaply and quickly to places where we can tap the vast resources of space, we need the industrial tools to do so. Alas, no one seems to be working on any of this home(planet)work backlog.

The "rocket science" portion of this agenda, we must leave to those with expertise in those areas. What we'd like to talk about is the vast, unexplored potential for making real money now, developing processes and industries to meet the common unexplored resource challenges of good old terra firma Earth and of sundry worlds in space alike.

The considerable "bricks & mortar" portion of Earth's economy, which will never disappear or become ire-levant, has been built entirely upon the tapping of "enriched" resources. It is obvious that it will be cheaper to mine rich veins of ore than more homogenized concentrations of the elements vital to

industry. It is obvious, too, that if we are to have self-reliant settlements on space, that they must also be able to "produce" economically, the elements needed for their own industries. The hitch is, that concentrated ore bodies are a terrestrial asset that we are unlikely to find elsewhere in the solar system. No where else has there been billions of year of geological processing of a world's crust and mantel in the presence of water. Not even on Mars, where such processing may have started only to be nipped in the bud much too early.

Poor Ore Mining Technologies

For accessing necessary resources on the Moon, on Mars, and even on the asteroids (where there is an unsubstantiated widely held belief that concentrated ores may indeed be found), we need to develop mining, beneficiation, and process-sing technologies that are economical in unenriched deposits. Talk to a mining engineer, and it is likely that if you bring up the subject of "mining the Moon" or Mars, you will be greeted with a contemptuous, condescending put down. No one knows with confidence, how to "produce" metals or other elements from such "poor" ores economically on industrial production scales. To point to lab-verified pathways of getting oxygen, for example, is not helpful or useful.

We will see no self-reliant resource-using lunar or Martian settlements until we have such technologies. Give us CATS and we will still have nothing! Nor would a political turnaround of unrealistic proportions that would make a lunar or Martian "outpost" a confirmed agenda item change this situation. "Local Industry" beyond a few relatively easy and simple symbolic things, will not be necessary for the token outposts such a political miracle might put on the agenda. We must not assume that if NASA (i.e. Congress) did indeed reverse itself, it would under-take crash programs to develop such technologies.

There is another way, a very mundane way to get the job done. Sadly, space-enthusiasts in general are too much too impatient to sidetrack their efforts to indirect methods that may in fact be much more powerful. These very same "Poor Ore Mining Technologies" would be very useful on Earth, whether we ever do go on to open up the space frontier or not.

Consider Earth's economic geography. The distribution of iron ore, copper, bauxite (aluminum), uranium, and other elements vital to industry has in large measure predetermined which nations have thrived and which have not. Of course, other factors play vital roles: arable fertile soil, access to the sea, forests, and the enterprise quotient of the people.

Poor Ore Mining Technologies would usher a substantial equalizing force into the world economy. Soils everywhere contain abundant aluminum and iron, but not necessarily in the concentrations and in the mineral forms we "know how to" work with cost-effectively. Chemical engineers must blaze new pathways that balance favorably energy inputs, secondary marketable byproducts, and environmental impacts. Concrete specific proposals tailored to the mineralogical circumstances of the various candidate locations need to be made to local or non-local investors and partners that stand to profit. Some of these poor ore mining technologies may have direct or indirect application to the situation we will find on the Moon or Mars or elsewhere. But even where this is not the case, we will be building up a pool of people with a "can do" attitude to supplant the present unhelpful crowd of "can't do" mining experts.

Molecular technologies under exploration by people like Steve Gillette of the Univ. of Nevada-Reno offer some real revolutionary promise of an end run around present mineral-cracking hurdles. When it comes to producing strategic elements that are much less abundant, like copper, zinc, silver, platinum, gold, etc. where a 1% ore is considered rich, bio-extraction technologies need to be pushed. Without concentrated ore bodies, such elements are often present in only parts per million [ppm], or even parts per billion [ppb]. Bioengineered bacterial cultures may be able to greatly beneficiate or enrich these ambient concentrations. Here on Earth, such technologies would make many nations less dependent on others, less subject to political blackmail.

Novel Building Materials

On the Moon, there are neither forests to supply us with wood, nor petroleum reserves to supply us with chemical feedstocks for the host of synthetic materials to which we are addicted. Even on Mars, with a carbon and nitrogen rich atmosphere and plenty of hydrogen at least in polar ice, bringing such traditional building materials and manufacturing stuffs on line will be a trick. But is the situation any different for scores of countries on Earth that do not have appreciable forests, or who cannot afford to make further inroads into those they still have, and without native oil reserves?

Glass-glass composites have been proposed, and lab-researched, as a promising option for lunar settlement industry. But if we learned to produce a versatile array of glass composite building products and manufacturing stuffs, that could be an immense aid to the economies of countries that must presently import vast quantities of lumber and other products. There would seem to be ample economic incentive for taking this exotic stuff out of the labs, make fortunes in doing so right here on Earth, and in the process develop, debug, and put "on the shelf" a ready-to-go industrial technology that could be a backbone of early lunar and Martian industrial settlements. We developed this idea in more detail in MMM # 16, June 1988. But while glass fibers are finding their way into new concrete formulations, no one has bothered to try to earn a buck by taking glass composites themselves beyond the laboratory curiosity stage.

Metal alloys are another area deserving more research. Most pure metals have poor performance characteristics and benefit greatly from inclusion of varying amounts of "alloying" ingredients. Yet it does not seem to dawn on most space supporters that the Moon's considerable "on Paper" wealth in iron, aluminum, magnesium, and titanium - the four "engineering metals" - does not guarantee the easy and economic production of the various alloying elements we are used to using to improve the performance characteristics of each. Steel needs carbon, in poor supply on the Moon. Aluminum alloys generally are rich in copper, a ppb trace on the Moon. Metallurgists who step in to research more "frontier-feasible" alloys which are still "serviceable" may end up producing alloys with considerable market-ability here on Earth.

Synthetic Chemical Feedstocks

Mars enthusiasts never tire of pointing out that the ocher planet is richly endowed with the elements that are the basic organic and synthetic building blocks: hydrogen, carbon, and nitrogen (oxygen being taken for granted as ubiquitous). But in fact, most plastics and other synthetic materials are normally not "made from scratch" but from nature-preprocessed cooking ingredients more or less easily refined from oil and other complex petroleum reserves (tar, shale, etc.) We are spoiled. But at the same time, countries not blessed with such reserves are at the economic mercy of those who do have them. If economical "from scratch" methods of meeting such synthetic materials needs could be developed by chemical engineers of the organic-persuasion, this would be of great economic value for many nations. And, as always, the power to equalize is the power to make money.

Bob Zubrin showed the world that methane could be easily made from carbon dioxide by using a totally automated "sabatier reactor". Apparently, the chemical pathways exist to make other simple organic molecules that could serve as synthetic feedstocks by a similar or adapted sabatier process. Applying such techniques here on Earth might prove profitable. If countries blessed with natural gas, but not with oil reserves per se, could build the equivalent of a petrochemicals industry upon the simpler rudimentary assets of air and natural gas, this could prove a powerful economic equalizer for them. And anything additional to methane that we can learn to produce by these techniques, will also have the happy effect of putting "on the shelf" pre-developed and pre-debugged technologies ready to go on Mars at a much lower cost to the frontier.

In the original oil crisis, research began into using certain plants to produce oils and other petrochemical-like feed stocks. There is money to be made here on Earth by pursuing such agricultural alternatives. And happily, many such advances will be useful to opening the Martian and lunar frontiers. We can learn to be much less dependent on wood, paper, and synthetic organic products. But if we are not to be confined to a the constraints of a "New Stone Age" on the space frontier, alternatives to conventional petrochemicals must be developed. And we can make money here and now doing so.

"Biospheric" Technologies

Biosphere II was an attempt to come up with a centralized solution for biological life support. Though the specific experiment "succeeded" only by "cheating", in fact we learned much. The only thing that can be dismissed as a failure, is an effort from which we learn nothing. It is much easier to dismiss than to criticize constructively, and when reading such negative reports, one should always discount for the temperament of the reporter.

Beyond Earth, settlements must reencradle themselves in mini-biospheres that each settlement must establish, grow, and maintain. This will entail the unprecedented challenge of "living immediately downstream and downwind" of oneself. Pioneers in space will not pollute because, unlike us spoiled terrestrials, they cannot "get away with it," putting off pollution problems to the next generation.

But to attempt to do this in a centralized way is just as ineffective as are centralized methods of growing and controlling economies. Modular "market" techniques must be the basis of any effort to establish, grow, and maintain space frontier biospheres. Systems that treat human wastes at the origin and greatly reduce any residual problem that must be handled on a larger scale are much better suited for non-ivory tower communities of non-static size.

In fact, many people are experimenting with "living machines" and other techniques to integrate plants, air quality maintenance, and waste treatment in unit-sized systems. Such an approach will not only make city-size biospheres a more practical prospect, but will also enable appropriate-size life support systems for spacecraft on long deep-space journeys. We need technologies that are "scalable." In contrast, solutions addressing fixed, static size situations are not helpful at all.

The terrestrial profit prospectus of modular biospheric technologies is immense. In the last few decades we have seen the emergence of gargantuan urban complexes in the third world. For the most part, such cities have grown and continue to grow faster than urban utilities can add capacity to keep up with them. The pressure on centralized water treatment facilities is unreal, and the loser is public health. Inexpensive ways to tackle human wastes home by home, unit by unit, that freshen interior air, and provide additional sources of food, would do much to make such monster "blob" cities more livable. There is a market! Let's make money now, and learn how to do space right in the process.

The Gospel of "Spin-up"

The traditional fare of the space faithful is what has long been known as "spin-off." NASA spends hundreds of millions or even billions of dollars developing new materials and technologies that the agency needs for use in space, all at taxpayer expense. Then these technologies are made available to industry at large, providing the usual litany of "benefits for the public" of space research.

"Spin-up" would take the opposite path. Enterprise would brainstorm technologies deemed vital down the road in space for their potential Earth-market applications, so as to make money now. The frosting on the cake is that technologies also needed on the space frontier, would be predeveloped now at the expense of the consumer, rather than the taxpayer (YES, there is a world of difference in this distinction), and would be ready in time "ready to go" and at relatively low cost to those who will in due course attempt to open the space frontier to genuine self-reliant local resource-using communities beyond Earth's biosphere and atmosphere.

"Spin-up" is a more economical and efficient way to get the research done in a timely fashion. It is the only path not dependent on uncontrollably fickle political tides. And in so far as it is consumer-user financed rather than tax-payer-forced, it is a more moral way to achieve "minority goals" such as ours.

But above all, the "spin-up" route is the only sure way to get the job done. To rely on the traditional route means putting all our eggs under a hen that is not motivated by instinct or any other reliable force to hatch them. We have complained before that those who want to open space by political coercion are abdicating the responsibility for the fulfillment of OUR dreams to those who do not share them, and cannot be made to share them.

If you are blessed with the talent to be an entrepreneur, consider that getting involved in pioneering some of the terrestrially useful technologies needed also in space may do more to guarantee the timely opening of the real space frontier than any amount of seemingly more direct involvement in micro-satellites and micro-launchers.

We do not expect those with electronics and propulsion expertise to get into totally different fields. Each of us must do our thing. Rather, we want to encourage and set loose the untapped talents of others who have not realized that they have a potentially powerful role to play, however indirect. The important thing in opening space is not instant gratification. It is well-targeted patient hard work.

If you are a young person not yet established in a career, consider chemical engineering, poor ore mining technologies, new materials science, "from scratch" synthetics production, bioextraction technologies, molecular mining technologies, experimental agriculture, and modular environmental systems as rewarding fields in which you can make a difference, both down here and out there.

Rocket science can take us to other worlds. It cannot enable us to do anything useful once we get there. Iridium may have failed. It was a detour. There are other, ultimately more powerful and profitable ways to build up to a space frontier economy. Do not waste a moment wallowing in discouragement at recent set-backs. In the end, they won't matter. **PK**

MMM #141 - December 2000

The MIR Station World Space Monument

A Better Option for Decommissioning

By Peter Kokh

How many times have we heard "if your only tool is a hammer, every problem looks like a nail!" NASA is committed to seeing the MiR Station removed from service. But need removal from service necessarily mean removal from orbit?

To be sure, MIR willnot stay in orbit by itself. At its altitude range, there is still enough wisps of atmosphere to continually drag down Mir's orbit to the point where it will eventually, controlled or not controlled, partially incinerate in the atmosphere, its remnants crashing into the ocean -- or onto land. It takes money to keep boosting up Mir's orbit periodically. So it would seem that to decommission Mir must mean either to allow its orbit to decay in uncontrolled fashion, or to deliberately accelerate the process in a way we can control it.

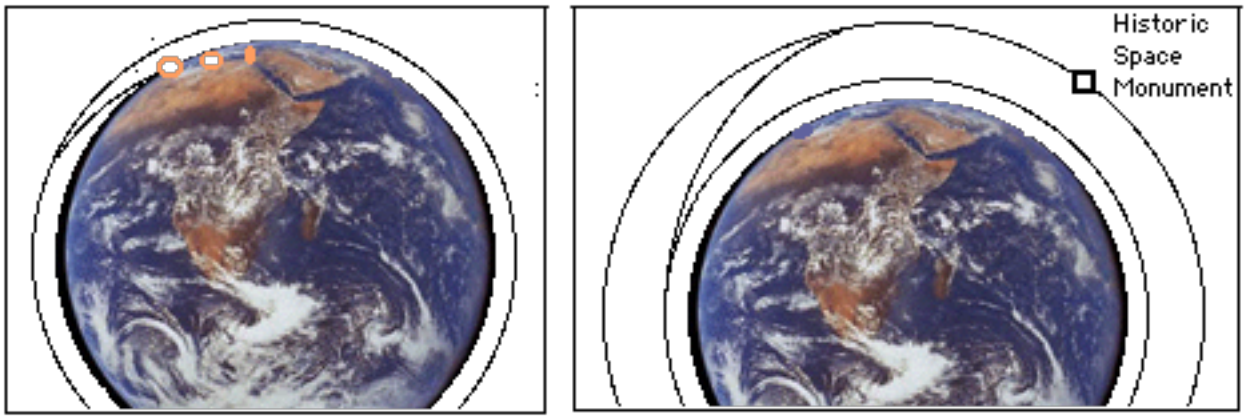
We propose instead, that a more expensive refueling mission boost Mir's orbit up to an altitude where it would remain safe for generations. It can then be given the status of a **World Space Historical Site**, or **Monument**. At some future date -- no need to determine that now -- an orbiting Visitor's Center could be built for students of space history and tourists to visit under careful guidance.

Mir should be seen as **a priceless treasure of technology and achievement.** That as long as it remains in service, it will be a thorn in NASA's side should not leave a destructive solution as the only option.

It is not to the credit of NASA, or the agency's leash holders, let alone to the Russian authorities, not to seriously pursue this other option.

Those Russians who object to scuttling Mir are being dismissed as ultra-nationalists and communists. Alas, having lived through McCarthyism once, it is distressing to see it arise anew this way.

We call on all parties to take the time to look at this new option. Especially considering the potentially high cost of the inevitable rain of Mir-debris on property and people, we owe it to ourselves and future generations to take another look. **PK**



The easy option - a shameful waste ---- **Saving MIR as the first Oribtal Historical Monument**

MMM #148 - September 2001

Thinking Outside the Box: Lessons from September 11th, 2001 (9-11)

The successes achieved by the September 11th terrorists caught most everyone by surprise. The public can be forgiven for this surprise, but not our security forces. We have all heard that "a chain is only as strong as its weakest link." The terrorist's job is to look for that weakest link. Security forces should be looking for it too. That they failed to see that a fully fueled commercial plane could be used as a missile demonstrates their failure to habitually "think outside the box." They failed to think "like terrorists" and in this, by their complacency, they let us all down. They settled for "quick fixes," for a "false sense of security." And they may do so again.

All Tools are indifferent. Any tool can be used for good or evil, constructively or destructively. It is the user alone who determines the morality of the work done by tools. Down deep, we all know this. Technophobes, of course, miss the point, much to the discredit of their own intelligence. Thinking outside the box is a "force" with "a dark side" too. And as with all tools, it is easier to put this to destructive use than to constructive results. Those impatient for results, find quicker gratification in destruction.

Thinking outside the box is a mental discipline that aims at identifying ways to "break out" of the constrictive set of expectations and assumptions imposed by the "conventional wisdom" in any area. Ways to open the Space Frontier are no exception.

Few people ever think outside the box of conventional wisdom - this is not a discipline that comes easily. Not surprisingly, people interested in space are no exception. Both terrorism and space are frontiers, however radically different, where conventional mental exercises can be expected to produce only marginal and trivial results. Conventional Wisdom is a millstone around the neck of anyone who aims to open or help open a frontier. The smugness of conventional thinking must bear much of the blame for the painfully slow and trivial progress made in opening the space frontier over the past few decades.

Conventional Wisdom, when it is accepted without reservation, is the true enemy inside. It straitjackets our minds, preventing us from seeing, testing, and developing alternative strategies.

NASA is not, and never has been the enemy. The agency itself has used "thinking outside the box" to make many breakthroughs. But in anyone or in any organization, successes "settle in" and create a new complacent expertise. Thinking outside the box is something that must be practiced continuously and afresh forever. And that is where we all tend to drop the ball.

That the startup rocket companies are all essentially pursuing "outside the box" strategies, some more effectively than others, is clear. NASA has sought to publicly discredit these efforts, seriously damaging their ability to attract venture capital. Does this demonstrate a culture-belief that only they are qualified to brainstorm - the High Priesthood Syndrome? Or do such spokespersons believe that "thinking outside the box" has already been pursued to the limits and that there is no more to be learned?

Those of us who are unwilling to settle for the conventional wisdom that space can be opened only by enormous bureaucracies with bottomless pockets refilled from general taxation, owe it to ourselves to operate as "cells" with cell mentality and strategy -- not for destruction, but in ever being on the search for breakthrough concepts, means, technologies, methods, and concepts. Again it is no agency that is the enemy. It is the smugness of conventional wisdom with its unsuspected, unexamined assumptions and presumptions of which we need to be wary.

On the technological front, it is simply not true that NASA has already tried everything. All too often a premature decision is made among competing technological concepts. The right way is to develop all the options and let the results pick the winner. Politics, political favors, and personal fancies often have more to do with the paths we choose. "The Path Not Chosen" may have been the better one.

Financial pathways, too, have been widened into paved freeways of "infrastructure" without careful and patient thought given to alternatives. "Private enterprise" options are dismissed because existing forms seem inadequate. But the need is again to think outside the box. What is there that has not been tried? Those who assume we have tried every-thing need to be ignored and left behind.

We are all impatient to possess the "truth." That is why people choose religious dogmas and political ideologies. They cannot stand being uncertain, to recognize and accept that what we don't know is more than what we do. We are people of the 21st century. We "know." No, we don't!

Faith passes itself off as knowledge and on that non sequitur rests so much hatred and evil. We too believe. We have faith that there is a place for humans in the solar system at large. We do not know that, we believe it. But that faith should motivate us to keep looking for the weakest links in the chain of

the conventional wisdom that would bind us to Earth forever. We must borrow the tools of terrorism but without "dark side" applications. Like those who brilliantly planned the attacks of September 11th, we must brilliantly plan assaults on the many bonds that threaten to keep us Earthbound. -- **PK.**

MMM #149 - October 2001

Distributing Risks: Lessons from "9-11"

"Those who do not learn from history are condemned to repeat it." One of the things that jumps out from the kamikaze airliner attacks of September 11th, is the very different results between the two targets: total destruction of the World Trade Center towers, relatively minor damage to the Pentagon. Yet both facilities were of a similar order of magnitude in total square footage and occupancy numbers.

The towers were essentially vertical structures where a local failure at any height inexorably doomed the entire structure. Gravity acted on cue to cascade the initial local damage throughout. Here the "Failure Mode" risk was shared. Additionally, in each tower there was only one escape route, and when that route was severed by the invading aircraft, those above that point were doomed.

The Pentagon is essentially a horizontal structure where gravity worked to collapse only the local sections damaged. In this case the Failure Mode risks were distributed. Additionally, the Pentagon is essentially a loop-type structure, with escape routes in either direction (clockwise, counter-clockwise).

The use of large airliners loaded with both people and fuel as piloted missiles was something unexpected by the architects in either case. Yet even so, air accidents have always been at least a remote possibility. Too remote to design for, perhaps.

On the Moon or Mars, where there may be no one to pick up the pieces or come to the rescue of possible survivors, and where impacts from the sky cannot be ruled out even though the odds are low, it would be insane to design a settlement megastructure with a shared failure mode: failure anywhere dooms everyone. The popular artist-inspired vision of lunar and Martian cities under glass domes is an example of fate-tempting architectural bravado. Puncture the glass "firmament" anywhere and poof!

On the other hand, settlements built of interconnected modular elements, would, if connections could be sealed, distribute the risks. Some, perhaps most, would survive all but the most unlikely strike. This is not to say that we won't see any domes at all. Domes anchored to bedrock in order to resist the outward push of air pressure could someday appear over parks and city "squares." Such domes would be quite local, and surrounding sections could be sealed off if the dome's integrity were compromised.

Given that it makes sense to go modular in the first place because that is a method of construction that suits growth patterns, a modular settlement may select from any number of overall plans. A linear plan of expansion along a spinal transportation corridor might be highly efficient. But given the lessons from the Pentagon event, such a plan risks cutting the settlement into two mutually isolated sections if there were a breach anywhere. But any "urban plan" which provided multiple interconnectivity between various sections, a loop being the simplest of these, would preserve the continuum of the settlement, no matter where compromised.

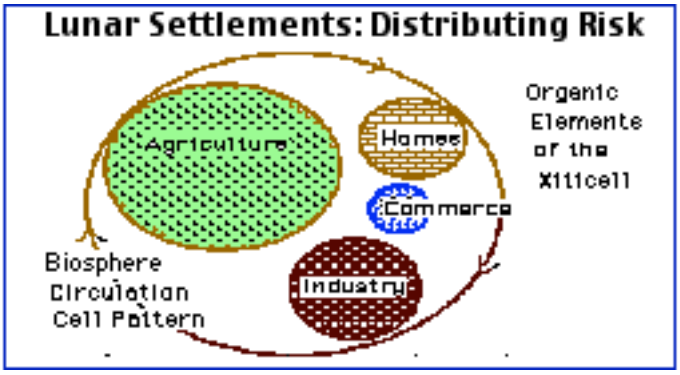
Building architectures are not alone in their vulnerability. In human chain of command/information structures, strictly vertical chains risk collapse if there is a failure at any level. Communist party "cell" architecture, with its multiple connections, is an early 20th Century parable worth learning.

Decentralization and Polycentric Infrastructure

On the Moon and Mars, the integrity we need to protect includes the pressurization "hullplex" and also the utility systems: fresh and waste water lines, fresh and stale air ducts, electrical power and communications. Again multiple connections will serve us well whereas an efficient and cheaper linear settlement plan would magnify any catastrophe.

In MMM #53 March 1992 pp. 4-6 "Xities and XITY PLANS: settlement layout options" ["xity" being our word for any settlement that has to provide and maintain its own biosphere], we suggested that it might work much better to design neighborhood scale utility systems. Instead of one central plant for each utility system, we would simple build additional plants as we added additional neighborhoods. Our intent was to accommodate variable growth patterns and, not to commit the settlement to soon out-

moded systems. If the settlement's utility structure was also modular, newer areas could have the benefit of improved systems when available. For this to work, each neighborhood cell must have all the "zones" it takes to function as an autonomous biosphere unit: residential, industrial, commercial, and agricultural.



If a settlement is planned and built one "neighborhood at a time, each neighborhood should have the above critical elements. The mx can be tweaked with each new neighborhood built, as we acquire experience.

But in the light of the recent attacks on New York and Washington, the idea of neighborhood-scale utility systems and nerve centers makes even more sense. The "urbicell" plan, as we dubbed it in the back issue cited, avoids putting all our utility eggs in one basket. On the space frontier this will be much more important than in the Pentagon. Because we live in a planetary biosphere, the utilities could all shut down and we would be only inconvenienced. Not so on the Moon or Mars. We have to make sure that everything that makes the settlement or outpost work is polycentric so the destruction of any center remains a non-critical, survivable matter.

The same goes for the intrasettlement transportation infrastructure. We court trouble not only if we design a linear system, but also if we design around one central hub. If, as the settlement grows, we had additional neighborhood hubs, we will be able to recover from the crippling of any one. Consider L'Enfant's plan for Washington D.C. as an example.

Admittedly, Washington acquired a downtown along the way, to the north of the White House. But in today's world, with the Internet and other electronic means of teleconducting business, commerce and finance, such concentrations of office and commercial space are less essential, if at all. "Infrastructure lasts forever," and while in the past decade many urban downtowns have seen a major renaissance, this rediscovery is driven more by the perceived plus of clustering entertainment and cultural activities, than by the traditional pillars of commerce, finances, and transport hubs. Stuck with these relics, we have been voting in ever-larger numbers to put them to good use.

On the Moon and Mars, where we can build with a clean slate, it makes more sense to build a series of hubs. While this make sense from a security point of view, it also avoids the historic pattern of city growth in which an ever growing downtown ends up swallowing the residential neighborhoods that surrounded it at the start, much like a black hole keeps swallowing up hub-hugging stars in a galaxies

nucleus. With a modular urbicell plan, this pattern of continual displacement becomes something of a past. Neighborhoods are free to be the stable life-fostering zones they should be.

Not only should the frontier city grow a number of co-equal hubs, the hub and spoke patterns of various systems should not overlay one-another. In New York, new subway lines and stations were built at the time of construction of the World Trade Center, routed to conveniently run through the Center complex's basement levels. These stations and tunnel sections are now in ruins. They should have been nearby, not under. That is hindsight, but hindsight we can learn from. Thus electrical substations, transport hubs, water and sewage pumping stations and treatment facilities, communications centers etc. should all have their own grid systems, so that the damage from any breach of the settlement pressure hull-continuum inflicts minimum damage, and is as survivable as we can make it.

None of these considerations are put forth to ensure survivability of our settlements from a "terrorist" attack. There may be human terrorists in space someday. But our real concern should be the non-human "mindless" terrorism of events of cosmic weather, including larger meteorite impacts.

Again, we must ever keep at the forefront of our attention the absolutely critical difference between settlements on Earth and settlements elsewhere in the Solar System. The former enjoy a given, surrounding planetary biosphere. One can flee to the "outside" and survive. In the latter, the "outside" is a life-snuffing environment, not a life nurturing one. Fleeing a disaster is much less of an option. Our only option is to disperse all our assets in as decentralized and polycentric a pattern as we can.

That said, even after we have planned as dispersed a network of functional assets as we can, there is another scalar level of risk that comes from population density. The conventional wisdom of science fiction writers and professional thinkers as well is that off-world settlements are going to be very compact. We'll be living cheek by jowl and have to get used to sardine can living because building on the space frontier will be expensive.

As always with conventional wisdom, the above consensus rests squarely on commonly shared assumptions that are, to say the least, questionable. We need to develop building materials, architectures, and construction methods that will allow us to build new pressurized spaces and modules by relatively inexpensive and labor-light methods. We do not have to model off-world construction on methods and practices that work on Earth. "Elbow Room" is a quality of life issue that should be a major goal. Not only will it make for better morale and mental health, the lower population density will be safer.

Unfortunately, we're a long way from building settlements off planet. But even much more humble outpost structures should be designed and built so as to distribute risks and failure modes where possible to minimize chances of total catastrophe.

Fire and Smoke

The Pentagon incurred only limited impact and collapse damage. Unfortunately, there is more to the story. Fire and smoke spread through extensive sections of the building to either side of the impact zone. Designing a building to isolate risk is one thing. Designing its utility infrastructure accordingly is another. Utility disconnects and automatic duct sphincters or fire and smoke barriers are another. The damage at the Pentagon was much greater than it had to be. Fire also spread through baffle-free chases in the roof structure.

On the space frontier, we will have to design all our utility systems - water, electricity, communications, and air - to isolate problems and damage quickly and effectively without impairing continued network operation, through alternate routing.

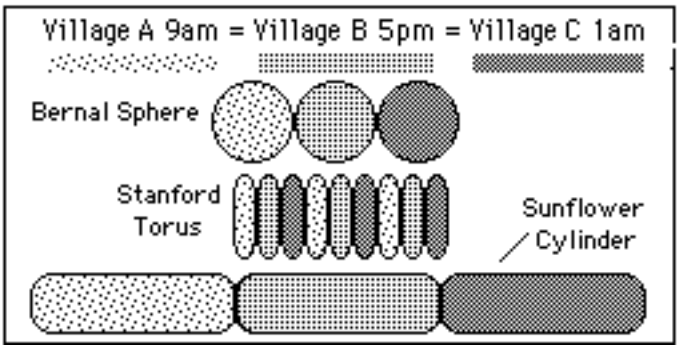
Lavatube Settlements

Lunar lavatube sections that are intact today have been intact for three and a half billion years or more. They are the ultimate "safe houses" in the solar system. Martian lavatubes are a billion years or two younger and probably equally safe. Impacts on the surface above can be expected to produce some spallation, break-off of some ceiling/roof material, but little more. Modular settlements within these tubes would provide maximum safety. Whole low-pressurized lavatube sections, more likely on Mars than on the Moon because of the scarcity on the Moon of Nitrogen for air, should also be fairly safe.

Vulnerability of Space Settlements

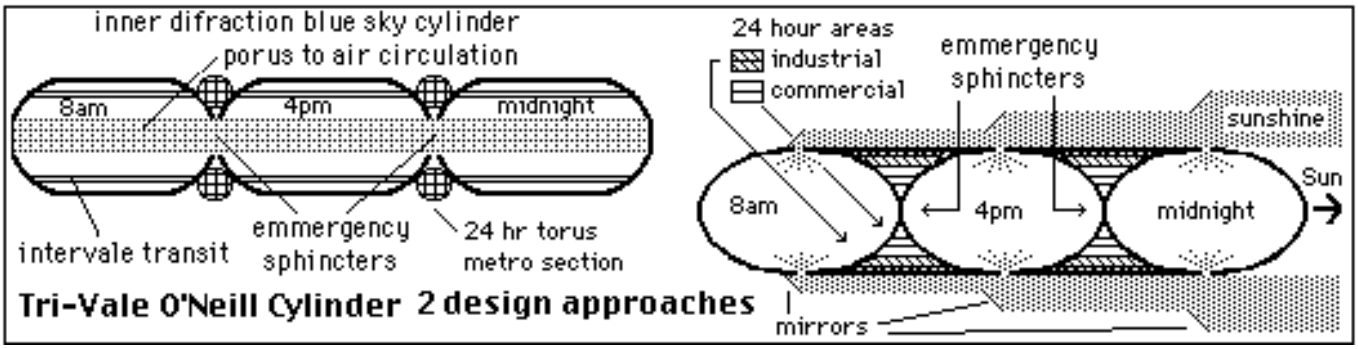
The “classic” space settlement designs known as the Bernal Sphere, the Stanford Torus, and the Sunflower cylinder - Gerard O’Neill & Co.’s “Island I, Island II, and Island II”, respectively, are all unitary mega-structures. As such they put all occupants at shared risk for any critical failure.

While these designs are revered, it must be said that academics, businessmen, bureaucrats, and many others envision things encumbered by the horse blinders of what we call “day shift chauvinism.” These structures will be expensive. If stores, shops, schools, playgrounds, factories and other expensive investments are used just 8-12 hours a day, then we deserve the problems that will ensue. The only sensible approach is to segment each space oasis into three residential parts (or multiples thereof) with staggered time zones, and with all these expensive facilities in 24 hour zone areas. See illustration below:



Happily, if we do that keeping risk distribution in mind, we will come up with new architectures that are more efficient and have a significantly lower construction and cost threshold (for implementing the first of the three parts, at least) and are safer, more survivable. See “Space Oases: the Next Generation”] at:

http://www.moonsociety.org/publications/mmm_papers/reinv_so.htm



This, of course, is much easier to say than do. We do not pretend to have solutions to the architectural challenges of such major redesigns, e.g., how to redirect available sunlight to triplicated units. Our purpose was merely to point out that classic designs leave much to be desired operationally, i.e. for how human settlements actually operate, and financially.

We also focused on the jump-the-gun decision to design for One standard Earth gravity without any concrete evidence that fractional gravity is as bad for the human physiology as zero gravity (no person has spent more than a few days in fractional gravity, i.e. the Apollo Moon astronauts.) This decision, coupled with tolerance limits on the rate of spin or rpm, mandates that 1 G structures in space be immense, and therefore unnecessarily prohibitive to build - indeed insuring that they never will be built. If experiment shows that at 1/6th g (lunar) or 3/8ths g (Martian) levels, physiological deterioration levels off at an acceptable plateau, we can build smaller, lighter oases, putting less people at risk in any one location. We lost too many lives on September 11th. But we can learn from this tragedy how to save many times more lives on the space frontier. **PK**

MMM #155 - May 2002

Opening of Space Tourist Era is for Real. Where to From Here?

Those if us forty or older may remember the excitement over the maiden flight of Space Shuttle one, the Columbia -- and the even greater excitement over its second flight. It was, in fact, the second flight, not the first, that confirmed that we had a 'reusable' vehicle (well, an 'overhaulable' one at least.) In like manner, I personally got a higher high from finishing MMM #2, than from getting out the maiden issue. The point is that the first time something is done or achieved often turns out to be the last time -- in other words, a 'fluke.'

There was a lot of excitement in the space enthusiast community when Dennis Tito, after many NASA-imposed roadblocks, succeeded in making it to orbit in April 2001. Space tourism was here, said many. Not so fast! But a year later, we have Mark Shuttleworth following in Tito's footsteps, and, bringing back some respectable souvenirs to boot! Now, at last, it seems that we can be confident that Space Tourism has a foot in the door.

I say a 'foot' because, as Ben Huset of the Minnesota Space Frontier chapter remarks, "When I can book a flight on Orbitz.com, don't need to pass a physical and do a year of training and you get complimentary drinks upon boarding station, then we can start to use the T word." Indeed, what we have here in "guest astronaut assignments to the International Space Station" is not the ordinary tourism of casual relaxed change of pace, but a "working vacation," with a lot of prior training. Nor is this an entirely new category. We have long had "working vacations" here below: "Windjammer" Cruises and archeological "digs" being instances.

Yet, thanks to the the zealous conversion of the Russians to the cause of private enterprise, out of sheer economic necessity, and to begrudging and belated compromises by our more socialized space program (who'd have thought!), the door to repeated working guest astronauts willing to pay the steep price does now seem to be propped open. And they might start occurring on a semiannual basis.

Ironically, it is the U.S. government itself that left the door open to civilian visitors to ISS when it canceled the X-38 Assured Crew Return Vehicle program, forcing reliance upon the Russian Soyuz craft. A Soyuz arrives at the station for a six month visit twice a year, and each time it has an otherwise empty seat. (This is only one example of how U.S./NASA cutbacks will have the unintended affect of commercializing ISS.)

Bringing down the Price of Space Tourism

$20 million smackers is a lot to pay for even a "once in a lifetime" experience. Yet there are indeed enough people out there with that kind of money, and, that kind of free time, to guarantee that even at that price, not too many empty Soyuz seats will go unfilled. It would seem that the Russians need not worry about pressure to reduce prices anytime soon. So how do we get off this dime?

A week-long visit to the International Space Station is, when you think of it, a rather ambitious level at which to jump start space tourism. In fact, that is not how we thought it would start. The X-Prize program, which has yet to produce one viable spacecraft, was supposed to open the door to sub-orbital hops, the kind of threshold crossing pioneered by Mercury capsule astronauts Alan Shephard and Gus Grissom in 1961, and by a X-15 pilot Joe Walker twice in 1963. To be officially considered having reached the edge of space, all one has to do is reach an altitude of 100 kilometers, 62 miles, however brief the stay (International Aeronautics Federation.)

Things haven't started that way. What the X-Prize incentive has failed to produce, however, the dire economic circumstances of the Russian Republic have. Necessity is the mother of invention, and the Russians have vehicles they can produce for the purpose of quickie sorties to gates of space.

Not only does Nature abhor a vacuum, so does Economics. Market demand, awakened by Tito's feat, is there in undeniable force. That someone would find a way to serve that market was inevitable. The "some-one" with the "right stuff" turns out to be a Russian-American for-profit partnership.

This time, a new start will be made from the first rung on the ladder -- the suborbital hop. And the price being quoted is more than two orders of magnitude (powers of ten) more reasonable, just "$98,000." For that sum, two tourists and their "pilot" will get a 60-90 minute flight to a minimum altitude of 62 miles, highlighted by five minutes of weightlessness, and a look out their porthole at the blackness of outer space and Earth's curvature.

Making this possible is a partnership that includes Space Adventures Ltd., the Virginia firm that brokered both the Tito and Shuttleworth flights, and Russia's Myasishchev Design Bureau, designer of the now-defunct Russian Buran space shuttle. The vehicle will be a new three person craft, currently dubbed the Cosmopolis XXI (twenty one), a mockup of which has already been previewed at an Air Base outside Moscow in mid-March.

The smaller-winged C-21 passenger rocket module would be affixed atop a traditionally jet-powered carrier aircraft, the M-55 "Geophysika." The flight will begin with a conventional runway take-off, carrier and its passenger module climbing to an altitude of 10 miles (16 km) before accelerating into a steep climb. At nearly 13 miles (21 km), the aircraft carrier separates so the passenger module can ignite its rocket engine to propel it to 62 miles and separate. The Cosmopolis XXI and its passengers keep gaining altitude in a zero-g trajectory, then steer in a glide back to Earth and a runway landing.

Flights aboard the 3-person Russian shuttle, still under development, would begin in 2005. As of mid-March, more than a hundred people have sent in their $6,000 down payment reservations.

SOURCE: HoustonChronicle.com March 15, 2002

www.chron.com/cs/CDA/story.hts/space/1296550

Meanwhile, not everyone has been content to wait patiently. A growing number of civilians have experienced a half minute or so of weightlessness aboard the KC-135A "Vomit Comet" used by NASA to conduct zero-gravity testing and experiments. Now, for $5,400, anyone can get a ride on the KC135A's commercialized Russian counterpart, the Ilyushin-76. Space Adventures, Ltd., offers the 2-hour flight from Star City, the Russian cosmonaut-training center outside Moscow. Passengers experience a half-minute of free fall during each of about 10 dives. As the plane reaches full throttle headed up at a 50° angle, the engines are cut and it coasts to the top of its aerial roller coaster run. Weight return as air friction begins to slow the plane on its descent.

From the bottom of the Ladder back to the Top

Starting at the top of the ladder, as illogical as this development would seem to be, has served its purpose in whetting the public appetite for first hand experience of "Space." Now, while the rich-set flights continue, the momentum will shift to the more humble threshold of space ventures. How big is the market for this? It would seem inexhaustible. Note:

- The around-the-world cruise market has proved quite sustainable at about the same price range
- A surprisingly large number of people, at least in North America, could pay for the ticket with a second mortgage on their homes (unfortunately, that doesn't include the writer, nor perhaps, the majority of MMM readers.)

If this three person craft can take only two passengers at a time -- and the turnaround time before it can fly again is unclear -- it would seem that considerable demand would remain unsatisfied. It will only be a matter of time before additional C21's are built. If the market proves to be as strong as most of us expect -- and if there are no untoward disasters to dampen enthusiasm -- the incentive will be there to produce larger capacity shuttles to meet assured demand.

On to the next rung in the ladder: longer and higher flights. We could start to see Intercontinental flights, and that would certainly jump start demand for hypersonic airliners, bringing the price down to somewhat above that of a trans-Atlantic flight on the Concorde.

Rung Three: up into orbit and back to the starting point (a distinct logistical advantage over Intercontinental flights). Around the world once in 90 minutes, repeating the first ever space flight of Yuri Gagarin in 1961. These tourists will coast much higher up, over a hundred miles, and see much more of the beautiful Earth below. Yet this remains a modest endeavor, with minimum hygiene and food or drink provi-sions, no need at all for the recreational diversions of much longer flights. We can expect to see one-orbit "Yuri Flights" by the end of this decade.

By that time, it is not clear in our crystal ball that working vacations for guest astronauts aboard the Space Station will still be going on. A lot depends on if and how the Space Station grows and evolves along with its support infra-structure. That is another topic. Hopefully, U.S. cutbacks will lead to other nations and commercial enterprises stepping up to the plate to fill the vacancy. A less dominating position for NASA might provide a more favorable climate for the emergence of an independent multi-national Space Station Port Authority, tasked, beyond politics, with growing the station to become "all it can be" -- which is a lot.

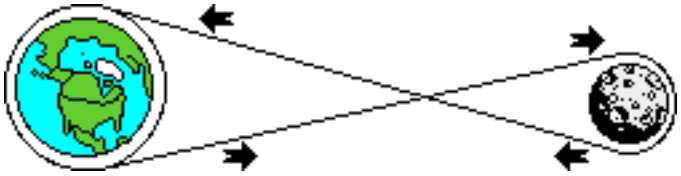
Beyond simple orbits – Orbitels & Moon Looping

The next step is providing "places to go," a "cruise ship stop" or two in orbit.

Bigelow Aerospace and others are already researching and planning for the time when the market makes dedicated orbital tourist facilities inevitable. Involved are two things:

- Larger space than a shuttle cabin provides – space to support additional activities: hygiene, exercise, dining, socializing, and more
- More provisions than are needed to support suborbital and one-orbit flights of a few hours.

Many will be surprised to hear that an orbital hotel may not be the only, or even the cheapest way to realize this quantum leap in support and services. For virtually the same amount of money as a week long stay in the "Cloud Nine" or "Terra Heights" resort complexes, one could transfer in orbit to a larger freshly refueled craft, and rocket off on a six-day loop the Moon trip on much the same trajectory as that of the suspense filled flight of Apollo 13, but hopefully without the drama.



The amount of provisions needed for the Moon loop would be about the same, with the spaciousness of the cabin facilities fuel-conservingly less, than for an orbitel week-long stay. What we are predicting is startling, perhaps. You will be able to loop the Moon without landing, cruising low over the farside terrain, at about the same time in history as the first orbitels and space resorts open for business!

There is one fly in that ointment – space sickness. The larger orbitels will probably be much better able to cope with guest indisposition than will tight-quartered Earth-Moon coastal cruisers. One possibility is that the Moonliners will require their passengers to have previous zero-g experience, in order to filter out those likely to weather the experience badly. There is an old sailors' poem which goes "Sail, Gale, Pale, Rail." Well, there won't be a handy rail on those early Moon-loopers!

We wrote a two page article on "Lunar Over-flight Tours" in MMM # 21, December 1988. You will find it online:

http://www.asi.org/adb/06/09/03/02/021/lunar_overflight.htm

So when do we get to go?

The answer to that "bottom line" question depends upon a number of things:

- The success of the Cosmopolis XXI suborbital venture Its real cost, its safety record, and positive passenger experiences
- The entry of competitors who will try to do that excursion "one-better"
- The general state of the national and global economies
- The construction of commercial orbital facilities unconnected with the ISS
- And any number of unpredictables

Despite the unknowns that are always present in any forecast of future developments, the long anticipated dawn of "real space tourism" would seem to be upon us. By the end of the decade, the number of actual space tourists should be over a hundred, perhaps well over that figure. Beginnings are the hardest. Once the threshold is crossed and experience on the other side grows, momentum and crescendo would seem likely. Engage! **PK**

MMM #160 – November 2002

Killer Asteroids vs. Killer Debris

Size is sexy; catastrophe is sexy. The threat of killer asteroids gets good press and sells movie tickets. And yes, the danger is real. However it is also statistical, for now. Anyone who thinks such a hiatus would be brief should consider how long the hiatus in manned lunar missions has been. Indeed,

The time path from Kitty Hawk to Tranquility Base may prove shorter than that from Apollo 17 to the next manned Moon Landing.

And were that to happen, a debris-caused halt to manned space operations, what would happen to our still-on-the drawing boards "Planetary Defense Systems?" Those who are serious about asteroid impact threats should be serious about keeping the door open for manned space operations. Space Debris could close that door.

The most promising space development to come may just be space tourism. But nothing could more effectively foreclose on those dreams than non-insurability due to escalating danger from space debris. So Space Tourism advocates ought also to be concerned about debris.

The sad thing about space debris is that it is unnecessary. The overwhelming majority of space debris items are the result of the traditional western refusal to interiorize life-cycle costs. It is cheaper to throw some-thing away, to jettison something, than to dispose of it properly. It is cheaper to make it someone else's problem. While it may be true that Russian space missions are dirtier in the debris they scatter, it is only a relative difference and we have no cause to be proud.

What we propose is a series of international workshops, each to zero in on a different source of space debris. When all the workshops have reported their findings, another series of workshops can begin to look at commonalities and where problem areas impinge on one another. Finally the time may be ripe for an International Conference on Space Debris charged with writing the language for a proposed International Treaty of Space-craft Design and Launch Standards aimed at drastically curtailing the current rate of debris production.

What could come out of such a study? We have some ideas but they may well be naive. We leave it to the engineers and spacecraft designers. As to the bean counters, it is hard to see how they can be part of the solution, since it is the bean counting practice of dismissing life-cycle costs that is at the heart of the problem. Could this be an opportunity for redemption?

It may take ten years for such a process to run its course, if people begin to take it seriously now. Sadly, it may take a killer blow for people to become concerned enough to be willing to accept design inconveniences and upfront costs necessary in the long run to keep the Space Age an open-ended Age. Even if we were to start today, there's no guarantee we could finish such a process in time.

Our attitude towards space debris is like that towards icebergs and sharks. Sure, they're out there. So is lightning. So what? Our advice is for the minority who do care to start the process quietly on their own. Rather than look for ways to cleanup what's out there, we should concentrate on slowing the generation of new debris by spacecraft yet to be launched. Once we've plugged the leaks in the damn, then we can turn our attention to mopping up. - PK

MMM #161 - December 2002

Vision Must be Defined in Terms of Obstacles & Challenges

Every movement and organization and enterprise has a basic, success-enabling need to define itself in terms of its Vision and Mission. For us in the pro-Space community, a Vision Statement describes the kind of world or universe in which we want to live, but is not yet at hand. The Mission Statement lists the means at our disposal by which we propose to work and strive to realize that Vision.

In composing our Vision Statement we list things which are not yet reality: "communities of people living and working beyond Earth's surface," for example; or human settlements in space, on the Moon, Mars, and elsewhere, using the resources of those places both to support themselves and help solve difficult problems on Earth." In the latter statement, we have included references to real challenges: sustaining life on worlds and in locations far less blessed with resources than our homeworld; helping overcome problems on Earth such as a growing need for abundant, and clean energy.

Stating a Vision Statement in reference to the challenges and obstacles in the way of its realization is definitely useful, perhaps even essential. Simple common sense should tell us that any Vision that does not explicitly recognize the obstacles and challenges in that stand in the way of its realization is no more than a grandiose group hallucination.

Why is statement of the principle obstacles and challenges that important? It's simple. The statement of obstacles and challenges define the Mission of the organization or enterprise, setting the principal Agenda for the effort. Is this not tantamount to combining the Vision and Mission Statements

into one? No, because the Mission Statement must do more; it must list the principle means at our disposal by which we can make progress in addressing those obstacles and challenges.

The Vision Statement then is much more than a Prophecy. And membership much more than a matter of getting a front row seat from which to watch the grand vision unfold. For the Vision is clearly not guaranteed. There are obstacles and challenges that need to be addressed and over-come by marshaling all the resources available to the organization or enterprise, and if these are insufficient, then by aggressively developing the missing tools and resources.

The Vision is "a Dream to be Realized by Work"
The Mission "Outlines a Work Strategy"

How are the various Space Societies doing?

I'm not sure an MMM report card can be accurate or helpful, and may even be counterproductive by stirring up defensive reactions. But let's take the plunge. Rather than take offense at low scores, we hope society leaders will be inspired to more effective and comprehensive overall efforts.

Planetary Society - 2002

+ Excellent development and follow through on projects that advance the realization of its Vision.
+Aggressive pursuit of resources needed for projects.
- Poor marshaling of the talents of individual members
- Does not encourage or recognize local chapters.
= Overall Score **A-**

National Space Society - 2002

+/- Addresses legislative and political obstacles only,
- Does not see any other obstacles as within its purview because it considers members as mere check writers and political activists, ignoring a tremendous talent pool of tens of thousands of gifted persons.
- Will not consider projects that can't be funded out of membership dues left over from basic operations.
= Self-limiting effectiveness. Overall Score **C**

Mars Society - 2002

+ Has a definite Vision and Mission Statement that identify concrete areas of activity that will advance the realization of the Mission.
+ Aggressive Projects Policy, going out and finding needed resources it does not already have.
+/- Initially aggressively sought to put the talents of all its members to work, but now neglects this resource.
+/- Some Task Forces are floundering. without leadership.
= Some real successes. Overall Score **B++ / A-**

Artemis Society - 2002

+/- Has a definite project but doesn't engage in periodic review and self-reinvention.
+/- Website projects only.
+/- Concentrates on fine-tuning the "reference Mission" - ignoring challenges it could benefit from addressing.
= Self-selected ineffectiveness. Overall Score **B**

Moon Society - 2002

+/- Except for one reference to the need to get private enter-prise involved in developing technologies needed, Vision and Mission Statements seem to be those of a fan club: "we're interested in all things Moon and we are the place to talk about it."
- No game plan or strategy to leverage what resources it does have.
- No strategy to marshal the talents of its membership, much less identify them, except for involving them in discussion groups and web projects
- Waiting for more members before taking on projects
= A dedicated core without a plan. Overall Score: **C**

MMM wants all these Societies to succeed!

We point out shortcomings as would a friend. **PK**

MMM #164 - April 2003

Our Space Settlement Goal: Let's Put the Horse before the Cart!

In early March, a group of space enthusiasts, meeting by invitation only, produced this statement:

Why Space Settlement

The human settlement of space is a noble cause that deserves the attention and support of people throughout the world for the following reasons:

- To enhance prosperity for all people and make use of the abundant resources of outer space;
- To fulfill the drive for discovery and exploration, which is an innate human quality at the core of progress and thriving civilizations;
- To ensure the survival of human civilization and the biosphere, and protect them from natural and man-made disasters.

Expanding boundaries to this new frontier is a pursuit of freedom, a fundamental element of progress essential to the fulfillment of human potential."

Principals at the Los Angeles meeting were co-chairs Buzz Aldrin, Dennis Tito, and Rick Tumlinson, and moderator John Lewis. Among the participants were author Vanna Bonta, JPL engineer Mike Eastwood, former Skylab crew systems manager Lt. Col. USAF (ret.) Bill Haynes, Space Frontier Foundation Secretary and longtime activist Brook Mantia, space activist Theresa Theiler and space frontier movement philosopher, Jon Carter McKnight.

Represented were the Space Frontier Foundation, the Planetary Society (which did not endorse the "humans in space" focused results), and the Mars Society. The Press release, however, was that of the group alone, and not immediately endorsed by any of these societies. However, the Moon Society Board, not represented at the meeting, did endorse the statement in a press release March 23rd.

The space leadership's media and public outreach team was not able to produce a companion consensus document, which is no surprise given the wide diversity of "how to get from here to there" strategies that guide individual space enthusiasts. And this is the crux of the problem.

In itself, the Space Settlement Statement does provide a rallying cry for those of us manned space supporters. But beyond that, it may be of little use. Our point is that this document is not a something we can use to enthuse the public, the media, or congress.

Putting the Horse before the Cart

Holding up the Settlement of Space as a Goal, to anyone but the already converted, "the choir," risks ridicule and contempt. Why? Because it seems outlandish on its face.

Everyone "knows" that neither the Moon or Mars, or anywhere else in the solar system, has **breathable air, flowing water, and edible plant life.** The very idea of trying to live out there is patently ridiculous to the uninitiated.

Of course, the choir is in on the secret that we can (or, more honestly, think we can) create livable minibiospheres out there, that we can produce air and water and food and building materials from raw materials on location, and that we think we can use resources out there to produce not only goods needed by settlers, but exports to Earth that will more than pay for the bill. And if Settling Space is the "Cart," these "think we cans" are the horse.

But how can we parade "think we cans" before the uninitiated and gain their support? We can't!

Clearly, **without considerable more homework on these "enabling technologies," we don't have much to excite the public,** to show them the "feasibility" of our bold visions for future human space frontier settlements, to give them exciting glimpses of how satisfying and fulfilling life on such a frontier might be.

Our horse is still but a glimmer in our eyes.

There is valuable work being done on a number of worthy projects, by the Space Studies Institute, the Mars Society, and by the Artemis Project™ business partners. The Planetary Society, with its Cosmos I Solar Sail project is also helping to pave the Technic Way to the Milky Way.

From the very first issue way back in December '87, MMM has concentrated on illustrating the possibilities and highlighting the research and development that needs to be tackled to make our vision of a thriving frontier settlement on the Moon a reality. And we'll continue to do that so long as we can continue to publish.

But how do we, a collection of societies with little to leverage except member dues, help tackle this backlog of orphaned R&D projects? We can work to identify/itemize what needs to be done, and help brainstorm business plans to develop needed technologies for profits here and now, on the basis of possible terrestrial applications. **This is our "Spin-up" answer to the NASA "spin-off" dead end.** – PK.

The Space Settlement Statement Online
http://www.spacedaily.com/news/oped-03y.html
http://www.space-frontier.org/Projects/Spacefaring/

Show me the person who has never failed,
and I'll show you a person who has never tried

MMM #174 – April 2004

Crew Exploration Vehicle Modularity brings Opportunity

When NASA designed the Space Shuttle Transportation system, It was an integrated package that left little room for private enterprise to offer competing components that would plug into the system at various points.

Only SpaceHab, which designed and built an "extra pressurizable space" module that could fit inside the Orbiter's payload bay, was successfully able to piggyback on the System.

Yes, there have been many designs for "shuttle-derived" vehicles, the new parts of which might have been provided by private enterprise, but despite a host of suggested uses and applications, no company succeeded in coming up with a business plan that was workable enough to attract the necessary venture capital.

The Shuttle was supposed to be reusable and economical. After it went through the political meddling and design by committee, we had neither. It was "overhaulable" and extremely expensive to fly and turn around.

Bow that a decision (yet to be seconded by Congress) has been made to replace the aging shuttle fleet with a "Crewed Space Exploration Vehicle, the CEV, we have the unique opportunity to

Design the CEV infrastructure in a way that would invite private enterprise to plug in at various points with new and improved designs for the various CEV modules.

These include the two-stages of the expendable launch vehicle, and the modular parts of the Crew Vehicle itself. To make this possible, NASA must:

- **Carefully design the interfaces between the various components** to make it easy to substitute, new and improved modules at every point• **Publish the specifications of this interface infrastructure** so that any company capable of designing and building alternative vehicles with greater capacities, and more attractive design features, could do so.

What are the possibilities?

- **More powerful launch boosters**, enabling
- **Larger and heavier Crew Cabin modules** for more ambitious missions, which could carry
- **Larger crews** and/or

- **More supplies & provisions** for
- **Longer deep space missions**.

Such developments would lead to for-profit missions with vehicles configured with fully compatible hardware, some-thing essential for repairs, rescue, and salvage. By this design route and strategy, a CEV common infrastructure could lead to for-profit missions to the Moon and nearby asteroids.

- Editor

MMM #177 - August 2004

Milestone Achievement Prizes: M.A.P.ing Enterprise Pathways to Space

Good fortune in the space world, can be rather elusive. But here's hoping it shines on Burt Rutan and/or the rival Canadian Da Vinci team. Both have announced dates for the first of the two required flights in the same ship, carrying three persons within a two-week limit, at the end of September and beginning of October, respectively. We trust that if either has a snafu, they will try again successfully. The Ansari X-Prize Foundation is only too happy to part with the $10 million prize money.

Such prizes, over a hundred in all from 1905 to 1935 successfully encouraged the technology developments that led to the birth of today's passenger airline industry. Can we follow up the expected X-Prize success, with a series of follow-on prizes that will lead to cheaper (than a $20 million Russian ticket to the Space Station) ride for ticket-paying civilians to ride to:

- Orbit?
- Orbiting hotels?
- "Loop the Moon" (skimming over the farside without landing) tours?
- Self-contained Moon landings?
- Moon landings at in-place tourist facilities offering surface excursions?

It is certainly worth our best shot. To lead to success, however, the prize requirements will need to be carefully "terraced" so that one success logically prepares the way for the next. That will require some collaborative planning. Meanwhile, there is a new bill in Congress that, if passed, would lend government support and seed money for such a prize program. S. 2772, the Space Commercial Human Ascent Serving Expeditions (Space CHASE) Act will presumably take the place of the original HR 3752, adding this definition of a

suborbital vehicle: "a vehicle, rocket-propelled in whole or in part, intended for flight on a suborbital trajectory whose thrust is greater than its lift for the majority of the rocket-powered portion of its flight."

Sponsored by Senator Jim Inhofe (Oklahoma) the bill's full title is "A bill to promote the development of the emerging commercial human space flight industry, to extend the liability indemnification regime for the commercial space transportation industry, to authorize appropriations for the Office of the Associate Administrator for Commercial Space Transportation, and for other purposes." Read the bill at: http://www.spaceref.com/news/viewsr.html?pid=13632

This bill would not offer prize money, but clear the many bureaucratic hurdles that X-Prize contenders had to surmount. This will make new private prize efforts that much more likely to end in successful achievements. But we do not need efforts that merely raise the bar to trivially newer heights, say "100 miles." Rather, we need prizes that each represent a quantum leap in the public mind. To ensure momentum, we need something more than a continuation of technological achievement; we need boosts in public interest -- in the public appetite for space tourism that is affordable to a large enough percentage of the population to create a "sustainable market." Being able to tap such a market will then be prize enough.

Next Quantum Level in Prize Offerings

How about **the first intercontinental flight with an apogee of 100 miles or more**, defined as involving a landing at some distance to be determined, say in excess of 5,000 miles (8,000 km.). That would give passengers not only their astronaut wings but a substantial period of zero-g filled with

amazing views of the Earth below. The cabin should have windows to provide such views. Flights like this would last on the order of a half hour to an hour plus.

Flying a cabin that holds perhaps two dozen passengers over such a route would be a good next step. More fares means lower prices for all. The next step would be to **fly such a capsule into orbit, for a loop or two,** without facilities to sustain passengers over longer periods.

Prizes work

Historically, prizes of this sort have raised an average 50 times as much money, by the competitors, as the size of the price offered. Those to gain from the achievement, such as companies in the luxury tourist market, and companies contending to supply supporting equipment, would be among the logical sources of the needed prize money, along with wealthy interested individuals.

Again, we need a series of prizes, one introduced at a time, that in the end will lead to the creation of a viable and sustainable space tourism market. Nobody is going to do it unless we do it, we including private enterprise> - **PK**

MMM #178 - September 2004

How Much can we do to Privatize "Moon to Mars?"

In the April 2004 MMM #174 In Focus essay "CEV Modularity brings Opportunity" we pointed out that if NASA concentrated on carefully defining the interfaces between the modular components of this new space vessel, it could leave the supply of the various modules up to private industry and competition. This would guantee that we would get the most vehicle for the least money, and a vehicle that would keep evolving as industry upgraded the various modules or module options. While our confidence level that NASA will choose such a pathway is low, this would get the program off on the right start, to be sure.

Indeed, when it comes to designing outpost habitat modules, NASA ought to tack the same tack: defining the interfaces -- how the modules would connect together, including plug-in utility runs -- and leaving the design of the various habitat modules up to competing enterprises. Here there is the added requirement that the modules must be transportable in payload bays and farings that are either on the shelf or budgeted enterprise projects. That the two-level "tuna can" of the Mars Direct design is best, rests on the assumption that the Ares shuttle-derived vehicle will be the vehicle of choice. But industry may come up with another vehicle, another faring container.

In either case, the design of the principal outpost habitat structure to fit that payload bay or faring volume should be left open to enterprise competition, observing the module-module interface standards set by NASA.

Beyond vehicles and habitat modules

But there is more to opening the human space frontier than modular transportation and habitat systems. The wild card in opening the space frontier, and NASA's biggest weakness despite a lot of effort and spending (most of it without private enterprise input) is whether or not we can come up with **reliable, hardy systems to maintain √ air and √ water quality as well as √ food production - all three integrated as far as possible, and with all the supporting equipment consisting of modules** (yes, the interface thing again) - so that the result is a working mini-biosphere that can grow, in modular fashion, as the outpost grows, adding one habitat and/or function module at a time.

Again, at every stage of this plan, there **is prime opportunity for private enterprise to produce the best systems, and to keep improving each, so that as the Lunar and Martian outposts expand, we are not locked into outmoded and inferior modules and components.**

Again, this desirable vision is the primary goal of the effort to **get the infrastructure right the first time!** Infrastruc-ture tends to last forever (think the 17th-18th century street grid of Manhattan) and is the one physical aspect of civiliza-tion that has consistently proved the most resistant to change. It is vital to get it right, right from the start. In our opinion, NASA's role in the realization of this human space frontier vision, is just this, designing infrastructure, and no more. Let private enterprise come up

with everything else. In other terms, let NASA come up with the grammar for the language of human expansion beyond Earth orbit (boundary space) and let enterprise choose the nouns, verbs, and adjectives!

New technologies

There is one more way, and a major one, that NASA can guarantee that this vision will be realized both at the lowest possible taxpayer cost and in the shortest time frame.

- **NASA** should be tasked by Congress with **defining the technologies, not yet on the shelf, that will be needed to open the human frontiers on the Moon and Mars.**
- Then **Congress** should enact an **incentive program to encourage private enterprise to predevelop these technologies ahead of time,** for any potentially profitable terrestrial applications that can be identified.

In this manner the needed technologies, or close precursor analogs of them, will be put "on the shelf," paid for by customers rather than by taxpayers and at less R&D expense (no NASA crash programs) and in a "just in time" fashion. This is the route of "spin-up" that we first proposed back in 1987 (MMM #16) as opposed to the time-honored but bankrupting "spin-off" route.

We can do it, for less,and sooner! – PK

MMM #179 - October 2004

The X-Prize Saga Continues: Can it Take us to the Moon?

We were all excited to see the X-Prize won, and handily so, in a flight that soared well above the 100 km, 62 mile altitude goal, passing it by over 12 km, almost 8 miles. The feat, the second qualifying flight coming within a week with more than a week to spare, left no doubt. Commercially produced rockets can take tourists to the edge of space!

When he founded the X-Prize Corp. in the mid-nineties, Peter Diamandis (earlier, the co-founder of The International Space University) hoped to jump start the age of space tourism and cheaper space access. Evidently he has succeeded, witness the quickly announced plans of Zero-G Corp., Virgin Galactic "Spacelines" and Bigelow Aerospace.

Diamandis' Zero-G Corp. (www.nogravity.com) has already commenced taking passengers up for airborne roller coaster rides and a half minute of free fall in a specially modified 727 for $3,000 apiece. NASA seems bent on undercutting this enterprise by expanding its "free" offerings in its "Vomit Comet." But as the number of thrill seekers rises, Zero-G should get ample business.

Meanwhile, Richard Branson of Virgin Atlantic has contracted with Burt Rutan's Scaled Composites Corp. to build a SpaceShipTwo plane with a capacity for seven passengers, for suborbital flights on Virgin Galactic.

How popular suborbital flights become depends on the price tag. Currently, the round-the-world ocean cruise market, at $50,000 to $100,000 apiece is, however out of reach of most of us, a "sustainable market." There are enough world-cruise-setters with the money and the time to keep a number of ships in that service fully booked. Space promises to be more exciting, and could well prompt some to remortgage the old homestead for a chance to go "where few have gone before." Even at the edge of space, 60 miles or 100 kilometers up, too low for orbiting, the sky is black, the stars are brilliantly out, and the curvature of the blue, white, tan, and green globe below is very obvious. Short suborbital hops could be for many, the thrill of a lifetime.

At the same time as these announcements were forthcoming, Robert Bigelow announced a new higher $50 million dollar prize, half of it put up by himself, for the first privately built spaceplane that can take seven passengers to orbit, whether to ISS, or to his own planned Space Hotels. (He is busy building real inflatable habitats, building on the abandoned NASA-TransHab program.)

How long it will take for someone to win this prize does not matter. It took almost a decade for the X-Prize to be won, but now momentum and excitement are there to telescope the time before each succeeding achievement milestone is met and surpassed.

But can this momentum reach a crescendo that has tourists visiting the Moon? Robert Bigelow seems to think so. While his first goal is to get visitors and residents for the Inflatable Habitats he intends on building in space, he wants to offer them something extra, a chance to go beyond Earth orbit, to the Moon. He has been designing Earth-Moon cruise ships to take tourists there, no less.

Distance and time constraints make the Moon the ultimate tourist Mecca. The Moon has the three essential assets: location, location, location. But how do we make the seemingly tremendous leap from low Earth orbit a couple hundred miles up all the way to the Moon and back? The fuel/energy needed for that boost is no more than it took to get you off Earth's surface into orbit.

It is a simple fact that a vehicle that can take people to Earth orbit, need only be refueled and stocked with provisions to last seven days, to rocket out from Earth orbit around a round-trip, loop-the-Moon cruise, in which passengers would get to skim close over the farside craters, without landing, before a double bounce off Earth's atmosphere deposits them safely in low Earth orbit again.

Now as you might expect, it's not quite that simple. Humans are not inert cargo. A short less-than-an-hour ride to orbit is one thing, but seven days strapped in a seat for a ride around the Moon? No way. They'll need berths, one for every two persons "hot-racking" on shifts, food, toilet facilities, some space to move around, and recreation. So that "same craft that brought them up from Earth" may in reality need to dock with a "Cruise Logistics Module" to provide minimum creature comforts. Bigelow will build it.

Landing Excursions to the Moon's surface are a good way in the future, with excursions to sites with ground facilities beyond that. But the point is that lunar overflight tours are a lot closer than most people dare imagine. Such a trip would take little more than a week of one's life, compared to a 3-4 year round-trip to Mars. Once prices fall, and they will, demand will be high, and steady.

And that will whet the appetite for the next step: self-contained Moon-landers that will take tourists to the Moon's surface for a quick sortie. Which in turn will lead to the building of tourist facilities on the Moon.

And to expand those lunar surface facilities at less expense, contractors will begin processing moondust into building materials and habitat modules. With or without a NASA return to the Moon, lunar beachheads with real resource-using development are in the future - our future!

And in the meantime, the first tourists may loop the Moon before the first astronauts return to its surface. If either the upcoming election or Congress kills the current Moon to Mars Space Initiative, we will still get there. Keep the faith! - - **PK**

Cosmic Attitude

If the forces of creation deserve our worship,
They do so from every corner of the universe,
Not just from this nest-world we call Earth.

This we cannot do by staying home.
Go and fill ye the empty cosmic spaces
And let your soul sing in praise
In endless new ways.

- Anonymous.

MMM #182 - February 2005

A "Safe House" in Orbit that avoids the "Infrastructure Trap"

When we brought the Apollo Program to an early conclusion, canceling the scheduled A18, A19, and A20 missions, everyone agreed that before we could return, we needed a depot in space from which to stage more complex lunar missions. At as space "depot," Moon-bound personnel would transfer from some sort of shuttle that brought them up from Earth's surface, to an awaiting LEO to Luna (or LLO, low lunar orbit) "ferry." We all rallied around this perceived need. And in doing so, we fell into the trap.

With more people seeing the usefulness of an orbital station than for an orbital depot, it was inevitable that the station would be designed as an Earth-facing end in itself rather than as a Space-facing stepping stone.

Yes, we need infrastructure, but not all of it right away. Railroads helped settle the American West. But we did not wait on them to begin that venture.

How stupid could we have been to think that the depot must precede real traffic? Traffic comes first, then support infrastructure to make that traffic easier to support, develops as needed one step and phase at a time.

The fact is, and yes, we must dare to say it, that Wernher von Braun himself got it wrong, and in our deference to him, we did not question him.

For example, a Safe House in orbit, or wherever it may be needed along the way, can be provided by a mated launch of a provisioned bare bones habitat capsule on an expendable launch vehicle, and left in space to serve that function for other manned missions into similar orbits. Don't have one handy? A second shuttle could be launched at the same time with minimum crew. Yes, it won't happen because it doesn't fit the game plan we've been following for two decades, the game plan that led us to the fix we are now in.

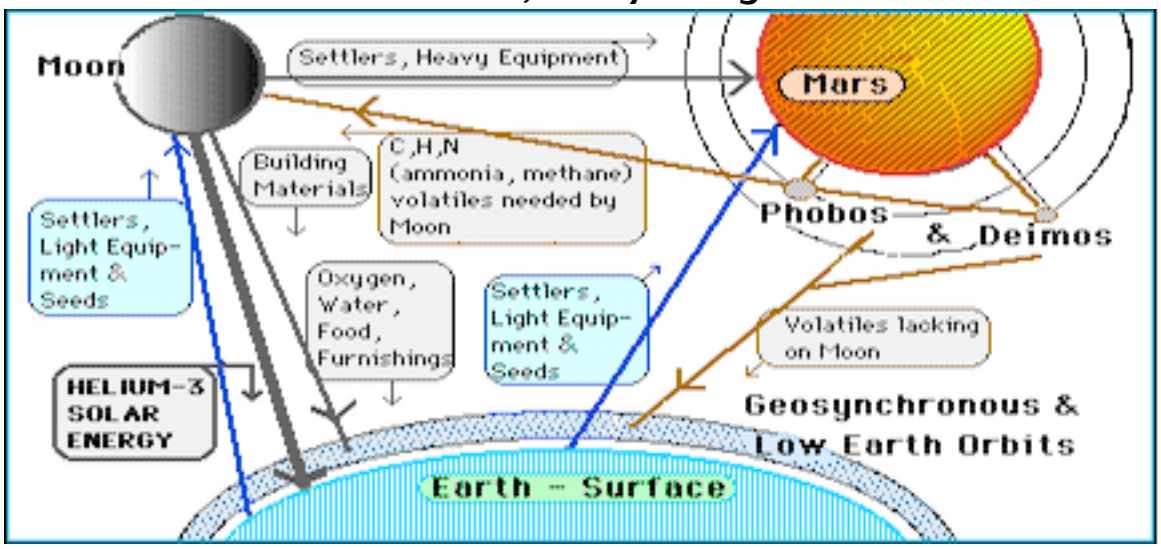
Robert Zubrin has been the lone person out there to see that ISS is a trap, a depot to nowhere. His "Mars Direct" was a bold plan to bypass it. But our point is not that deep space manned missions must be "self-contained" but that far less elaborate and more mission-appropriate staging options are available. We cited double shuttle launches, as just one example. When Bigelow Aerospace's full-scale operational inflatable Nautilus Habitat is ready, one could be launched into a deep-space-friendly lower inclination orbit (28° from the Cape will do, but lower would be better) and left there. Nautilus would need docking ability and solar power panels, and a means of periodic reboost to keep it at the desired operational altitude. For complex missions in which the craft bound for the Moon or Mars needed to be assembled, this could be handled if the assembly could be designed to be effected simply by man-tended docking requiring minimal EVA time.

As traffic to the Moon and/or Mars builds, a depot staging and servicing station could be built, designed to grow with the traffic. This concept of building an orbital Taj Mahal and completing it, before any further manned missions to deep space, back to the Moon or on to Mars, is indefensible. Von Braun authored it, and in unquestioning respect for him, we bought it hook, line, and sinker. We have no one but ourselves to blame for the 35-year hiatus, going on half a century, in manned missions to the Moon.

NASA, under O'Keefe, has shown some capacity and willingness to change long entrenched thought patterns and mission development paradigms. But the danger, inseparable from the reality of government financed and micro-managed programs, remains that any "rung" will be redefined in committee as an end in itself, no longer as a rung in a ladder leading to a rung higher up.

To this day, a discouragingly high percentage of space enthusiasts put all or most of their faith in government space, in the socialized space program. Without disrespecting the venerable old agency, our only sure and steady bet is the commercial path to space. Private enterprise will build infrastructure - but only one stage at a time, as it is needed. In our opinion, that's our only choice. - PK

Economic Case for Mars Requires the Moon as Trading Partner
And from that, many things follow



Turf-retentives on both sides miss the point. Neither frontier will be viable without the other.

- **Both frontiers will be under the gun to produce, and sell, enough exports to pay for import-ing**
  what they cannot (yet) produce locally. Earth will remain the most expensive source of im-ports, simply because it sits at the bottom of a comparatively deep gravity well.
- If some of the import needs of the Moon can be met from the very shallow gravity wells of Mars two mini moons, Phobos and Deimos, and others from the intermediate gravity well of Mars itself, that will alleviate import cost pressures on the Moon. Conversely,
- If some of the import needs of Mars, and its moons, can be met from lunar sources, that will reduce import bills for the Martian frontier.

In short,

The viability prospects for both frontiers seem much rosier if they develop side-by-side than if only one is developed.

First, the Moon. There are sources of volatiles on the Moon, and not just at the poles. Hydrogen, nitro-gen, and carbon can be had in at least minimal quantities for the price of the mindset of gas scavenging practiced de riguer.

The upper two yards/meters of the lunar regolith contains these gases, the gift of eons of bom-bardment of the Moon's surface by the solar wind, trapped by adhesion to the fine dust particles. If, whenever we move regolith

in the process of construction, road building, mining, etc., we heat it up to release these gases, trap and separate them, we shall not want. That said, we may want more. Having to be always stingy and Spartan in our lifestyle habits can be dampening. There is likely more at the poles, but we do not know yet how easy or difficult it will be to retrieve it.

Yet, these volatiles may also exist abundantly on Phobos and/or Deimos (it is beyond under-standing why NASA, any other agency, or even the Mars Society itself) has not prioritized missions to both of these Moons.) In that case, they could be extracted, and refined for efficient shipment, as meth-ane CH4 and ammonia NH3. If needed, these volatiles could be shipped much more cheaply from Mars' moonlets than from Earth.

Mars has had at least some hydro-tectonic ore-enrichment, whereas on the Moon, such geo-logical processes never got started. Should we not find the lunar equivalent of a copper-nickel rich "Sudbury"
[Ontario] impact crater, Mars may be a cheaper source than Earth of such industrially strategic elements as copper, zinc, lead, gold, silver, and platinum.

The two frontiers may develop along differing Industrial diversification pathways. That is only to be expected. As a result, both will inevitably produce some goods needed, but not produced locally, in

the other, and purchasable at a definite cost savings over equivalent products produced down the throat of Earth's gravity well.

Having a developing frontier partner world will be an enormous bootstrap lift for each. The need of the Moon for Mars is so clear, that support of a Moon first strategy (in case the effort ends here) may serve in fact to derail efforts to open Mars, and thus hinder the Moon's viability. That is why, speaking only as an individual, and not on behalf of the Moon Society or of any other organization, I agree with Robert Zubrin's strategy. Rather than "do the Moon first - and, oh, by the way, testing equipment that could be adapted for use on Mars," we should go to the Moon with equipment designed for Mars in the first place.

The danger in not doing so, is that the Moonbase initiative will become an end in itself, and no more lead to Mars than the Space Station has been designed as a depot to deep space. If we do not see (and design) each "rung" on the ladder to lead to the next, losing sight of the ladder, than we but paint our-selves in a corner, choose the infertile cul de sac path.

We are also so convinced, based on ample past precedent, that heavy NASA involvement will choke off and suffocate private enterprise initiatives on the Moon (intentionally or unintentionally does not matter) that we prefer to see NASA preoccupied with opening Mars, and using the Moon only as a test bed for Mars-bound technology.

The path to Lunar industrial settlement does not lie through a NASA lunar outpost, but through private enterprise development, possibly first for tourism and contracted support for agency-erected lunar observatories, then in support of Earth's insatiable energy needs.

The Moon alone is a viable tourist destination. The Moon can produce building materials for tourist and industrial facilities in low Earth orbit. Mars has little to sell the Earth directly, but quite a bit to support the lunar settlements and industries. The Moon is thus Mars' ticket to earn revenues to spend on imports from Earth.

But it is not enough to say we should open both frontiers at once, the Moon perhaps always one step ahead. We must also come around to see that we cannot open Mars effectively without tapping re-sources on Phobos and Deimos as well, and at the same time, if not again, one step ahead. The big rush to do Mars first, not only ahead of the Moon, but also ahead of its own moonlets, is an impatient plan that can only doom the effort in the long run. "Visit the ruins on Mars!"8 the tourist posters will say one day. Why? Let's do it right. We need to develop a whole inter-trading system. Moon-Phobos-Deimos-Mars, and perhaps more! **PK**

MMM #184 - April 2005

An End to the "Lunar Dark Ages"?
Beware of the "Wooden Nickel" Trap!

We didn't know it then, but the Lunar Dark Ages began when Apollo 17's Challenger lifted off the moon at 5:55 p.m. EST December 14, 1972. Three more missions had been planned to explore Schroter's Valley in the Aristarchus Plateau, Hyginus Rille, and the great crater Copernicus. Apollos 18, 19 and 20 had been canceled due to cuts in NASA's budget by Congress, and Nixon's indifference.

In the interim there has been some activity. The Soviets kept at it for another four years.

- Luna 21 (Lunakhod 2 rover, Le Monnier Crater) Jan 1973.
- Luna 22 (orbiter) June 1974
- Luna 23 (lander, Mare Crisium) October 1974
- Luna 24 (lunar sample return, Mare Crisium) August 76

Galileo took new, color-filtered photo's of the Moon as it flew by in December, 1992. In early 1994 Clementine, a mission by the Strategic Defense Initiative Organization tested instruments (meant to map the Earth), on the Moon

In 1998-9, Lunar Prospector, a mission developed outside NASA, was flown by NASA to look for evidence of hydrogen at the lunar poles. But in all this time, since Apollo 17, there has been no NASA-originated Moon Mission.

It has been difficult for many Moon-enthusiasts to "keep the faith" during these Dark Ages. Will this end?

There has been much excitement since President Bush announced that NASA would abandon the Earth-science focus of its Manned Space Program, build new manrated vehicles, return to the Moon, and go on to Mars. Those who state reservations about NASA's new lunar outpost plans, are urged to "quit rocking the boat." But unfortunately, as in almost all other cases when something seems to be too good to be true, the thankless role of the Devil's Advocate is essential.

An end to the Lunar Dark Ages? What we all want is a return to the Moon to stay. Unfortunately, a great many space supporters are naive enough, or with no or too short a memory, that they believe that because the stated intent is to put in place a "permanent" moonbase, that a new human presence on the Moon will continue to the end of time. Now we could point to past government assertions and eventual realities (NASA will abandon support of ISS six years after it's truncated final version is completed) but such an argument will carry no weight with those desperate to believe.

Instead, we appeal to reason. "Permanence" has to be earned, by laying the foundations on which it can become self-maintaining. Otherwise, all assertions to the contrary, the Lunar Dark Ages will not have ended.

Readers who had even a brief course in Logic know what a syllogism is: a form of argument in which a conclusion follows inescapably from two premises. Here is how I see the situation with respect to NASA's return to the Moon.

Premise: No human presence on the Moon can be permanent unless it aggressively expands using local resources in order to be able to produce the bulk (by shipping weight) of its needs, and enough export products and services to earn what is necessary to purchase those of its needs it cannot (yet) provide for itself.

Premise: NASA, despite tentative, easily-cancelable plans to do token in-situ resource use demonstrations, has no plans to expand an initial lunar base or to use lunar resources for expansion, or even to bring civilians to the Moon. Any of that would depend on government (Administration and Congress) decisions.

Conclusion: The NASA/Government plan to return to the Moon "to stay" is self-neutering, just so many words. So what do we do: Supporting NASA's efforts are fine and good, especially as it helps keep up public interest. But, that said, we must remain aggressively vigilant that:

1. NASA involves private enterprise (not just "contractors" who are not risking their own capital) as much as possible.
2. NASA does not discourage non-agency efforts to develop the Moon for industry, settlement and/or tourism.
3. In short, we must be vigilant to make sure that 3. In short, we must be vigilant to make sure that the NASA Game is not the only game in Moontown.

We cannot, dare not, must not take it for granted that private enterprise will follow NASA to the Moon, that NASA will pave the way, that NASA will be supportive. All the evidence of the past four decades should tell us otherwise. We have had a Socialized Space Program that we think is "as American as apple pie." Socialism only becomes capitalism after a revolution of sorts. When NASA says "private enterprise" there is a fundamental disconnect between what it understands by the term and what we understand by it. We have to remain aggressively vigilant.

"Rocking the boat?" Perhaps, but that is the only way we are going to free the boat from the sandbar on which it now rests. Yes, NASA's plans are exciting. But NASA, following the majority opinion of planetary scientists who are totally disinterested in the idea of lunar settlement and development of lunar resources, seems intent on selecting a lunar polar site, the worst possible location from the point of view of developing a lunar resource-using industrial civilization. And alarmingly, the apparent majority of space enthusiasts are mesmerized by this plan's stated advantages (i.e. not having to deal with the reality of the lunar environment).

Please, let's not settle for "wooden nickels." **PK**

MMM #188 - September 2005

Shuttle Design Choices had undercut success from the outset

NASA built us an "all-purpose" Shuttle that had state of the art cryogenic engines. But it was not the vehicle envisioned by von Braun, whose plan had been hijacked and contorted by congressional compromises. The cost/benefit ratio of the complex SSME and tile technologies were not justified, moreover, and ended up kicking us in the ass, for seeking beyond state of the art engineering and design, instead of cheaper, more reliable, more reflyable second best alternatives.

We were promised a vehicle that was "reusable." That was a considerable stretch of the truth, a Trojan Lie, if you will. We got a vehicle that was "overhaulable" given ten thousand man hours. Congress is to blame for giving us the ET-SRB booster system, instead of a manned reflyable booster such as von Braun had envisioned. Pennywise, and gigapounds foolish. Why should that not be called treason?

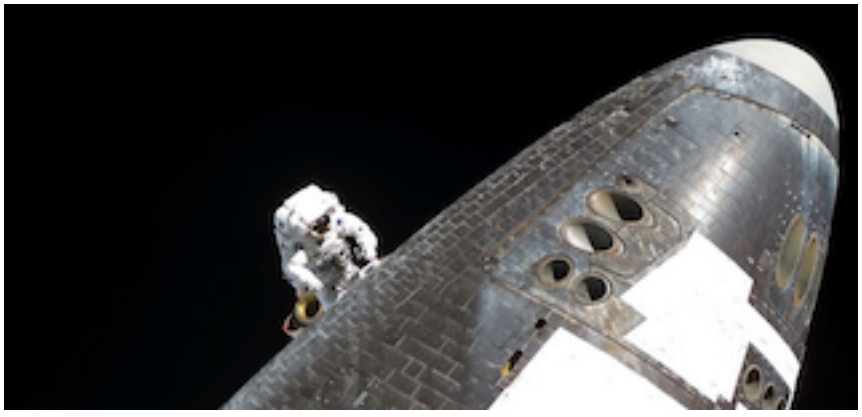
Wisconsin Senator William Proximate loomed as NASA's sharpest critic. We literally hated him back then, for claiming the Shuttle would be more costly, by a appreciable amount, than continuing to rely on proven expendable boosters. We were all so sure it would be much less expensive, as von Braun promised. But Proxmire would be proven right, all because Congress itself changed the plan.

There is nothing that can be done about what happened except to learn our lessons, lest we be condemned to repeat the same chain of mistakes. Government is government is government, however. And NASA, despite all the brilliant and well intentioned people who work for it with great dedication, is still, well ... "government."

We can get back into space, and back to the Moon "and beyond" la de la, much sooner via NASA than through private enterprise. Deep pockets trump! But, as in the past, it won't be to stay. Not because of NASA but because the government, by its very nature as a public creature, does not have staying power, and never will.

We'll get there one day, slowly and humbly, and to stay; but it will be on the backs of those who have a stake in the new frontier, pioneering enterprises and pioneering individuals. Meanwhile, Michael Griffin's new plan would use existing shuttle system components to get humans back to the Moon sooner and less expensively, but without any commercially designed and built components. Nor does Griffin's plan call for a heavy lift cargo launcher, shuttle-derived or commercial, which will be needed to launch habitat modules for any real moon base, temporary or "permanent." Griffin offers us an Apollo Sequel

Where should we go from here? We are doing the right think by separating human and cargo transportation! If we go with a new manned vehicle that does not use the External Tank, the development of a new Crew Vehicle to be coupled with existing "safe" boosters seems the logical way to go. But both the crew vehicle and the boosters should be open-sourced. **Let NASA decide the interfaces, but let the components be decided by enterprise and market place.**



The **Shuttle Tile Thermal Protection System** with thousands of tiles, none interchangeable, was a design choice that guaranteed thousands of man-hours to turn a shuttle around.

Griffin wants a NASA-designed crew cab to be coupled to NASA's existing SRB in a stretched version. Both can be fallback choices -- if private enterprise does not rise to the occasion and come up with alternatives with greater capacities, less cost, more safety, more reliability, and quicker turn-around. NASA vehicles should be a last resort.

Meanwhile, it is plain stupidity not to build upon existing space shuttle system components to build up a family of cargo-only shuttle derived vehicles. We need a fallback heavy lift vehicle, and the components are mostly off the shelf. Without a heavy lifter, we may be able to return to the Moon, but without the components needed to build an outpost. We'd only be returning to plant a new set of foot-prints. And that's all Griffin's new plan can offer.

Face it! NASA can only do what it already knows how to do. And that isn't what we need. NASA should gather knowledge, develop new technologies, and explore. Private Enterprise and Space Commerce and Space Tourism should build upon NASA's technological pioneering in an open-source manner -- if what we truly want is an "open-ended" human "civilian" presence on the Moon and Mars.

Those readers who grew up after Apollo will not appreciate these remarks. They are encouraged by the new Moon, Mars & Beyond vision. We are not. Even at best, all it would do is produce an Antarctic style presence on the Moon, not resource using settlement. Indeed, by lulling most supporters into un-justified optimism, the NASA plan will work to discourage private enterprise initiatives. In that sense, the current initiative may be worse than no NASA initiative at all. "We don't have to keep agitating. We have won!" wrote one reader in response to the Bush plan.

Alas, we're just being duped into laying down our arms. Without increased activism, aimed at getting NASA to adopt the open-sourced commercial route and to build an outpost with a mission to grow increasingly dependent upon local resources (not with a mission to do more scientific curiosity itch-scratching) we will betray our own dreams. Let us not be Benedict Arnolds to our own dreams!
PK

MMM #190 - November 2005

Politician-Proofing is Moon-Mars Mission Priority #1

Since President GW Bush laid out his space exploration vision, there has been a fresh ground-swell of public interest and enthusiasm for its two flagship goals: deploy a permanent outpost on the Moon; and send humans to explore Mars. As usual, those who say "Hey, wait a minute...." are disdained as spoilers. "Join the party!" we are encouraged.

Most of the enthusiasm comes from those too young to have lived through the yo-yo mood swings that took us from the ecstasy over the first moon landings in 1969 to the agony and insanity of our retreat from the Moon just three and a half years later! You know the old adage about what happens to those who learn not the lessons of history.

Politicians have been the enablers of great space endeavors. They have also been the spoilers. They control the up front money. And as long as up front money is the principal driver, our space dreams will remain hostage to politicians who, if they do appreciate the value of space programs, do so for all the wrong reasons.

Politicians are the spoilers, for two reasons. They can cancel a program on a moment's notice, as the way our system works, program approval remains tentative until the time a program runs its course. It can be canceled in mid-stream at any time, for any silly reason, usually money.

But cancellation is not the most insidious threat posed by the regime of constant and repeated political review. The worst danger by far, because it is not seen as a danger, is forced redesign by com-

mittee. That is the fate that befell the Shuttle, and then the Space Station. We ended up with "strong, hardworking " beasts of hardware. But they were mules, not horses, Through the redesign by committee process they were both sterilized, not capable of supporting "the next step" offspring.

How do we "politician-proof" the EMM&B vision? Robert Zubrin, founder and leader of the Mars Society gave his answer at the Mars Convention last August. In a talk entitled "The Moon by 2012, Mars by 2016" he pointed out that if the bulk of the equipment needed was well under development by the time Bush had to hand over the reigns to his successor on January 20, 2009, the program will have become too robust to cancel. Okay, reaching that goal is a goal then, but realistically given the historic budget deficit created during the same period, an unlikely goal.

What other ways are there to politician=proof the return to the Moon and exploration of Mars? We've talked about them. It would mean getting NASA not to be the control freak it has always been.

The Aldridge Commission advised NASA that it must seek ways to involve private enterprise, not just the usual stable of major contractors addicted to NASA money. But after a pro forma period of soliciting ideas for a new CEV vehicle, is it any surprise that NASA has come up with its own design, or that the usual guilty parties will be the contractors?

Reaching the point of no return is important and we agree with Dr. Zubrin on that score. But we identify that milestone differently. We will reach that point when we have grown the self-funding entrepreneurial component to the point where business (not Congress) has too much at stake to let the Government opt out -- or even better, to the point where a business-industry front would be able to "to go it alone" should those who have never really been in our camp anyway, decide that the government must pull out.

This is especially true of the Moon. A government base will be put in the wrong place to support expansion of an industrializing lunar economy, and will be designed as a science and exploration base only, á la McMurdo Sound. The presence of the government even with International Partners on the Moon will work to discourage the rise of a private industry presence there. And only the latter can ever be called permanent. A government presence can be withdrawn at any moment: witness what is happening now to the government's support of the Space Station.

How do we get to this very different milestone marking a point of no return? Yes, it will involve a critical down payment level. But we see that as involving a critical mass of technologies and hardware that business & industry can use, rather than NASA, should NASA opt out, and private enterprise be faced with the need to "take over."

We repeat our recommendation, that NASA restrict its design activities to "interfaces" between modules, whether they are modules that will make up the CEV or any equivalent vehicle, or modules with which to complete the Space Station, or from which to assemble a lunar or Martian outpost. Interfaces are the Infrastructure. Let NASA concern itself with that. Such a foundation laid, business and industry rivalry will create the best options. NASA is to proud to let it self be relegated to such a role, failing to realize how important and future-enabling it would be.

Along with such "design infrastructure" goals, we need to create a legal groundwork that will favorably support, not cripple or stunt, business-industry initiatives on the Moon. This is about property rights and the right to develop resources.

Alas, the bulk of the space enthusiast community continues to wear horse-blinders as they cheer on what they think is a champion steed (but is only a mule). However, we can hope that business and industry will do its own thing regardless of NASA efforts to co-opt the future.

Keep the faith! PK

MMM #191 - December 2005

Dear Santa: a Moonbase Designed "to Work on Mars"

It's not about "what" we want! It's about "the best strategy" to get what we want!

It is sad to watch the continuing "debate trap" into which many devoted "Moon first" and "Mars first" true believers fall. For in truth, not only would either Moon or Martian settlement prove economically non-viable without each other as a trading partner, both face the very high likely-hood of being stillborn, if not summarily aborted, if either one is pursued alone.

Politics is the reality, and Collaboration the strategy.

Consider the track record. George W. Bush emasculated the International Space Station by summarily reducing its design manning from seven to three (it takes 2.5 crew man time just to maintain the facility.) Yet he boasts that we have a Space Station.

A Moonbase, designed and pursued as an end in itself, would most likely suffer a similar fate. Reduced manning. No capacity to pursue resource utilization (oxygen production, cast basalt, metal alloys, building materials, etc.) We'd be able to boast that we have a "permanent" outpost on the Moon. Congress would care little, so long as it did not cost any more.

But if the goal is to build a workable Mars Base and try it out on the Moon first, then guess what we'd have?

- **A life support system that went beyond umbilical cord style resupply, rescue, and repai**r, but had to work without relief for extended periods of time, two years or more. This most likely would involve a considerable greenhouse food-growing operation, something that could be easily dropped from a Moonbase-only program, given inevitable budget pressures.
- **A design that had to take "shieldability" into account** because the long stay times on Mars demanded such protection. On the Moon, in contrast, you could do without shielding if you rotated crews frequently enough.
- **A robust machine shop and repair facility** because, on Mars, one might have to fabricate a critical part if the last spare had been used.
- **Development of an adequate power system** not reliant on "eternal sunshine" which is something that would not be available on Mars. We might end up with a power system that would let us operate anywhere on the Moon, not just in the polar cul de sacs of "eternal sunshine."
- **Inclusion of a superior medical facility** that with aid of the latest computer software programs from Earth would allow treatment of almost any medial emergency. In a Moonbase-only operation, we'd have emergency transport back to Earth as a crutch to fall back on.
- **Faster development of expansion architectures that relied as much as possible on locally produced building materials, modules, and parts.** In a Moonbase-only operation, we'd continue to rely on shipment of made-on-Earth modules (hard hull, inflatable, or hybrid) and parts.
- **The living spaces would be more likely to include the perks and amenities needed to ensure sustained crew morale and productivity over yearlong plus stays.** In a Moonbase-only operation, we'd make do with submarine style living standards, or less. Such perks are an essential step towards the introduction of optional re-upping, signing up for continued stay duty - one small step on the road to the first "settler."

I am sure there are still more points to make!

The one thing that wannabe Lunans and wannabe Martians both don't seem to get, is that while Mars offers an atmosphere rich in oxygen, carbon, and nitrogen, plus a hydrosphere of unknown size, a more day-like rotation cycle, and other amenities, it remains initially a much harder nut to crack, because it lacks the one thing that the Moon offers: "location, location, location."

Ironically, however, that "location benefit" can and will serve as a crutch that will be used by bean counters and politicians to restrict full development of any "government" (national or multinational) outpost to the bare minimum to allow boasting that "we have one."

I write this article as a solitary individual, as editor of Moon Miners' Manifesto, not as President of Moon Society, many of whose members, and perhaps directors will be hard to move off previous turf-protective positions. But I counsel them to consider that it is in our best interests as advocates of lunar outposts, and resource-using settlements that on this point of posture towards the Bush Exploration Initiative, it is very much in our own best interests to ally ourselves with the well-articulated position of the Mars Society and standing side by side with them, work in unison for a Moonbase Designed for Mars.

It's not suicide. It's not a paradox. It's simply far and away the only strategy that makes sense. Now I suspect that younger readers and members (not old enough to have vividly remembered our retreat from the Moon at 8:42 p.m. EST on December 16, 1972) will disagree. But if you don't remember history, you are doomed to repeat it!

Let's not be fools. To one who lived through the Apollo era, the naiveté of many younger enthusiasts is both incredulous and discouraging. We must take the longer view, and that means playing our strategies to the hilt. **PK**

MMM #193 - March 2006

Where we're at & Where we need to go in Mars Exploration

The International Robotic Exploration of Mars has been in full swing now for several years. Every successive launch window, 25+ months apart, sees a number of new orbiters and/or lander/rovers sent out by NASA and ESA. The Japanese and Russians plan to get in/back in the fun.

While the twin rovers, Spirit & Opportunity are still hanging in there, sending back many thousands of fascinating pictures, their science is very, very local. The European Mars Express, and its bevy of instruments, however, have been revolutionizing how we see Mars. Mars was once wet, a looong time ago, and still retains some water ice reserves. Some of these are quite near the surface, shielded from sublimation by a thin layer of dust. Other reserves have been detected at some depth.

What has not been detected is the widespread presence of underground aquifers such as we find on Earth.

The implications of this are that we will have to be quite choosy where we decide to set down, so that accessing subsurface water-ice is not an improbable challenge. The mars Express instrument readings also seem to rule out present day sources of geothermal power. This is disappointing but hardly a surprise. The great Martian volcanoes seem to have been quiet now for billions of years. Get used to it: geothermal power won't be among our energy options.

A fleet of Mars Prospectors

There is much more to learn about Mars before we can rationally plan a manned landing mission, especially to a location where we intend to dig in for an indefinite stay:

- **Orbiter Probe to detect Subsurface Voids:** Conditions for the formation of Karst limestone caves do not seem to have ever existed on Mars. However, we would be stupefied if the vast Tharsis Uplift and great Martian shield volcanoes were not laced with lavatubes that could provide voluminous shelter for settlements, industrial parks, and warehousing.
- **Lander driller(s) to determine thermal flow** subsurface temperature gradient(s)
- **Chemical Prospector Orbiter to look for** all the elements needed to support an industrial civilization: Fe,Al,Ma,Ti,Na,K,P,Lb,Cu,Pl,Th, etc.
- **Data Mining Challenge for Earth based team:** define the drainage basins from existing MOLA data; highlight future rivers and lakes in a terraformed Mars, as well as logical transportation corridors.
- **Phobos-Deimos Prospector Mission** to analyze the chemical makeup of the surface regolith and any exposed bedrock on Phobos and Deimos. This is absolutely necessary if we are to determine the roles these two moonlets can play in bolstering the now weak Economic Case for Mars (realistic Export products that can competitively earn income for the settlements.)
- **Establish an Artificial Intelligence-run forward teleoperations base on Phobos** and/or Deimos to

allow tele-exploration of Global Mars in near real-time, without the absurd 6-40 minute time delays experienced in teleoperation of Spirit & Opportunity from Earth.

Evidently, we have quite a lot to do to prepare for an aggressive manned Mars Mission program. And it seems clear that with missions currently decided by Planetary Scientists who may be disinterested in a Manned Mars Program, that we will not get the type of orbiter and landing probes we need without aggressive agitation, going over the heads of the "specialists," if need be. Privately funded Mars Missions under the Planetary Society, may be our big hope.

The Planetary Society is at the top, when it comes to designing probes, or instruments to be added to them, that excite the public attention: e.g. the Mars Sundial, and the Mars Microphone. But NASA's abandoned "Kittyhawk" project to fly a drone plane over Valles Marineris should be revived as well. There is obviously room for organized activist input! In the strange absence of Mars Society initiative here, the Planetary Society may be our best hope.

The upshot is that while NASA/ESA are generally moving in the right direction, corrective inputs are much needed.

One can ask who is trying to do the same for the Moon. True activists launched the effort that Alan Binder would bring to conclusion: a probe that would find indications of water ice particles concentrated at the poles. That was the "and behind door #1*" (of the common perception that the Moon is no more than a rubble pile.) A similar effort that we might call "and behind door #2", an effort to get launched a probe that could detect any subsurface voids such as lavatubes that would serve as safe harbor from the scouring cosmic weather has failed. Perhaps such an instrument first flown over Mars could be reflown over the Moon. **PK**

The Gamble

"One doesn't discover new lands without consenting to lose sight of the shore for a very long time."

\- A. Gide

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MMM #194 - April 2006

"Information" Whets the Appetite for "Experience"

When I was in High School, in the early 1950s, the "future" was a time when all means of transportation and construction would be revolutionized. Cities would abandon street crossings at grade in favor of a maze of flying highway ramps. Monorail trains would cross the country in hours. Flying wing and flying saucer shape aircraft would dominate the skies. While in fact we have made advances in transportation, housing, and construction, 90 % of every-thing remains "old." a natural pattern that will always be the case unless wholesale obliteration by war or natural calamity intervenes. The point is, however, that the "future" of the "fifties" is not our present.

The real and unsuspected revolution has been in information technology, and while many space buffs remain fixated on rockets and rocket science, the real revolution in space has been in what we know about the universe. Information is the crest of the wave of time.

Certainly for the astronomer and planetary scientist and the large percentage of the public who follow each new planetary mission, the ongoing revolution in our picture of the solar system from the Sun out to the Oort cloud is one that continues to fascinate.

Some have stated that the most significant product of the Space Age is knowledge. I can well remember when all we know about the planets could be summed up in a page or two in a late 1940s "coffee table" book about "Nature." Now we know as much about little moonlets hundreds of millions of miles from Earth as we did then about Mars -- not much more than a table of statistics: diameter, axial tilt, orbit facts, length of day, etc. And we must admit that some of what we thought we knew back then was not just sketchy, it was dead wrong. Venus is the classic example.

Some would sum up the products we can expect from space as "zero mass imports."

Information, information relays, information storage.

But we must beg to differ. When has it not been so that information whetted the appetite for experience? The more we know about these strange worlds, many of them only recently discovered, the more we want to go see and experience their alien horizons and landscapes for ourselves. And if we can't go ourselves, we want to see pictures taken by human eyes that could go.

Tourism is in many countries among the top five industries in terms of expenditures. In quite a few countries, it is number one. Space tourism? It may be for the jet setters, at first, but the sustainable market for extreme and off-the-beaten-path adventures is a clear indication that the time will come when many people will be able to go beyond Earth's shores, with careful income and savings planning. "The trip of a Lifetime" is a dream that a growing number of people hold up as a goal.

How far can this go? Suborbital hops will only work to increase the demand for affordable orbital excursions and for ever more orbital hotel/resort complexes. It may be a while before LEO has the same siren effect as Las Vegas, but I would not bet on it being more than a generation away at most. Meanwhile the advance guard of the wealthy and those not-so-wealthy that have planned well will be taking loop-the-Moon non-landing tours.

As destinations go, the Moon has the most important three attributes: **location, location. location**. In comparison to the Moon, a trip to Mars is like a climb up Mt. Everest compared to a weekend trip to the beach – a much larger commitment of time, money, and preparation .

For a while, those seeking experiences will push lunar development: places to go and things to do on the Moon. The virtual reality people will dominate the market for translunar experiences. VR itineraries will be available for many areas of Mars, compiled by robot rovers, and a scattering of human pioneers. Rover compiled data will be turned into Virtual Reality tours of ever more distant and hostile worlds. Even with the introduction of nuclear thermal rockets, a round-trip sightseeing excursion to Mars or to the cloud tops of Venus will eat up a year or more of a tourist's life. But there will be those who will take the plunge. For some, there will be little to put "in order" before embarking on such a venture. Explorers and adventurers in the past often said there goodbyes for months and years at a time. Those times will return.

We don't mean to imply that information and experience are the only two realistic products from space. But it may well be that the latter leads to most of the others, including the development of local resources wherever tourists want to go bad enough. We can foresee a very varied line of exports from the Moon, especially to other markets in space such as low Earth orbit industrial parks and tourist oases, settlements on Mars, expeditions bound for the asteroid belt and beyond. But for other worlds, including Mars, building a viable economic scenario that involves trade is an uphill venture. How we will do that, is far from clear; though some clearly "have the faith" if nothing else to go on.

From Earth it pays only to send people, tools, and seeds. It's steep gravity well, so steep, that there will be strong enough incentive to source all other needs locally or elsewhere in space. And that trade, in quite a few things besides "information," is what will develop the human economy from an Earth bound one, into an Earth-Moon one, and finally into a Solar System economy and civilization.

At least, that's how the "future" looks from here, fifty-some years later. **PK**

MMM #195 – May 2006

Worrisome Bumps on the Roadway Back to the Moon

The Return to the Moon program is currently on hold. It appears that the NASA-preferred shuttle-system-derived CEV (Crew Exploration Vehicle) will not have the throw weight needed to enable it to carry to the Lunar south pole the downsized components of what is unflatteringly called "Apollo on Steroids." That leaves three options:

a. Go easy on the steroids and deploy an even more humble "Apollo upgrade"

b. Abandon the south polar site and head for the Moon's equator (in our opinion, that has merit.)

c. Go back to the drawing boards, i.e. "listen" to the private enterprise contractors with minds open, not closed.

What NASA will do, and what it should do are two different things. In our opinion, NASA cannot think outside the cultural fishbowl it has been in for decades. The agency cannot switch paradigms, even under orders from the President and the Aldridge Commission.

Meanwhile, NASA "talks the talk" about needing to rely on local lunar resources to support the outpost and the need to find ways to make money by operating on the Moon. But that will take delivering more equipment and weight to the Moon than the current CEV architecture can support. The result? NASA can't "walk the walk."

First, for transport, we need a family of vehicles with a whole range of lift capacities, from less than a ton to hundreds of tons. At the top end of this range, a Shuttle-derived heavy lifter is a must.

As to the rest, we suggested in MMM # 174, April 2204 "In Focus: Crew Exploration Vehicle Modularity Brings Opportunities" that NASA confine its role to identifying and defining the interfaces between modules, and let the private enterprise contractors compete for the best module for each stage or position in the CEV assembly. This plan would confine NASA to its proper role, allowing private enterprise to blossom into the vacuum so created.

The Administration has not given firm guidance, beyond enterprise-touting platitudes that leave too much escape room for an Agency that wants to do what it is used to doing. That is to be expected and natural. Change, real change, sometimes has to be forced down the throat.

We are kidding ourself anyway. Can't have both endless war and space both. It is difficult to believe that the cancellation of the present "vision" is not just a matter of time because we have gone too heavily into war-debt.

But we need to agitate to have the administration force needed cultural changes on NASA. To the agency's credit, it has been looking for new technologies and inputs, through the Centennial Challenge and by other means. On this topic, we have suggested before, ad nauseam perhaps, that NASA award "Spin-up" prize incentives to identify technologies needed on the Moon (and Mars) and to predevelop them for any potentially profitable terrestrial applications. This is a process which would give entrepreneurs near-term return on investment for putting needed technologies "on the shelf" for when they are needed, paid for by you and me not as involuntary taxpayers but as voluntary consumers.

In our opinion, this is the only way we will ever have the technologies needed to stay on the Moon, and to expand towards settlement. Anyone who thinks that NASA will be funded by Congress for these "extras" has to be living in a fantasy land. Four decades of Congressional micro-management and forced cutbacks, downgrades, stretch-outs, and cancellations should have taught us something. Yet some enthusiasts seem to be living in a fairytale world.

We have to change the rules of the game! As long as NASA is the player, the meta-contractor, it is difficult for industry to compete on a level playing field, and in fact, industry is demotivated in such a game.

Bit what has happened was foreordained by the Administration itself. How? By doing something demanded by the space enthusiast community - setting a date, a timetable, a deadline for a return to the Moon and for the deployment of a "permanent" outpost. Now that's an outrageous assertion, you may object. But by setting a deadline, the Administration put NASA in a position where the only way it could guarantee meeting the deadline was to depend only upon itself and not wait upon the mechanisms of free enterprise to produce the needed components. The party made responsible is de facto given the authority.

So in last analysis, we have only ourselves to blame. Our impatience, made quite clear to the Administration, set the stage. We cannot have it both ways, reliance on free enterprise and hard and fast deadlines. Impatience is the root of all failure, whether it comes swiftly, or belatedly.

Patience requires a step by step approach, a first things first approach, "terracing." What ever did happen to "terracing"? That's a road paved by private enterprise where the profitability of one step lays the groundwork for the next. Enterprise is a world neither bureaucracy or academia understands. There is a cultural divide. What most of us mean by private enterprise and what NASA or academia means by it is a case of apples, oranges, and pears.

If all three must work together to move humanity out into the solar system, it is enterprise that must call the shots. We ourselves may be too caught up in the paradigm of a national, socialized space

program to understand this. Our role? We must control as free consumers, not as obliged taxpayers. There is an enormous difference. PK

The merits of being "unreasonable"

A reasonable man adapts himself to the conditions that surround him.
An unreasonable man adapts the surrounding conditions to himself.
A**ll progress depends on the unreasonable man.** – George Bernard Shaw

MMM #201 – December 2006

MMM's 20th Anniversary Issue: Inspiration Sources

A Tale of Two Origins:

I: The Moon as a Challenge

In the late 1970's the editor was already a life member of the National Space Institute, since 1974, and of the L5 Society, since 1977 0r 78. I decided that I would try to write an alternative history novel of "where we could be now (then) if we had not retreated from the Moon with the liftoff of the Apollo 17 Challenger LEM on December 17, 1992.

Surely, I thought, we'd be on Mars or headed that way. Believe it or not, I was a "Mars man" back then. But we'd had have to have "done the Moon" first. So I began trying to figure out how we would "do the Moon." Here we

have what appears to be a round rubble pile, lacking in many elements we are used to having in great abundance, not just as traces. I became hooked by the challenge.

That the Moon is deficient in key elements is not an issue. I began to see the Moon as the Japan of the solar system -- Japan, at the start of the Industrial Age found itself in a similar position. It turns out that natural resources are not the key. Human resources of creativity, resourcefulness, enterprise and determination are!

I began to brainstorm how we would substitute for wood, paper, plastics, and many other things. I was soon thoroughly hooked on the "Lunar Challenge."

This brainstorming soon gave birth to a deep conviction that pioneers would learn to make themselves "at home on the Moon" and be able to support a growing economy based first on local import-substitutes and on exports to a growing off-Earth economy including facilities in Low Earth Orbit: research, industrial, and tourist installations in the "suborbs" of Earth.

II. Then one Sunday morning in May. 1985

Eureka moments happen only for those who are prepared to receive it. I was looking through the Home section of the Sunday Milwaukee Journal and my eye was caught by an ad about a "unique" underground home that was be open for tours 20-some miles NW of where I lived. I got in my car and headed out to see "TerraLux" - Earth-Light. Prior to this day, I had accepted that future Lunans would live like moles, in underground warrens as Robert A. Heinlein described them in his classic science fiction novel, "The Moon is a Harsh Mistress." Life underground would be protected from harsh cosmic weather, meteorite impacts and thermal extremes.

But here was a home, unlike the usual "Earth-sheltered" homes of the period, without an exposed southern exposure window wall for thermal input. It was all underground, with access through a partially exposed garage. But enter, and wow! The home was flooded with sunlight, and in every wall was a picture window showing the beautiful Kettle Moraine glacial countryside without. You can read about this in "M is for Mole," **MMM #1**, online at:

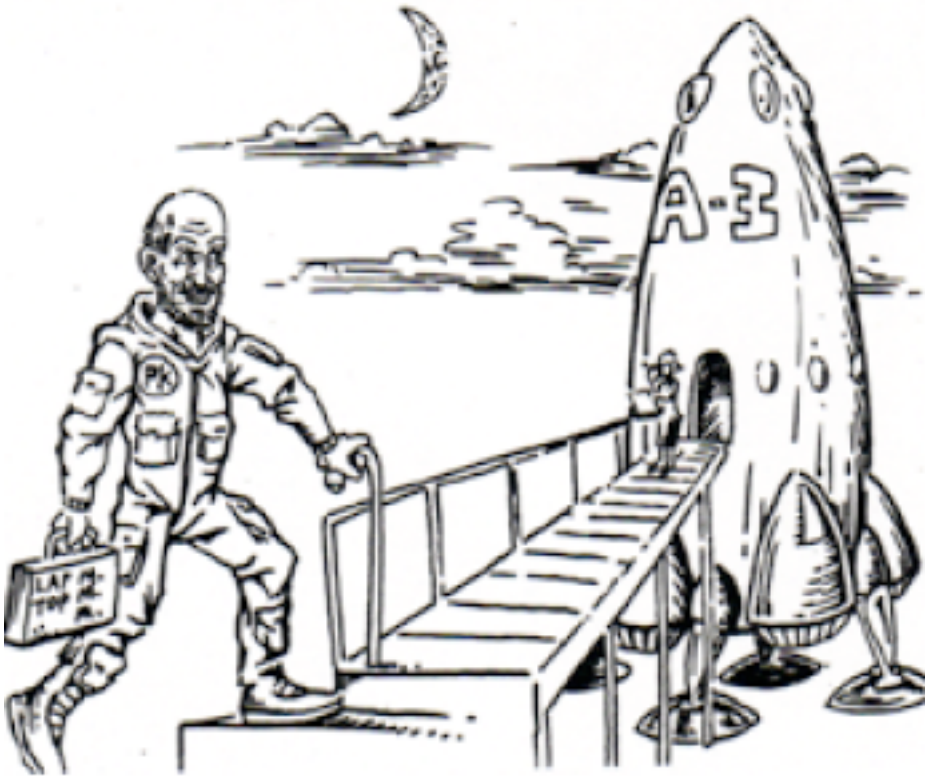
http://www.moonsociety.org/chapters/milwaukee/mmm/mmm_1.html

This article is also reprinted in MMM Classics #1
http://www.lunar-reclamation.org/mmm_classics/

Left: TerraLux exterior Right: Our Lunar Homestead Model (on a 36"x80" door frame

Well, the long and the short of it is that I never wrote the novel, but all the research I had done to show just how we could rise to the Challenge of the Moon would find its way into articles in Moon Miners' Manifesto illustrating how pioneers would live and thrive on the Moon, and become "at home" there. Sixteen months after the "Eureka" experience at TerraLux, a team of L5 Society "colonizers" from Chicago and the Twin Cities descended upon Milwaukee to talk to at large L5 members in the area, and the rest is history. These two beginnings are still "powering" MMM, and the Lunar Reclamation Society.

We have every intention of keeping on going. PK



Cartoon by Dennis Cripps shows the MMM Editor boarding a Moon Ship for Luna City (intending to discontinue MMM and to launch "The Mother Moon .News" instead

(While Dennis did insightfully predict that we would have slimmed down to our High School graduation weight, we've missed that 10th anniversary date by going on 2 extra decades.)

Here it is, December 3, 2012, LRS and MMM will be celebrating our 26th anniversary at our annual holiday party in a few days, and the only way we are going to get to the Moon in time to publish #301 from Luna City, is aboard an alien UFO!

But it feels good, in the interim, to have completed archiving all the timeless articles from the first fourteen years. It continues to be a very rewarding blast! Peter Kokh

Beyond Our First Moonbase:
The Future of Human Presence on the Moon

By Peter Kokh, Editor: Moon Miners' Manifesto, President: The Moon Society – kokhmmm@aol.com
[Reprinted with permission, from

The Moon: Resources, Future Development and Settlement

By David Schrunk, Burton Sharpe, Connie Cooper and Madhu Thangavelu,

in which book it appeared as Appendix T.

Beginnings

If all goes as planned, U.S. budget crises notwithstanding, mankind's first outpost on the Moon will start to become real around 2020, a historic event, that were it not for politics, might have happened decades earlier.

The vision outlined in **The Moon: Resources, Future Development and Settlement** is a bold one, showing how we could set up our first outpost so that it would become the nucleus from which human presence would spread across the face of the Moon.

NASA itself has such a vision, but the agency can only do what it is authorized to do. If the history of the International Space Station offers clues, NASA's official goal, which only includes setting up a first limited outpost as a training ground for manned Mars exploration and nothing more, will be under increasing budgetary pressures to slim down into something with no potential for growth at all. The intended crew size, the planned physical plant, and the capabilities that are supported, will all be tempting "fat" for budget cutters who cannot see, or appreciate, the possibilities beyond. This is the risk of publicly supported endeavors in space. It is difficult to get political leaders, and the public itself, to look beyond very near future goals. The chances that our first outpost will be born sterile cannot be dismissed.

But if private enterprise is involved and ready to take over when and where NASA's hands are tied, there could be a bright future for us on the Moon. Much of that promise may involve finding practical ways to leverage lunar resources to alleviate Earth's two most stubborn and intertwined problems: generating abundant clean power, and reversing the destructive pressures of human civilization on Earth's environmental heritage

Cradlebreak: early lunar building materials

The Moon has enormous resources on which to build a technological civilization. But first things first. How can we break out of a first limited-vision outpost? A humble start can be made by demonstrating the easier, simpler ways to start lessening the outpost's heavy dependence on Earth. Oxygen production comes first. Close behind is hydrogen harvesting, whether from lunar polar ice deposits or from solar wind gas particles found in the loose regolith blanket everywhere on the Moon.

If we have access to basalt soils in the frozen lava floods of the maria, we can cast this material into many useful products. Not the least of those are pipes, sluices, and other components of regolith handling systems: cast basalt is abrasion-resistant. If we expand the outpost with inflatable modules shipped from Earth at significant savings in weight per usable volume over hard-hull modules, we can use cast basalt products, including floor tiles and tabletops to help outfit these elbowroom spaces. We can learn from a thriving cast basalt industry on Earth.

Experiments done on Earth with lunar simulant, of similar chemical and physical composition to lunar regolith, then repeated with precious Apollo moondust samples, give us confidence that concrete and glass composites will be very important in any future construction and manufacturing activity on the Moon. We could make additional pressurizable modules from fiberglass reinforced concrete or glass composites. We can make spars for space frames and many other products out of these composites as well. The Moon's abundant silicon will allow us to make inexpensive solar panels for generating power. Production of usable metal alloys will come later. The Moon is rich in the four "engineering metals:" iron (steel), aluminum, titanium, and magnesium

An Industrial Diversification Strategy with maximum potential for cutting dependence on Earth imports: The name of the game is Industrial "MUS/CLE."

MUS: If we concentrate on producing on the Moon things that are **Massive,** yet **Simple,** or small but needed in great numbers (Unitary) so as to provide the major combined tonnage of our domestic needs, we will make significant progress towards lessening the total tonnage of items needed from Earth to support the expansion effort.

CLE: Until we can learn to make them ourselves, we continue to import the **Complex, Lightweight,** and **Electronic** items we also need, but which together mass to much less. It would be very

helpful to the success of such a strategy, to design everything needed on the Moon as a pair of subassemblies, the MUS assembly to be manufactured locally, and the CLE assembly to be manufactured and shipped from Earth, both being mated on the Moon.

Simple examples are a TV set: works manufactured on Earth, cabinet on the Moon; a metal lathe built on Earth, its heavy table mount manufactured on the Moon; steel pipe and conduit on the Moon, all the fittings and connectors from Earth. You get the idea.

As the population of pioneers and settlers grows, and our industrial capacity becomes more sophisticated and diversified, we can assume self-manufacturing of many of those items as well. Making clear and steady progress in assuming an every greater share of self-manufacturing physical needs is essential if we are going to encourage both continued governmental support and attract every greater participation by private enterprise

Paying for the things we must import

Seeing that Earth seems rather self-sufficient, and products from the Moon would be expensive, many writers have concentrated on trying to identify "zero mass products" such as energy, to provide the lunar settlements with export earnings. The need for exports is indeed vital. As long as the settlement effort must still be subsidized from Earth, there will always be the risk of unrelated budgetary pressures on Earth fueling support for those who would pull the plug on lunar operations.

Thus it is vital that settlers develop products for export to help them pay for what they must still import. Only when we reach import-export parity, will the lunar settlement have earned "permanence." Permanence can't be simply declared. Tagging NASA's first moonbase as "a permanent presence on the Moon" is in itself just so much empty bravado. If we do not begin developing and using lunar resources seriously and aggressively, the effort will fail of its own costly weight.

Now here is the point where many will balk. Yes, there are grandiose plans to use lunar resources to build giant solar power satellites in geosynchronous orbit about the Earth, or to build giant solar farms on both the east and west limbs of the Moon to beam power directly to Earth, and/or to harvest precious Helium-3 from the lunar topsoil or regolith blanket, a gift of the solar wind buffeting the Moon incessantly for billions of years, the ideal fuel for nuclear fusion plants. But none of these schemes will materialize right away. Meanwhile what do we do? Cannot anything the Moon might manufacture to ship to Earth be made less expensively here at home? No!

But that does not matter. Earth itself is not the market. Developing alongside of an upstart settlement on the Moon will be tourist facilities in Earth orbit. And that is something the lunar settlement effort can support. Anything future Lunan pioneers can make for themselves, no matter how unsophisticated in comparison with the vast variety of terrestrially produced alternatives, can ge shipped to low Earth orbit at a fraction of the cost that functionally similar products made on Earth can be shipped up to orbit. It is not the distance that matters, but the depth of the gravity well that must be climbed. It will take one twentieth of the fuel cost to ship a set of table and chairs, a bed frame, interior wall components, floor tiles, even water and food, from the Moon, 240,000 miles away, than from Earth's surface, 150 miles below.

Thus, in the near term, the future of Lunar Settlement will be closely tied to the development of tourist facilities, hotels, casinos, gyms, etc. in orbit. This sort of development will start to bloom about the same time as a lunar settlement effort starts to break out of an initial limited moonbase egg. But the linkage will become visible much earlier: it is very likely, that the first space tourist will loop-the-Moon, without landing, before the first astronaut since Apollo 17 in 1972 sets foot on the Moon.

The Russians say that they can provide such a tourist experience, skimming low over the Moon's mysterious farside, in just two years after someone plunks down $100 million. That will indeed happen, and it will create a benchmark that others will want to follow, inevitably brining the price down for a ride to an orbiting resort.

The Moon from a Settler's Point of View

Magnificent Desolation? Yes. Harsh and unforgiving? That too! Alien and hostile? Of course! It has always been so from the time our ancestors on the plains of East Africa started pushing ever further into unfamiliar lands: the lush, dense jungles, the hot dry deserts, waters too wide to swim, high mountain ranges, and eventually, the arctic tundra. Judged by the pool of past experience, each new frontier was hostile, unforgiving, and fraught with mortal dangers ... until we settled it anyway.

Once we learned how to use unfamiliar resources in place of those left behind, once we learned how to cope with any new dangers, as if by "second nature," then the new frontier becomes as much

home as places we left behind. Anyone raised in a tropical rain forest, suddenly transported to Alaska's north slopes, might soon perish, unable to cope. The Eskimo never gives it a second thought. How to cope with ice, cold, the arctic wildlife, the absence of lush plant life, has become second nature.

And future Lunans will reach that point as well. Yes there is sure suffocation outside the airlock. Yes the sun shines hot and relentlessly with no relief from clouds for two weeks on end. Yes the Sun stays "set" for two weeks at a time while surface temperatures plunge. Yes the moon dust insinuates itself everywhere. The litany goes on and on. Lunans will learn to take it all in stride. How to take due precautions for each of these potential fatal conditions will have become culturally ingrained 2nd nature. The Moon will become a promised land to Lunans.

Making ourselves at Home

Even in the first lunar outpost, crew members could bring rock inside the habitat as adornment in itself, or perhaps carve one into an artifact. An early cast basalt industry, early metal alloys industries, early lunar farming, will all supply materials out of which to create things to personalize private and common spaces alike. Learning to do arts and crafts on the Moon may seem useless and irrelevant to some, but it will be the first humble start of learning to make the Moon "home." And so it has been on every frontier humans have settled.

We will also learn to schedule our activities and recreation in tune with the Moon's own rhythms. We'll do the more energy-intensive things during dayspan, the more energy-light, manpower-intensive things saved for nightspan. With no real seasons, the monthly dayspan-nightspan rhythm will dominate. The pioneers may bring some holidays with them, but will originate other festivities and both monthly and annual celebrations.

Getting used to lunar gravity will also help the pioneers settle in. They will quickly abandon trying to adapt familiar terrestrial sports, which can only be caricatures of the games of Earth. Instead, they will invent new sports that play to the 1/6th gravity and traction, while momentum and impact remain universally standard. Alongside the development of lunar sports will be forms of dance. Can you imagine how ethereal a performance of Swan Lake would be on the Moon? How many loops could an ice-skater do before finally landing on the ice?

But they have to live underground!

On Earth, our atmosphere serves as a blanket which protects us from the vagaries of cosmic weather: cosmic rays, solar flares, micrometeorite storms. If our atmosphere were to "freeze out" it would cover the Earth with a blanket of nitrogen and oxygen snow about 15 feet thick, and still provide the same protections.

On the Moon, eons of micrometeorite bombardment have pulverized the surface and continue to garden it into a blanket of dust and rock bits 10-50 feet thick. Tucking our pressurized outpost under such a blanket, will provide the same protection, along with insulation from the thermal extremes of dayspan and nightspan.

Will our outposts look like somewhat orderly mazes of molehills? To some extent, perhaps; but the important thing is that we do not have to live as moles. We have ways to bring the sunshine and the views down under the blanket with us. In the spring of 1985, I had the opportunity to tour a very unique Earth- sheltered home 20-some miles northwest of Milwaukee where I live. Unlike typical earth-sheltered homes of the period, TerraLux (EarthLight) did not have a glass wall southern exposure. Instead, large mirror faceted cowls followed the sun across the sky and poured sunlight inside via mirror-tiled yard wide tubes through an eight-foot thick soil overburden. Periscopic picture windows provided beautiful views of the Kettle Moraine countryside all around. I had never been in a house so open to the outdoors, so filled with sunlight, as this underground one. At once I thought of lunar pioneers, and how they could make themselves quite cozy amidst their forbidding, unforgiving magnificent desolation. The point: yes, the Moon is a place very alien to our everyday experience. Nonetheless, human ingenuity will find a way to make it "home."

What about us outdoorsmen?

While Lunans will find plenty do do within their pressurized homes, workplaces, and commons areas, many will miss the pleasures of outdoors life on Earth. Fishing, swimming, hunting, boating, flying, hiking and mountain climbing and caving. The list goes on and on.

Yet some of these pleasures we may be able to recreate indoors, fishing in trout streams, for example. We will want an abundant supply of water, and waste water in the process of being purified

can provide small waterfalls and fountains, even trout streams for fishing and boating. In large high ceiling enclosures, humans may finally be able to fly with artificial wings, as Icarus tried to do.

Out-vac, out on the vacuum washed surface, it will be more of a challenge. Present space suits are too cumbersome, too clumsy. We need suits that offer more freedom of motion, that tire us less easily. Then out-vac hiking, motor-biking, mountain climbing, and caving in lavatubes will become practical. Out-vac sporting events, rallies, races, and games will follow. As we learn to take the Moon's conditions for granted, and to "play to them," we'll invent sporting activities that suit the environment.

Agriculture and mini-biospheres

The idea of going to the Moon with sterile tin cans and a life-support system tucked in a closet with a few token house plants thrown in for good luck is absurd. As it happens, NASA has abandoned "Advanced Life Support." Instead we have to approach creation of living space on the Moon as a mating of modular architecture with "modular biospherics." Every pressurized module should have a biosphere component, so the two, living space, and life in that space, grow a pace, hand in hand. The clues are not in the organic chemistry labs but in the many down to earth "back to earth" experiments thriving on Earth as we speak. Earth life must host us on the Moon even as it does on Earth, not vice versa. Lunar settlements will be "green" to the core. And we will feel at home.

One settlement, a world "doth not make"

The Moon's resources are not homogeneously situated. A site handy to polar ice reserves will not be near mare basalts, nor iron and titanium rich ilmenite, nor vast underground caves formed long ago bu running lava. As the lunar economy expands, we will need to establish settlements in a number of differently advantaged areas. And that will make the Moon a real "world." Lunans will be able to travel elsewhere, get away from it all, experience cultural, artistic, archeological, and climate variations. Even as an outpost cannot be "declared" permanent, neither can a solitary settlement. No matter where we choose to set up shop first, we need a global vision. The authors have this vision, and their brilliant concept of a lunar railroad network illustrates that well.

Getting through the Nightspan

To many people spoiled by abundant energy "on demand," the need to store up enough energy during the two week long dayspan to allow the outpost to not just survive the nightspan, but to remain productive is daunting. Yet all of human progress is built on utilizing various forms of power storage, starting with firewood. Even in nature, the spread and survival of species has turned on this point, from bear fat to squirreling away nuts. The problem is one of attitude. Those with the right attitude will find a way, many ways in fact. The same goes for managing the thermal differences between lunar high noon and predawn. Since we first began to move out of our African homeworld to settle the planets of Eurasia and the Americas, we have tackled harder problems. Those not intimidated by the challenge will lead the way.

The pattern emerges

Lunan pioneers will make progress in all these areas together: providing the bulk of their material needs by mastering lunar resources; becoming ever more at home through lunar-appropriate arts, crafts, sports, and hobbies; creating a uniquely Lunan culture. This process must start immediately. The first outpost should be designed to encourage, not discourage experimentation by those with the urge to create and fabricate with local materials. Things shipped from Earth should be designed and manufactured in MUS/CLE fashion, so that their simpler and more massive components, made on Earth can be replaced with parts made on the Moon, freeing up the original parts for reuse. Parts made here of elements hard to produce on the Moon, like copper or thermoplastics, will help spur infant lunar industry at a quicker pace.

The Necessary Gamble

It is predictable that NASA, however free the life styles of its individual employees, will continue to take a conservative stance on fraternization between outpost personnel. It is predictable that there will be an absolute ban on pregnancies. Yet, this is something that cannot be conveniently postponed. The only way to know for sure if infants born on the Moon will turn out to be healthy, is to see how the second native born generation turns out. Will they be fertile? Experiments with animals with much shorter life cycles will give us debatable clues. There is but one way to find out for sure. Do it! Take the plunge.

Official policy may be quite strict and allow no exceptions. But then individuals will take matters into their own hands. Confidence in this outcome will grow, if there are for-profit commercial outposts on the Moon.

As long as we play the "outpost game," and that is what it is, of rotating crews with short tours of duty, as long as we avoid allowing people to choose to live out their lives on the Moon, raising families, as nature dictates, we will not see the rise of a lunar civilization, nor real use of lunar resources to help solve Earth's stubborn energy and environ-mental needs in sustainable fashion. Human choices must be taken out of the hands of politicians and administrators afraid of conservative opinion. Nations may build outposts, but only people pursuing personal and economic goals can give us settlement. If history is any guide that is exactly what will happen.

outposts are a dead-end paradigms no real use of local resources, no economic activity, no real society. For the Moon, we see instead, a real human frontier in which an initial small outpost will seed a self-supporting frontier of hundreds of thousands of pioneers in a number of settlements. Many of these Lunans will be native born, others fresh recruits from Earth seeking the promise of starting over, starting fresh, getting in on the bottom floor. Throughout history, those doing well stayed put. Frontiers have always been pioneered by the talented but "second best" seeking a more open future.

The Moon will become a human world. <**PK**>

"All men dream, but not equally.
Those who dream by night in the dusty recesses of their minds wake in the day to find that their dreams were just vanity.
But the dreamers of the day are dangerous men,
for they may act out their dreams with open eyes
...making what they dream possible."
- T.E. Lawrence

MMM #203 - March 2007

NASA Moon Plan gets an "F" as "Preparation for Mars"

In our MMM #191 DEC. 2005 editorial, "Dear Santa: a Moonbase made for Mars," we pointed out that if NASA's goal is to build a workable Mars Base and try it out on the Moon first, we would get several things advantageous to a moonbase that we might not get otherwise:

- A life support system that went beyond umbilical cord style resupply, rescue, and repair, but had to work without relief for extended periods of time, two years or more. This most likely would involve a considerable greenhouse food-growing operation, a system that could be easily dropped from a Moonbase-only program, given inevitable budget pressures.
- A design that had to take "shieldability" into account because the long stay times on Mars will demand such protection. On the Moon, in contrast, you could do without shielding if you rotated crews frequently enough.
- A robust machine shop and repair facility, because on Mars, one might have to fabricate a critical part if the last spare had been used.
- Development of an adequate power system not reliant on "eternal sunshine" which is something that would not be available on Mars. We might end up with a power system that would let us operate anywhere on the Moon, not just in the misnamed polar cul de sacs of "eternal sunshine."

Unfortunately, NASA seems to have dropped the ball on at least some of these considerations. NASA has zeroed out the budget for all further advanced (biologically based) Life Support Systems, shutting down both the BioPlex at Johnson Space Center in Houston and the NSCORT project at Purdue. To save money in the classical penny-wise pound-foolish manner,

NASA will rely on just in time supplies of oxygen and water to the Moonbase, just as it does to ISS. Only in the latter case, the Russians are there to come to the rescue when NASA is grounded. This decision makes it unlikely that a Moonbase will be staffed indefinitely without short or long interrup-

tions. We all know that the "penny wise, pound foolish" approach is sheer stupidity. Of course, we can always blame it on the financial black hole otherwise known as the war in Iraq.

Some NASA moonbase designs show a modular ranch-style horizontal layout. But other mock-ups show the highly vertical, difficult to shield, Zubrinesque double tuna-can, in which at best, "sand-bags" will be placed on top, is if the only direction of incoming radiation was from the Zenith. We are only at the paper stage as of now, so NASA may yet adopt the easier to shield horizontal approach. We predict NASA will take the cheapest "out," no matter what the consequences downstream.

No indications of a machine shop, repair facility, fabrication shop yet. We'll have to wait and see.

NASA seems determined to take the easiest way out in developing a lunar power system. and that means that the agency probably will not predevelop a nuclear power plant for Mars to pretest on the Moon. Is all this necessarily bad for Moon-buffs? We think so, but would be happy to be proven wrong.

1. That NASA has decided that the moonbase will not pretest systems intended for Mars, will cost Moon supporters what support we had from the more thoughtful fraction of the Mars-enthusiast community. This "predesigned for use on Mars" formula was something Zubrin insisted upon to earn his concessionary support for prior moonbase deployment. NASA having reneged, the cautious support of Zubrin and other Mars supporters has evaporated, probably for good. I think that is sad. As I pointed out in last month's issue, on the face of it, Moon-supporters and Mars-supporters have many reasons to be allies.
2. This means that it is up to the Moon Society and private enterprise to push the development of practical biospheric life support solutions. This is not all bad, as I strongly feel that NASA was taking the wrong track. Biospheric life support should be modular, growing apace with the modular physical settlement complex. The private enterprise/academia success with the Antarctic South Pole Station Food growth Chamber is something to cheer about and pursue further.
3. Whether or not NASA includes an adequate workshop and fabrication shop in its moonbase plans, we should include one in our Lunar Analog Research Station designs, following the lead of the Calgary Space Workers.
4. The Moon Society should also push and promote research and development of robust power storage systems adequate to manage the two week long nightspan solar power drought on the Moon. This will allow us to set up shop wherever on the Moon it makes sense to do so on resource utilization grounds. Lunar industrialization is necessary if the Moon is to play its destined role in helping solve Earth's heretofore intractable and intertwined energy production and environmental degradation problems.
5. Passing the R&D torch to private enterprise and nongovernment funded societies and institutions is the only way to sidestep what it is becoming increasingly clear will be only a gestural NASA- led presence on the Moon. We will be there, in the sense that Kilroy was - if that means nothing to younger readers, don't worry about it. Baby Boomers and older persons get the allusion.

Unfortunately, there seems to be no way to insulate NASA projects or any other worthy government endeavors from the financial Katrina we are now experiencing currently and into the forseeable future. On paper, the world economy is booming. In reality, accumulating debts are outpacing accumulating assets, and to this observer, it looks very much like a house of cards.

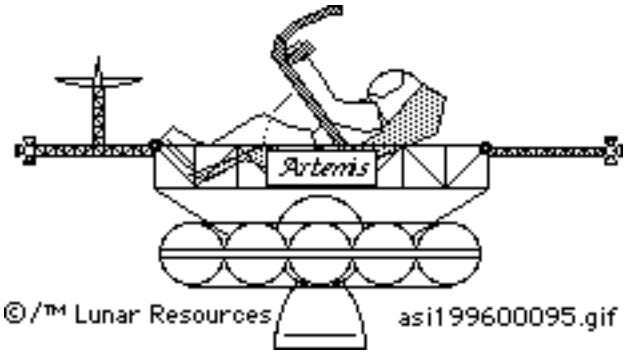
However, what is happening now in the private sector, especially with the COTS initiative, promises the development of private launch systems which could easily scale up to "do the Moon." On that silver lining note, we bring this discussion to a pregnant pause. PK,

MMM #209 - October 2007

Moon Lander & Base Design Concepts & Artemis Project™ Influence

Above: Moon lander concept in AIAA.02.20.07.pdf, John Connally, NASA Lunar Lander Office, www.nasawatch.com

In the NASA Lunar Lander Office concepts study cited above, we were struck by a number of features which, if not borrowed wholesale, seemed to show some brainstorming evolution from ideas first floated in the Artemis Project™ Reference Mission. Indeed, NASA has been aware of the ASI Project since the mid-1990s.



Minimizing the ascent vehicle mass in this way allowed the delivery to the Moon's surface of a habitat structure significantly more spacious than the cabin of the Apollo Lunar Module. The "Artemis™ triple SpaceHab would have 5 times the volume of the Apollo LM.

Following this inspiration, the NASA Lunar Lander Office is also seeking to minimize the ascent vehicle, but in a less risqué fashion. The astronauts would return in an airlock, much smaller than the Apollo ascent stage.

I asked Artemis Project™ founder and chief architect Greg Bennett about this: his reply on 09/30/2007:

"That design for the Ascent Stage was all my fault. I reviewed it with Bob Overmyer (who was a retired Shuttle commander at the time, one of the MOL astronauts) and Bob showed it several of the other pilots. They said they'd volunteer to go on the mission just to be able to fly that thing! :)

"This week I saw another Artemisian philosophy heavily propounded by NASA: Leave the lunar transfer vehicle (Orion) on its own in lunar orbit and have the entire crew go to the surface. That's a page right out of the Artemis Data Book! It's very gratifying to think that the Artemis Project work might be having a positive effect on the new lunar missions!" - GRB

Undoubtedly, many members who have been with us since the Artemis Project™ days of the mid-late 1990s may have thought that all this brainstorming on our part had proved to be so much ado about nothing. Not so! Watch the Constellation/Orion Moon Lander Video

www.nasa.gov/externalflash/cev/index_noaccess.html

NASA has adopted the spirit of what we were trying to do, but as always, reinventing everything and making it its own, as it should. Just take a look at the crew module atop the Lunar Lander as depicted on our front page NASA artwork. It is big, very big, in comparison to the cramped Apollo LM cabin. According to the NASA study, this cabin will carry a crew of 4 and provide support for 7 days. It has an airlock, not a mere hatch (which involved venting the cabin when opened.) As to volume comparisons, this says it all:

Apollo Lunar Module	6.65m3= 235 cu ft
Lunar Surface Access Module (LSAM)	31.8m3=1123 cu ft

That is a volume (and comfort) increase of 478% or nearly five times, just what we were looking at. Nor is this an isolated instance. Many concepts originated by us "enthusiasts" have influenced current NASA thinking. Let's be aware, and be proud, and keep up the work! - PK

MMM #211 - December 2007

Easing NASA out of the Space Transportation Business

The very word "business" would seem to say it all. Business is for business, not for a government agency. The status quo has precedent however: "Amtrak." But in that case, we had reached a time when

the various railroads no longer found passenger service profitable. Without the creation of Amtrak, passenger rail would have disappeared in the United States, at least for a while. Now, new private railroads have arisen, engaged in specialty tourist excursions, both in the U.S. and Canada.

That there was reason for NASA to get into the business of space transportation as well as, and beyond the business of space exploration, does not mean that this situation should not be reexamined. The way NASA does business has guaranteed that "space transportation" will be terribly expensive. As an agency that must answer to the public, NASA must of necessity be very risk averse, simply because the public at large has become so, the pioneer spirit of Americans having largely evaporated through prolonged prosperity à la Rome. In other areas of great engineering endeavor, that there will be deaths is taken as a matter of course. But building bridges, tunnels, and tall buildings is the job of private enterprise, even when the bill is government paid.

Beyond the need to accept risk

Yet it is becoming ever more urgent that we find a way to get NASA to concentrate on what it does best, space exploration and Research & Development of the technologies needed for that effort. The cost of doing space will only come down when space transportation services are provided by private enterprises in competition with one another. The precedent we cited is not really a shield behind which to hide. Amtrak is in competition, not with other railroads but with Greyhound and other motor coach lines and with the Airlines.

We are nearing the dawn of a new era in space, when exploration will continue as a sideline while the real push will be human expansion to the Moon , driven by the need to preserve the viability of Earth and repair some of the damage that our clumsy adolescent civilization has caused in its "growing pains."

For this transition from exploration to human expansion, drastic cuts in the cost of transportation are needed. NASA has had no incentive to cut costs. It tallies the bill, and the government pays. But now we are talking not about a few dozen more exploration missions, but about routine "transit" between what will become a plurality of human worlds, one greater "inter-world."

Creating a point of entry for enterprise

How can we encourage this transition in NASA's role? How can we grease the skids for the government space transportation system? One way is for Congress to mandate that NASA publish the designs, standards and requirements for the interfaces between the various stages of the new Constellation vehicle, the Ares. That simple move would allow private companies to design and produce alternate stages that could "plug-in" to the stack without difficulty. If a private company built a stage that was either more powerful, more capacious, more fuel-efficient, less expensive to manufacture -- or any combination of the above, NASA would be mandated to purchase it, or, if it is reusable, to lease it.

With such a mandated policy in space, we would gradually transition the NASA-owned Ares/Constellation into a family of newer, cheaper, better vehicles owned by private enterprise and either privately operated or leased to NASA, at a cost savings to everyone, taxpayers in particular. The effect would be to greatly accelerate the opening of the Moon, the development of its resources, the establishment of lunar settlements, and the mitigation by use of lunar resources of Earth's serious energy and environmental degradation problems.

This would be a win win for everyone, with NASA now having more money for unmanned space exploration. We'd like to see the Moon Society and NSS, even the Mars Society come together behind this recommendation to Congress. To quote SFF founder Rick Tumlinson, "NASA must open the door to space, not be the door "

Realistically this won't happen until …

Business needs incentive, the strong likelihood of significant profit. And nothing will provide that as much as high volume of orders, that is, promised high traffic. The Vision for Space Exploration, previously dubbed "the Moon, Mars and Beyond" will certainly not provide that volume. But the NSSO plan to build a network of solar power satellites using lunar materials, certainly will!

There are, however, space advocates who dearly want commercial space transportation to come into its own, yet seem content with the goal of a permanent lunar outpost structure, sporadically visited for a while, eventually to become a historic ruin. There are those who want us to open space to tourists, but do not necessarily want to see lunar settlement. Face it, we can't really open space without opening the boundaries of the human world to include "exo-continents" across the intervening seas of space, in one greater solar economy. Half measures won't do.

Is that why NASA never seems to mention solar power satellites anymore? Ever since Congress told the agency, after it had presented lawmakers with the three scenarios by which lunar reources could provide the world with abundant clean power, that this august body did "not want to hear the word 'Moon" anymore," NASA has had its tail between its legs. It is no surprise that it is not NASA but other parts of the government that are taking the lead in the NSSO plan, ironically citing NASA's own research.

But even before the government approves the NSSO report (or decides to become a has been over-the-hill nation), it would help encourage commercial providers to mandate that NASA publish those Ares interfaces and that any superior plug-in stages produced commercially must be substituted. We have to start somewhere, and in the more places the better. **PK**

MMM #213 - March 2008

Rocket Science is not enough to get us to Mars and back

Rocket Science is not enough to get us to Mars and back. We can't launch a manned mission of over two weeks without an umbilical support line for oxygen & water.

First, let's get one thing clear. this writer is, and always has been, a strong supporter of manned exploration of Mars, and of eventual settlements there. Nor is this about the stupid "Moon or Mars" debate, when it is amply clear that we must do both. It's about what Mars advocates won't even tell themselves.

The evidence

Both the Shuttle and the Space Station leak badly, and it is not just from airlock cycling. The shuttle can stay up for up to two weeks, thanks to taking along enough "consumables." ISS can stay up indefinitely only because of Progress freighter consumable resupply. Most of us space enthusiasts have known for a long time that lunar outposts and expeditions to Mars are quite un-realistic unless these problems are tackled.

One of the reasons we supported the effort to deploy a space station is our mistaken assumption that NASA would be forced to find a way to conserve and recycle air and water.

The agency may have given the challenge a freshman-level college try but that is not enough. We thought that a station that conserved and recycled volatiles would prepare us for opening a viable station on the Moon. We were mistaken. We got only a "regenerative system" that uses up water.

In announcing the "Moon and Mars" initiative, the clear intention was that by going to the Moon, where Resupply, **R**escue, and Relief are possible, we could safely learn how to wean ourselves of this umbilical cord. But crying "not enough money" rather than being honest with Congress, the taxpayers, and space supporters, NASA decided to postpone indefinitely a "permanently manned" lunar outpost for a "permanent structure" (read future ghost ruin). That puts off indefinitely learning how to live "without the cord" with technologies absolutely needed to go to Mars on missions that would last a minimum of two

years. While NASA continues to make all the wrong choices, the Mars Society (to which I also belong) continues to be silent. Let's make it quite clear

We must learn how to "live without the cord" to get to a place where we can begin to "live off the land"

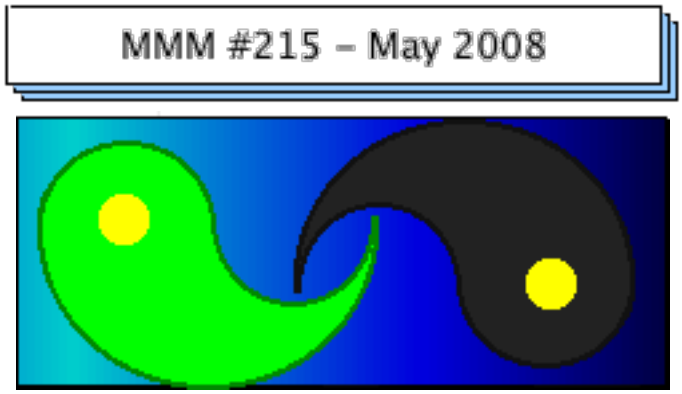
Meanwhile, crying budget woes, NASA has cut all biological life support systems research because, if we are only going to have a visitable lunar outpost, we can continue to maintain our addiction to the umbilical cord. "But what would you have NASA do?" Well, for starters, they could be honest with Congress, the President, and the American people. "We cannot pursue the mandate we have given because the budget does not allow us to make progress towards these critical goals." Still no money? Then

the agency will be off the hook. Meanwhile, it is not just our new Moon Rocket that is "Apollo on steroids" but the outpost structure itself.

More: -- A Mars outpost left standing on the surface, naked and unshielded (at the mercy of Mars weather as well as to the cosmic elements) will need a lot of power to heat. The surface and atmosphere temperatures are in the same range as all-season temperatures in Antarctica. If we burrowed in or covered ourselves with marsdust, we would enjoy a more moderate thermal environment.

The Mars Society is now looking for a big new challenge project as it retires its Analog program. My

suggestion? Demonstrate the technologies, not just to "live off the land" on Mars, but to "live without the cord" en route and back. And, oh, by the way, we need less cumbersome spacesuits also -- NASA cut spacesuit research as well. In short, the Mars Society should demonstrate how we can do biological life support systems "to and on" Mars. It makes sense to learn "how" to do this on the Moon. "Mars only" is undoable. - PK



***"Mother Earth and Father Sky"* - Putting Yin & Yang Together**

Earth Day 2008: Taking the Green Spirit to the Moon

We all know that at best, public interest is space is shallow: "a mile wide, and an inch deep." Among young people and among the growing percentage of those who are, or are becoming, "environmentally conscious," one of the most frequent reservations we hear is this simple challenge: "Why should we go to the Moon (or Mars) and trash them the way we are trashing the Earth?"

It is not to our credit that too often the response is to dismiss the question as well as the questioner. If we are going to build support, as we must, so long as we are stuck with a tax-supported program, we need to take this on this challenge with due respect. To fail to do so, only confirms the plaintiff's suspicions. Not exactly to our credit, too many space enthusiasts consider environmentalists the enemy, instead of natural allies whom we must do out best to court. It is possible!

If we love our own vision, we owe it to our own dreams to get past this silly pettiness. Nor should we pout and wait for "them" to make the first move towards reconciliation, cooperation, and collaboration. Unless we take the lead, we can forget about building significant public support. We already share one most significant goal in common: preservation of Mother Earth for future generations. We come at it from different perspectives, and from different cultures. This gap can be bridged!

What follows is a brief outline that our conversation with the Greens, and with ourselves (a guideline to considerations we must address in our own plans to advance the day when civilians will be living on the Moon, engaged in pursuits which will assist those on Earth to survive our current crises, crises probably typical of "adolescent" intelligent civilizations. Later in this issue, we will address these points in paragraph form, leaving fuller treatment to individual future articles.

Points to Make with the Environmentally Concerned

(A) Mining concerns:

Mining methods: most of the major and minor elements we will need are found in sufficient abundance in the rock powder blanket that covers the Moon's surface. The need to strip mine or mine deep underground is very minor.

Tailings: By conducting a cascade of mining sequences where removal of one needed element makes the tailings that much richer in other elements, we constrain our regolith mining operations and greatly reduce the total of energy input needed, and then using the final tailings residue for secondary construction uses.

(B) Recycling concerns:

Recycling spent energy; Everything we make embodies the energies needed to produce it. We can recycle that energy by recycling the materials, as items are replaced.

Industrial design: We can choose assembly methods so that diverse materials do not contaminate one another and can be easily separated for proper recycling.

Economics: to become economically viable, we need to make maximum use of everything we produce, and that can be done best by a comprehensive recycling system. This maximizes use, minimizes throughput (resources in/discarded waste out), minimizing our lunar "footprint."

Enterprise: A very high percentage of entrepreneurial opportunities for pioneers will be in the area of reusing materials no longer serving their original design purpose.

(C) Concerns raised by our bad record on Earth:

Postponed urgency: Our biosphere (atmosphere, hydrosphere, flora and fauna) is so vast until recently it has been doing a good job of handling of recovering from our environmental sins. We postpone solutions to the next generations (for which we will be condemned.) On the Moon, we must live in self-contained mini-bio-spheres, essentially living downwind and downstream of ourselves. What we do wrong will hurt us immediately. We learn to live in harmony with our mini-environments, or we will quickly get the "game over" message. The lessons we learn can be exported to Earth. – **PK**

MMM #217 – August 2008

Taking the lead in the "Holistic" Environmental Movement

"Oh no, complicating discussion by adding in a new term!" Sometimes it is necessary. Environmentalists, despite the sincerity of their passion, and the apparent soundness of their philosophy, have produced a very one-sided movement. It is one-sided, because the context of the rise of humanity includes more than our home planet, Earth. We could not be, Earth itself could not be, what we are without the larger cosmic context. And taking that meta-context into consideration vastly expands environmental "caretaking."

Humanity's and Earth Life's (Gaia's) environment is in fact dual. It is a matter of both Mother Earth and Father Sky. We are equally children of the Universe at large as pointed out in our feature essay, pp. 7-8 this issue. Sadly, the integral cosmic component of our environment is all but totally ignored by environmentalists.

But we space enthusiasts ourselves fail to realize how radically pro-environment our own goals are, and in that failure, we contribute to the mutual hostility of the two groups. As we bring into focus in our "Human Expansion Triway into Space" presentation,

www.moonsociety.org/spreadtheword/ppt/Triway1.ppt

In this presentation, we show how those focused on asteroids want to preserve our planet from the threat of killer impacts; how those focused on the Moon want to tap lunar resources to help us tackle our intertwined environmental degradation/energy shortage problems; how those focused on Mars want to create a "just-in-case" "second basket" for Humanity's and Gaia's "eggs."

The Moon Society and the National Space Society, working as a team, put together a conference proposal tasked with beginning a "conversation" between space solar power advocates and environmentalists. Presented to the EPA for funding, we did not make the first cut. We may try again, but it is worth doing on our own, if need be. But sadly, not all space enthusiasts seek to combine forces with the environmental movement. Many of us, especially politically conservatives, see the environmentalist as the "enemy" rather than a natural ally. Yes, "they" are hostile to us! But to match hostility with hostility is not only self-defeating, it is childish. We must take the lead in bringing the two sides together. We

must realize that we ourselves are environmentalists who treasure Mother Earth. And our own divergent focus points show that as we have just stated. We can better see both sides.

But we have apologies to make. The hostility of environmentalists to us is not without cause; we are blinded to a situational fact of life! To be truthful, given the long lead time for SBSP, it is both dishonest, foolish, and counter-productive in a manner that courts global suicide not to lend our support to shorter lead time, local and community based efforts to diminish and contain the problems, on a one-on-one basis.

If we spurn environmentalist efforts to promote wind and ground-based solar, and other cleaner energy solutions as "inadequate," we lose significant opportunities to buy Earth time, while we are continuing our efforts to bring space bases solar power technologies to a near-term readiness state. We cannot afford to do nothing while waiting 10-20 years for SPS to begin to come online! That would be cutting off our nose to spite our face. It would be childish and immature.

Collectively, we need to quit posturing and instead to seize the leadership in **promoting a holistic version of environmentalism** that recognizes the duality of Mother Earth and Father Sky, and in that context, work side by side with traditional Mother Earth environmental groups for a better future for our children and grand-children and for our descendants for generations to come as we spread beyond Earth to the Moon, Mars, the Solar System at large, and begin our pilgrimage back to the stars that begin it all. "Of stardust we are, to the stars lest us return." Think holistic: Mother Earth & Father Sky. It's not an either or proposition. It never has been. We must change our mindsets accordingly. **PK**

MMM #219 - October 2008

Using the Green Movement to Advance Technologies Needed on the Lunar Frontier

An Electronic Book Reader

In our article "Books on the Moon" pages 5-6 this issue, we write about Amazon.com's new electronic book reader, the Kindle, as a prototype for what we'll need to read books in a situation where paper will be as priceless as platinum. Amazon's Kindle will appeal to Green enthusiasts (we are one of them) but, of course, Amazon.com went forward with this project for profit motives. But that is immaterial.

What counts is that Kindle will also appeal to those who would like to find ways to slow down deforestation. Forests help keep the atmospheric cycle healthy, serving as sinks for carbon dioxide. That is especially important as we continue to produce ever more CO2 as consumption of fossil fuels continues to increase as the "Third World" continues to accelerate its already rapid "catch-up" pace.

Inorganic Substitutes for Wood Furniture

On the Moon, you can forget about wood "case goods," furniture industry jargon for wood furniture such as dressers, tables, etc., including bedroom sets, dining room sets, etc. So if we can leverage the Green Movement to slow deforestation by switching from wood case goods to a substitute (definitely not plastics derived from fossil fuels) that will not only help slow deforestation but will develop prototypes of something we will need a lot of on the Lunar Frontier. One possibility here is to predevelop glass-glass composites as a substitute furniture material. Just as there is plenty of sand and rock dust on Earth, we have an inexhaustible supply or rock powder and dust on the Moon – called "regolith" or more simply "Moondust."

We've been pushing this for twenty years, and now we have at last a strong incentive to predevelop this technology for making profits here on Earth, hitchhiking on the growing Green Movement. See: http://www.lunar-reclamation.org/papers/glass_composites_paper.htm

In our article in MMM#4 April 1987, "Paper Chase II" we discuss possible substitutes for a variety of wood and paper uses: labels on cans and bottles, posters, letters and greeting cards, wrappings and packaging, and much more. For the Moon, the economic incentive is of "make or break" priority. While at the present, wood and paper substitutes are not always really cost competitive, the motivation of those seeking Green Solutions, especially solutions that slow deforestation, is strong enough to provide a test market for new products that could serve as prototypes for wood, paper, and plastic substitutes we will absolutely need on the Lunar Frontier. www.asi.org/adb/06/09/03/02/004/paperchase2.html

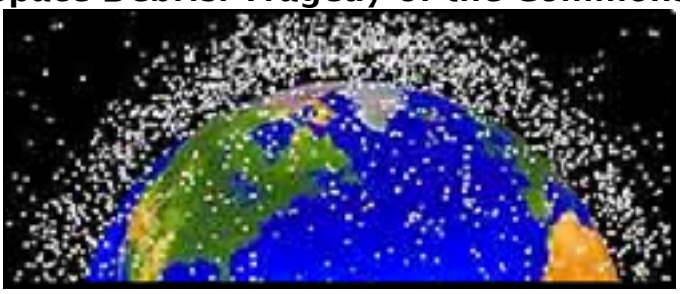
While we don't expect most environmentalists to care a bit about the needs of future lunar pioneers, those space space enthusiasts who do care, can now look for economic support from the Green Movement to help introduce such new products even at a some competitive disadvantage. In other words, the enterprising among us Lunnies ("Lunans") can attempt to predevelop such products in an atmosphere where cost-comparison is not a factor for a growing percentage of those willing to pay a bit more to reduce their "carbon footprint." Ordinarily, new products are at some cost-pressure disadvantage by having to amortize quickly the development costs involved in bringing them to market.

What we are saying, is that right now we have an increasingly more friendly environment in which to pre-develop some of the many technologies that will be needed to make a Lunar Frontier work economically in a situation where wood-paper-plastics, ultra-cheap on Earth because of our enormous biosphere, will be ultra-expensive on the Moon where there is no existing bio-sphere to tap, and where the elements needed to develop a biosphere (hydrogen, carbon, nitrogen) are quite rare.

If you are a Moon guy, and an entrepreneur who wants to help, but needs to make money now, this is your big chance. Read the articles cited! **<PK>**

MMM #224 - April 2009

Space Debris: Tragedy of the Commons



Not quite twenty years ago, in MMM #31, Dec. 1989, we ran an editorial, "**Space Debris: Cleanup and Prevention**." Yes, twenty years ago, the problem we face today, while now much more urgent, was clearly recognized. Then, as now, most talk is about finding ways to cleanup the mess, none at all about ceasing to contribute to it. Changing our dirty habits would be too …. er, "inconvenient." Why? That's easy.

No space agency or contractor wants to stop doing what is easiest, to continue to regard space as a bottomless sink for discarding the no longer useful

- It is the "Tragedy of the Commons."

If if (i.e. Earth orbital space) belongs to no one, no one will take responsibility for keeping it clean, and, in fact, no one has. "Would've, could've, should've." So we've messed up in a typically adolescent brat kind of way (if the shoe fits ….) There is no point in saying "I/we told you so." What do we do now? There have been put a number of schemes for cleaning up. All of these seem to suffer from significant ignorance of the size and scope of the problem. And most schemes totally ignore the most

significant challenge, the velocity at which most pieces of debris are orbiting, not in some synchronized swimming type of way, but helter skelter from all possible vectors.

Cleanup is going to be difficult. No one scheme will tackle more than a portion of the mess. The most practical thing we can do now, while sadly we are still in the talking stage, throwing out wild ideas, is to rank the various schemes in terms of: A) to what percent of the debris is the scheme applicable? B) how much would the scheme cost? And C) How soon could it be implemented?

Meanwhile we could be more productively busy trying to figure out a set of internationally acceptable protocols to prevent adding even more to the current problem. What are we doing wrong? That's easy. We are acting like typical spoiled consumers, wrapping up our packages then ripping the packaging off without taking measures to do anything more than shove the wrapping and packaging detritus to the side.

Many rockets shed their farings at an altitude where atmospheric friction will soon remove them as a problem. But some make it to orbit and are just shoved to the side. We do not know what are the "most common" other sources of debris. But these need to be addressed. From the MMM #31 editorial:

"**We propose that the Moon Society and the National Space Society refine, and strongly advocate the following international conventions to govern future objects bound for low Earth orbits.**

1 Farings and payload shrouds must be so designed to remain attached to the host booster and must incorporate sail-like devices that will automatically deploy to accelerate atmospheric drag on such boosters so that their orbits decay in six months to a year.

2 All payload satellites bound for drag-governed low Earth orbits (below 700 km) and not intended for intact recovery, must be equipped with a "dead-man's drag" folded sail device that will automatically deploy if power is lost, and which can be tele-deployed by ground controllers in other kinds of craft failure.

3 All orbit-bound payloads of a certain threshold size and weight must incorporate an internationally standardized grappling coupling.

4 Any orbiting payload or craft will be declared derelict by an International Board after failure by its launch agency to regain effective ground control within a two month period and if not retrieved or decay-accelerated by its owner or agent within a six month period, will be open to salvage of opportunity by any agent.

Space debris, already orders of magnitude more threatening than the natural micrometeorite, if shunted to the background of concern by apathy, has the potential to quarantine our species on our home planet. If we fail to rise to the challenge, we will deserve that fate.

Against any disease, and that's what space debris is, prevention is the first line of defense."

<PK>

MMM #231 - December 2009

Zubrin: "Earth is to Moon and Mars as Europe to Greenland and North America"

So says Mars Society founder Robert Zubrin in a recent release. Let's get real! **Earth is to Moon and Mars as Europe is to Iceland and Antarctica.** This comparison is truer both in distance and logistics costs, and in terms of economic viability. North America is every bit as fertile and livable as Europe. That certainly is not the case of Mars in comparison with Earth.

We agree 100% that Mars is destined to be the second most populous human world. But that will take some time. Meanwhile, there is an economic case for opening the Moon: first, lunar tourism, while expensive at first, is eminently doable. But who, no matter how rich, is going to spend three years of his/her life, a year of more just in transit to and from Mars, and then a year plus on Mars before being able to come back home?

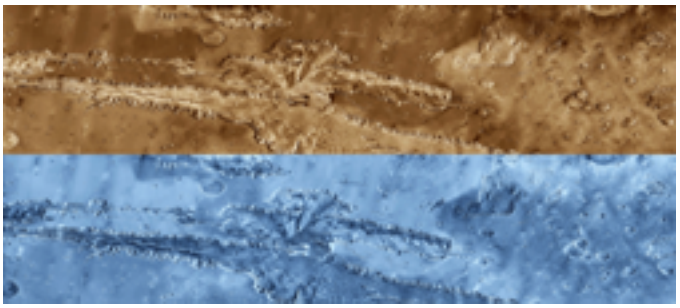
More to the point, there is a real and significant market for lunar products: Anything that can be made on the Moon can be delivered to Low Earth Orbit and to Geosynchronous Earth Obit (LEO & GEO) at a significant transportation cost advantage over competitive products made on Earth and shipped up the steep gravity well; That means building products with which to make space stations, orbital industrial parks, and orbital tourist complexes – all in LEO, as well as giant satellite-hosting platforms in GEO

(where there are only 180 available slots 2° apart), energy relay stations and solar power satellites. All of these things will be needed to further build out our terrestrial economy without further damage to the environment.

What is the economic case for Mars? Zubrin had reached into tenuous fantasy to come up with "pharmaceuticals made from soils on Mars that can't be made on Earth. We have been after him for two decades to work on the Economic Case for Mars. So far there has been only one realistic suggestion, and it is ours, and something RZ opposes or ignores: mining Phobos and Deimos for volatiles (should the postponed Phobos-Grunt probe confirm that one or both are of carbonaceous chondrite composition) and then shipping them in the form of liquid ammonia (NH3) and liquid methane (CH4) to volatile-thirsty markets on the Moon.

It does not matter that Mars has a much more complete set of resources on which to base a self-sufficient second human world. What matters is that no one, no set of companies, no set of governments, is going to pour that kind of investment into Mars, with no hope of return, no hope of Martian exports to defray the cost of a world-making flood of capital goods imports!

A point needs to be made. No how much wetter and warmer Mars once was in its past, it is now stuck in the same thermal range as Antarctica, a place with fresh breathable air, and surrounding sees full of seafood. Yet no one is beating down the gates of the Antarctic Treaty to earn the right to settle even the friendlier fringes of the western coast of the Antarctic Peninsula. The terrain may be similar, but the temperatures are not. Below: what Mars looks like (top), and what it feels like (bottom).



http://www.moonsociety.org/images/vallesmarineris.gif

Once this fact is driven home, the pool of willing Mars settlers will dry up, …. except for one source: hardy Lunans who will see Mars as a "walk in the park." PK

MMM #232 - February 2010

"Flags & Footprints 2" is Dead - A real Moon effort can now emerge!

By Peter Kokh, speaking personally

On page 16 Column B, we have printed NSS' Press Release on NASA's new direction. Perhaps many people will agree with it. I do agree with the first part, but part company at that point. To many people, NASA is "as American as apple pie." NASA, however, is a Socialized Space Program. How can a "socialized" anything be "as American as Apple Pie?" "NASA should open the door to space, not try to be "the door!" as Space Frontier Foundation founder Rick Tumlinson has long said. It would appear to me that the Obama Administration has gotten this message.

The overly expensive and technologically troubled Ares-1 is cancelled. But this is no loss, as we have at least four vehicles waiting in the wings, each of which can lift almost as much or even more than Ares-1, and can be man-rated for much less money: Falcon 9, Taurus 2, Delta-4, and Atlas-5. Old timers will recall that a much earlier Atlas carried the Mercury capsules to orbit! The Administration is putting money on the commercial market. It is likely that any or all of these vehicles could be ready to carry American crews to ISS before Ares-1 could be readied to do so. So no loss here!

As to heavier-lift vehicles, more powerful versions of both Delta-4 and Atlas-5 are in the planning stages. But they might not be necessary. The Administration wants to fund development of **orbital**

refueling depots. That would make it possible for lighter craft to carry crews to the Moon, and even sooner than the already dead-on-arrival published NASA date of 2020.

NASA Administrator Charles Bolden believes that NASA should partner with other space agencies in an international Moonbase. NASA had already signaled to the Russians that it did not want to partner with Russia (read "ever again!") In fact, ISS' time in orbit is to be extended at least to 2020, and is to be expanded using inflatables and other new technologies. Keep in mind that unlike the Moon Mission, ISS is immune to Congressional or Administrative budget cuts (and/or cancellation) as it is an international partnership, which implies commitments that we feel obliged to continue. An international moon base effort would be much more likely to become real, much more likely to be robust, and to more quickly expand, and to sooner develop lunar resource utilization technologies, and to more quickly morph in the direction of a first lunar industrial settlement.

NASA had only committed itself to a re-visitable shelter, one that at first would not support "overnighting" and growth into something capable of more than allowing us to brag, as in World War II, "Kilroy was here."

We think that the Obama Administration is administering to NASA a long overdue attitude-adjustment, and preparing us for the real and more robust commercially-supported opening of the Moon. To NSS, we say, this does not close "space beyond Earth orbit to human activity!" Quite the contrary, by getting NASA out of the way, and doing something more truly "as American as Apple Pie," the new policy would burst the door to manned activity beyond Earth orbit wide open.

At 72, I might not live to see 2020, but now when the time comes, I will pass much more confident that the Moon will become another human world, than I had been up to this point.

The Administration plan has been careful not to leave any NASA center dry, giving them new roles in the new space program, roles that are exciting, roles that are open-ended. We encourage everyone who has expressed disappointment and letdown to be encouraged. This is the day that many of us revolutionary space enthusiasts have been awaiting for more than two decades. We did not need another Flags & Footprints dead-end start! **PK**

MMM #233 - March 2010

steps on the Moon & other leaving

The Choice has been between "Moon Flags & Footprints 2" and "Mars Flags & Footprints 1" - We say "NO, "to Flags & Footprints, period!

Those who, in good faith. would settler for either F&F scenario, work to undermine our common dream, expansion of the human frontier beyond Earth orbit. Space supporters too concerned about the "giggle factor" to openly advocate establishment of real human frontiers on the Moon and Mars, do us all a disfavor. What it takes to mount human exploration missions on either world with minimal bases, is not at all what it takes to lay foundations for truly open frontiers. That is, human exploration does not logically lead into human settlement. Not only is the list of pre-requisite technologies very different, but the public "sell" is also quite different. Of the three principal "vectors" of human expansion into space,

(a) **Planetary defense** from would-be killer asteroids
(b) **Using lunar resources** to help heal Earth's environmental wounds with virtually limitless clean energy
(c) **Creating a second home world** on Mars should the first two efforts fail,

Only the asteroid defense people seem willing to put their cards on the table.

To be fair, there are those of us lunar enthusiasts who do spread the message about how tapping lunar resources can help us better handle many of Earth's most intractable problems, but we are the minority, and the message that the public gets is that we just want to go to the Moon to satisfy various boring geological curiosities. And, we all see where this tactic gets us: a groundswell of opposition united under the banner of "been there, done that."

Yes, there is a giggle factor to using lunar resources. And we can remove that only by doing the right kind of research. Some of that research will need major investment by governments, but not all. We need to be brainstorming ways to demonstrate the feasibility of key technologies, especially those with terrestrial applications that could be rather profitable. There is nothing so convincing as concrete demonstration!

For Mars, the situation is worse. Even those who are for establishment of a human frontier on Mars seem to be afraid to talk about it, and push only for more digestible exploration missions. The problem is that such missions are most unlikely to choose locations best for settlement or to develop the technologies that will be needed to stay indefinitely on Mars as opposed to locations picked to satisfy scientific curiosities. After the worldwide excitement of our first landing, the boredom index will begin rising swiftly among a new generation of "been there, done that" chanters. And soon another hiatus will follow, perhaps as long as that which has followed Apollo 17, maybe even longer.

If we are going to do this (Mars, and the Moon), we need to do it right, or once again, all this expensive effort will be for naught. Geology and exobiology bores the public. Settlement based on prior demonstrated technologies will captivate the world.

We must sell settlement, and be clear about the reasons for doing so. Selling exploration is not good enough and hardly prepares the way. The difference is that between a blind date and a marriage.

The problem is that we swell our numbers in order to look like a stronger movement, with those who do not share our goals or passion. That is a suicidal strategy that has been tested and failed over and over again throughout history. Will we learn this lesson before it is too late? **PK**

MMM #237 - August 2010

The Moon: Time to wait, but no time to waste

By Peter Kokh

There can be no doubt that that many of us feel let down, by NASA's redirection. In part this is NASA's own fault by choosing an "Apollo on Steroids" {Mike Griffin] mission plan that was sure to cost too much money and offer too low a flight rate. Yes, now there will be delays and setbacks. Meanwhile, there is much homework for us and others outside NASA to do. If NASA were ready to take humans to the Moon tomorrow, WE would not be ready to hitchhike a ride towards establishment of lunar frontier industrial settlements.

Homework needed for the establishment of a permanent lunar community

We need to do much more R&D on the kinds of **building materials** we can produce from lunar regolith without a lot of capital equipment or sophisticated precursor technologies.

Concrete, steel and other alloys, glass and glass composites, ceramics, and cast basalt are prospective lunar-appropriate technologies.

It is not enough to rest on paper studies and anecdotal laboratory trials. It is also up to us to develop modular architectures that build on the characteristics of these new materials. This will require the work of materials scientists, metallurgists, and chemical engineers, and, yes, entrepreneurs willing to invest in analogous technologies with potentially profitable terrestrial applications and markets -the "spin-up paradigm."

We need to do a lot more work on biospheric systems. They should be modular, so that they grow as the outpost or settlement grows. Practical research with graywater systems and living walls are promising in this regard. NASA had stopped all biological life support system research.

We need to develop methods of insuring plants survive to harvest in an environment with 15-day long dayspans of continuous sunlight and equally long night-spans when only artificial light is available. We need to experiment with all sorts of plants but concentrating on those that best promote menu variety. We need to develop plant cultivation methods suitable for teleoperation from Earth to free personnel on the Moon for other things needed to expand the outpost and its operations.

We need to further develop inflatable technologies, especially "hybrid-rigid-inflatable options" begun in the TransHab program but seemingly abandoned by Bigelow.

Inflatables will be our first way of providing livable elbowroom but we must advance quickly to production of habitat and activity modules manufactured on location with lunar materials.

Until we reach that stage, true lunar settlement will remain an illusive dream.

To help address some of this litany of research needs, especially those technologies at a low "readiness state", we will soon introduce

a decentralized but comprehensive lunar analog research plan, quite unlike the analog terrain based Mars Society program, that will endeavor to advance the readiness state of the required technologies.

We will welcome other organizations, even our individual chapters, to participate if interested.

Those of us with writing talents need to work harder to get the message across to the public. This plan will be designed to invite academic and student participation, and to incorporate public outreach programs.

No time to rant, rave, or pout!

Yes, we seem to have been forced onto an unexpected and unwelcome detour.

I have a plaque in my bedroom that reads,

"The contented man is the one who enjoys the scenery along the detours."

My life experiences have found that bit of wisdom to be so true. To mope and complain wastes valuable time and energy. The new path is loaded with opportunities. We must not wait for NASA to discover them, or to take advantage of them. There are so many avenues of research that NASA has not had the money to follow, at least not in its accustomed manner and overly expensive way of approaching everything

We must all keep in mind that NASA's goals are far short of our goals. We envision

"**The creation of communities on the Moon involving large-scale industrialization and private enterprise"**

[From the top of the Moon Society home page]

NASA is not now and never has been focused on such a goal. In many ways, NASA is captive of planetary scientists interested only in answering questions, not in enabling the building of a new human frontier.

If we are to get there, we must take responsibility for seeing to it that the significant amount of research not prioritized by NASA does gets done. There are many options to whittle away at the long homework list. But we don't have a chance of making progress if our wagon remains hitched to NASA's. So let's not worry about NASA doing its job. Unless we do ours, it won't matter how well they will or won't have done theirs.

Have faith. It will all sort itself out; but only if we do **our job**. Remember, a permanent civilian frontier on the Moon is **our dream**. The man who does not take responsibility for his own dreams is not to be taken seriously.

Part of NASA's prior Constellation Program may be restored. That is a shame because it is still Space Transportation 1.0 and we need badly to invent and plunge into a Space Transportation 2.0 paradigm. If Congress approves some level of Constellation Program restoration, that will delay us doing what we need to be doing instead. At best, NASA will give us something to hitchhike on, at an unnecessarily exorbitant price. NASA's shoulders are not those on which we need to stand.

Getting to the Moon in a much more economical way is not the total answer. It is up to us to ensure that we are ready to take steps to expand in the direction of industrial settlements once a less expensive space transportation architecture is in place.

Our dreams are the greater ones. We alone are responsible for taking measures to realize them. What we are called upon to achieve is even more daring and stupendous than the boldest of NASA missions. So let's not get distracted. Let's dig in with even more fervor. **PK**

"Yesterday is history,
tomorrow is a mystery
and today is a gift;

that's why they call it 'the present.'"

---Eleanor Roosevelt---

New lands were discovered by iron men in wooden ships,
Not by wooden men in iron ships.

MMM #238 - September 2010

"In this decade"

3 words that won us the Moon Race but crippled us ever since

When JFK gave his famous "We choose to go the Moon" speech, these three fateful words torpedoed Wernher von Braun's plan. Sure von Braun got to be in charge, but it was no longer his tune to which we would march. We could not delay achievement of **the real goal, beating the Russians**, and

> "Oh, by the way, we will visit the Moon …. To set up a logical infrastructure along the way so that if we planned to stay, we could do so with an economical space transportation system."

But we were in a race, and the Moon was just a handy goal, dispensable once met. We would not delay the race to build an orbiting depot and assembly station. We would never have gone to the Moon as all, if it were not a way to trump the Russians big time, at their own game.

Those of us who were around at the time, when Nixon (not Congress) pulled the plug on Kennedy's thing, were disappointed to be sure. But Saturn V was not the right vehicle and transportation system on which to build a sustainable Moon venture that included a permanent and growing presence. To stay, we would have had to pull the plug on Saturn V, which we did anyway, and start with a transportation system that involved logical nodes. And so began the campaign to convince President Reagan to give NASA a new goal, building a space station.

Well, we lost that one too. We got a space station of sorts, but it was a "yoyo space" thing, downward looking at Earth, and not a outer-space oriented depot or assembly station. It was even put in an orbit unfit to serve as a transfer point. Yes, that orbit was necessary to get the Russians to agree to partner with us, Clinton's deal-clinching strategy to keep Russian scientists gainfully employed rather than out there looking for work in nations with mischievous intentions. Yes, the Space Station has done great things, and kept space in the public eye. But it is boundary layer space, not the outer space that includes the Moon and planets and beyond.

Once again the space community mounted an effort to get the government to consider going back to the Moon. Both Bush's came up with flawed plans. By then NASA only knew one way to do the Moon, the wrong way. So along comes Mike Griffin, who gives us a Saturn V substitute, a way to get to the Moon without building the infrastructure that might allow us **to stay!**

Let's stop blaming Obama for halting what was a farce in the first place. Let's stop cheering on Senators who would reverse Obama's decision. If we want to return the Moon "to stay," we have to abandon **Space Transportation 1.0**. We have to start with a clean slate, and brainstorm **Space Transportation 2.0**

What we have been trying to do for over forty years has been a pathetic reenactment of the tale of Sisyphus, the mythical Greek figure who kept trying to push a big rock to the top of a hill, only to lose the battle and watch it roll back to the bottom, retrace his steps and try again to push it to the top. We did not settle the west that way. We did not set out from the East Coast with a gigantic 50 ft wide half a mile long Conestoga wagon pulled by a team of a thousand horses. No, we built places along the way, St. Louis, Kansas City, Omaha, Denver, Salt Lake City, etc. At these stops we could replenish all our supplies, even personnel. At each stop, we dropped off things (passengers too) needed there and

picked up new supplies, fresh people. Every waypoint made the next waypoint doable and at a reasonable cost. Going from Sacramento to San Francisco, the last step, was no more expensive than going a similar distance much further east.

So how do we take a page from the mid-1900s, a century and a half ago? It is pathetic that it is taking so long to learn what is really an obvious lesson!

Waypoints on the Road to the "Moon to Stay"

Let's back up a bit. No I am not a rocket scientist. But rocket science is the problem. Why, because it is impatience that is always the problem. Building bigger and more powerful rockets is just making it more expensive to go nowhere.

It would seem that low Earth orbit is waypoint one. But I think it would pay to revisit how we launch from Earth. The most expensive thing is getting off the ground, and vertical launch is the most expensive way to do that. Fly back boosters, even rocket sleds, to launch horizontally to a level where the atmosphere is much thinner, need to be revisited. Always keep in mind that impatience is the enemy, the chief way we defeat ourselves in whatever we do. It simply should not take that much oomph to get us into orbit, or to the point where a smaller second stage could take over from a smaller first stage and successfully get the same payload into space. The masculine power trip way is not only not always the best way; it is almost always the worst way. So the first way point is the in transit level at which atmospheric resistance significantly drops off.

Low Earth Orbit

We all know how useful low Earth orbit is. It is a great place to study the Earth. Our remote sensing and weather and navigational satellites have given us a much better understanding of our home planet. And the International Space Station has helped as a platform. It is also a great place to assemble things to large and/or to heavy to be sent up in one payload. To date, except for the Space Station itself, which proves the point, we have tried to avoid in-space assembly by building ever-bigger rockets for ever-heavier and larger payloads.

What we haven't yet got right is that every part of a rocket that makes it to low Earth orbit, could have been designed "transformer style" to serve as components for something to be assembled in orbit. We just throw that "stuff" away: farings, spent stages, External Tanks!

For every ton of satellite mass in orbit, we have thrown many tons away that could not be integrated into something useful whether larger platforms, assembly and repair facilities, additional space stations or facilities for space stations. But then we are a throwaway people. Like our simian predecessors, who seemingly can't be house-broken, we apparently can't be planet-broken; it is easier to throw away and to trash than to reuse and reassign items and materials that have done their initial job. Had we not been so macho, and had been into husbanding everything that makes it into space, we could be decades ahead of where we are now, and probably without a space debris problem of such magnitude.

Impossible? If you think so, perhaps your imagination has become fossilized. Hold a design competition for ideas on what we can do with this or that throw-away item and prepare to be amazed at what still flexible minds can imagineer! Get with the program or get out of the way. We'd all still be in the stone age if it were not so.

Geosynchronous Orbit

Now we get to where it gets real fun! Perhaps most of us do not realize the scale of Geosynchronous orbit. At 23,000 miles above Earth's surface, 27,000 miles above its center, it is $2\pi r$ or 170,000 mi. (230,000 km) in circumference. Yet, it is limited. We don't need our communications satellites slowly drifting into one another, so international agreement limits "stations" to 2 degree intervals. Dividing 170,000 by 180 gives us a spacing less than a thousand miles apart. But we already have well over 180 objects in GEO. And if and when we start building solar power satellites in GEO, and these things will be large, the situation could become dicey.

One way to alleviate crowding would be to build giant platforms that could provide power, station-keeping and repair services to dozens, hundreds, or even thousands of individual communications and TV relay units. Where would we get the materials to build such platforms? We need not build more GEO-bound rockets, but only design their rocket casings in a way that, again, "transformer-style," can self-unfold into platform strut sections. Maybe we need to mandate our rocket scientists and engineers to watch more Saturday morning cartoons – some of them probably never heard of the "transformers." Well, the kids and toymakers all know, so maybe when they grow up, they can turn things around.

Ultimately, of course, building materials for GEO platforms and SPS stations, can be shipped down from the Moon at much less expense than up the shorter distance from Earth. IF GEO is to be the linchpin of the 21st century economy (up from $250 **b**illion per year of economic value to $250 **tr**illion), lunar resources will be the principle enablers. (Mars will contribute nada, zilch.)

The Earth-Moon L1 Gateway

This is the next waypoint, the "Sacramento" stage if you will. And in similar fashion, this gateway can be built up from components needed to get that far, but not going the rest of the way to the Moon's surface.

We will want an L1 Space Station with storage, even warehousing capacity, vehicle repair and mainte-nance facilities, fuel storage, cargo storage for trans-shipment, crew quarters for personnel in transit. L1 will grow apace with facilities on the Moon's surface, into a major transfer and service space-port in the sky.

If L1 doesn't grow, neither will the lunar frontier. Reuse of every last item that arrives there not going further, is the key. See our slide show on L1 growth:
www.moonsociety.org/spreadtheword/pdf/LIphases.pdf

The Moon's Surface

Nor does our "transformer" routine stop at L1. Every part of a ship that lands on the Moon, and which is not needed for a return flight (100% if it is au unmanned cargo ship) should be designed for reuse or cannibalization on the Moon – down to the last strut, landing pad, fuel tank, --- everything, not just what's in the cargo hold – and that goes for packaging materials as well. To paraphrase a col-orful description of rural southern cooking, using every part of the pig except the squeal (and maybe finding a use for that as well.)

Now I have just offended those who believe that reusability is the key to economy. No, not if you mean reusing the same thing over and over for its original purpose. To do that you have to get it back to its original port and that is wasting fuel. Second, by reusing as is, you do not benefit from the econ-omy of mass production. We don't need ten reusable rockets that get used a hundred times. We need a thousand rockets that get used only once, as a rocket, but then are put to permanent use taken apart and transformed into something needed on the frontier. Old timers will remember the World War Liberty ships, which we turned out cheap by the hundreds. Mass production and total reuse of materials at a destination – that's economy on steroids, if you will!

Yes things should be reused, but as materials, not as originally assembly components. We have to get into this new way of thinking avout things and their utility. Look at a lander's legs and pads, and see a mobile crane! We may have to tweak original designs to get the most reuse potential out of them. And this redesign may cost some, but the rewards for reusability will pay off handsomely. Let's sponsor and run contests annually for the most innovative reuse of all these things used only once in transit. Let the young people clear the cobwebs in our older brains! We will fail if we do not pass the torch!

Summing up "Space Transportation 2.0"

Every item that leaves Earth surface should be designed for reusability of its constituent parts or materials.
Components should be designed to serve some new function or purpose at the way station at which their original function has been achieved
Power is less important than economy and reusability
Nothing that can be used at a way station should be sent back down the line Earthwards. It is better in the long haul to keep sending up new rockets and rocket components that can be put to new use up the line, than to return them back down the line – false economy
Complete **H**ardware **U**tilization **M**ission **A**rchitectures = **"CHUMA"** (thanks to Dave Dietzler for this acronym)
Everything in the sacred traditional way of doing things should be reexamined in light of this new paradigm.
The goal is not to return to the Moon.
The goal is not to return to the Moon to stay.
The goal is to return to the Moon and keep growing a lunar frontier civilization which in turn will feed Earth's needs in GEO and elsewhere and help us all rejuvenate and

preserve the Eden that Earth once was. We are going to have to travel a lot of light years to find another paradise world like it.

If this is the most absurd, ridiculous idea you ever heard, check out this report: http://www.foxnews.com/story/0,2933,529059,00.html

We have to quit saying "we can't" when we haven't really tried. To the Moon, to stay! **PK**

MMM #239 - October 2010

Science should NOT be in the driver's seat in Lunar Outpost Establishment

While this topic may seem irrelevant now that NASA has been redirected away from establishment of a permanent structure on the Moon, it begs discussion. The lunar science community has strongly favored a south pole location because it lies on the rim of the vast South Pole-Aitken basin, the deepest on the Moon, most of it in the farside southern hemisphere, These scientists see a South Pole site as a jumping off point for overland expeditions that would probe the SPA's secrets. What's special about the SPA other than it being the Moon's deepest basin? There is an expectation among some that there are mantle materials to be found here and there on its surface. On the nearside, the mantle lies miles below the surface. What seems puzzling is that scientists are supposed to be "smart." Yet the Apollo crater in the NE part of the SPA, where the deepest areas are to be found, is on the order of a thousand miles from the pole, across really rugged terrain.

In general, the South Polar area is extremely rugged, and as moths that need the mythical "eternal sunshine" they would not get far from the pole before they would have to turn around to get back before dark.

But that is not our point. To these scientists, establishment of a permanent lunar frontier is a low priority if they give it any priority at all.

Yet, the more people on the Moon, in the more places,
for an open-ended period,
the more science will be supported
and in the more places.

If Europe had sent a dozen science expeditions to both North and South America each, but never settled, how much would we now know about these two continents compared to what we, as inhabitants, have learned over the centuries? One can only conclude that as these scientists, however brilliantly focused in the short term, are obviously myopic when it comes to looking further ahead, their advice needs to be weighed against other more practical considerations.

We do need lunar science to help identify key locations on the Moon with the various resource concentrations that would make them ideal for industry-based settlement. No spot on the Moon has all the needed mineral resources. The lunar frontier must be global in character. The South Pole, as attractive a site as it seems to be, has some severe drawbacks. The polar ice does not seem to be a near-term resource. That some very rocky anything-but-flat areas get a lot of sunshine is irrelevant if there are no "buildable" locations nearby, locations large enough to support considerable expansion. And because the pole is so extremely atypical, learning how to erect and maintain a base there does nothing to help us prepare to establish human presence globally.

The renewed call for a "fly & flunk" program

Some lunar mission advocates, well-intending, but destructively impatient, have convinced some U.S. senators that the Constellation program should be reinstated. This effort may be sincere, but in our opinion is seriously misguided. Why spend our limited funds on a program to "fly & flunk" when we should be laying foundations for a Moon Program that will patiently and deliberately phase in permanent human settlement based on industries that will help tackle Earth's most important problems: environmental degradation and limited clean energy reserves.

The motivating factors behind this effort to reinstate Constellation are clear: the careers of some planetary scientists and some involved in the old program are at stake: career-based self-interest. It has become more important to some lunar enthusiasts to see something happen in their lifetime than to face death, not having seen the favored frontier open, but knowing that we are on the right track to doing it right, doing it to last, doing it to fulfill all its promised potential. **PK**

MMM #240 - November 2010

"Green" Space-Based Solar Power Needs "Green" Rockets

Toxic Boosters – Shuttle SRB Boosters

Above: An ATK (formerly Morton Thiokol) Solid Rocket Booster. Each Shuttle uses 2 4-segment SRBs. Constellation would use 2 5-segment ones. "Each SRB produces 80% more liftoff thrust than one F-1 engine, the most powerful single-chamber liquid-fueled rocket engine ever flown." It is easy to see why we use them. The hush-hush problem is that the SRBs put our very dirty, even toxic, exhaust fumes. See our "In Focus" Editorial.

One of the space projects supported by many if not most space enthusiasts is space-based solar power, that is, a multitude of solar power satellites in GEO, Geosynchronous Earth Orbit. And it is obvious that we have to begin with a demonstration unit built of materials and parts launched from Earth. Most of us see this as a solution to the growing shortage of "clean" energy. This is something we can sell to the public, and especially to the environmentally aware.

If the demonstration unit convinces enough investors (power generation company consortia and national governments) that we need to deploy hundreds, even thousands of larger such units, to meet Earth's energy demands – in a clean way – then that raises an issue. Our current arsenal of heavy-lift rockets is not really very clean, especially those using SRBs. But to launch under a dozen such a year does not create an issue of high, much less immediate priority.

But to launch thousands of heavy lifters a year to deploy SPS systems at the rate needed, does raise the environmental impact question. Now, we do not pretend to know the answers, much less how to rate present rockets and boosters in this respect. We must determine:

a) Through what altitude range, does the engine in question release its exhaust plume?

b) How much higher does momentum carry that plume?

c) Through what altitude range do the chemicals in question pose a long-term environmental problem?

d) What alternative rockets and rocket fuels do we have that would pose less of a problem?

We do not pretend to be able to answer any of these questions. Rather, we present them as questions that should be given priority attention and investigation.

Many space supporters question the L5 thesis that using lunar materials would be a cheaper way of constructing SPS units. Granted there is a high-threshold initial investment in setting up lunar industries that could meet such a demand. But once up, that investment could be amortized rather quickly if we are deploying not just a dozen, but hundreds, even thousands of units. The reasoning here is that it takes 1/22nd the fuel cost to launch the required mass of components off the Moon's surface, through its shallow gravity dimple, down to GEO than it will to boost the same payloads off Earth, up through its deep gravity well to relatively nearby GEO.

But the issue raised above adds another consideration. By launching from the Moon, we avoid the issue of polluting Earth's upper atmosphere in a way that could be very hard to remedy.

Now Space Elevators are an alternate way of taking things to GEO without using rockets. But say that we do succeed in deploying such an elevator under notoriously unstable tropical weather conditions. Its capacity, whatever it is, will be limited. We might have to build many space elevators to meet the demand. Will this be cheaper than setting up industries on the Moon? We don't know the answer, but we remain skeptical.

One point of this editorial is to point out that we have a lot of preliminary research to do, some technical, some economic, before we can come up with the best answer or a best mix of answers.

A second point is that we cannot pretend that SPS systems are the "Green Answer" to our growing energy problem, unless we do this research. Certainly, to launch "Green Power Systems" with rockets that are anything but "Green," will be transparent nonsense.

A third point is that if we need to earn the support of the growing environmentally-conscious constituency to win the political support, we need to present Space-Based Power as environmentally benign not only once deployed, but also hrough the deployment process. **PK**

MMM #242 - February 2011

Telepresence-operated "Robonauts" will revise all "Scenarios"

At first impression, those of us who want to see human frontiers develop "and prosper" on the Moon, Mars, the asteroids and elsewhere in the Solar System may think that the emergence of robonauts threaten that dream. But quite the opposite is likely. These "stand ins" will pave the way at far less expense,

We have already integrated "teleoperation" of equipment" into our expectations. Japan and Russia, as well as our own Carnegie-Mellon robotics team, have suggested that site preparation and many construction chores could save substantial amounts of time and money. It costs a lot to put a human on the Moon! Humans are most effectively assigned to chores that cannot be teleoperated. Teleoperated equipment will allow humans to go to the Moon to begin at once to do what only they can do.

Enter the "robonauts" and telepresence! Here the human controller on Earth "sees what the robonaut sees, and feels what the robonaut feels." This is ideal for scientific tasks – for example, where it is not the size, shape or weight of a rock which is of interest, but its chemical-mineralogical makeup." Robonauts can collect samples of special interest thus freeing humans of that tedious chore, so that when they arrive, they can examine a pre-selected collection, without wasting hours and days in field work.

Roboanuts do not need food, rest or relaxation. They can work around the clock, through a team of telepresence operators on Earth. They do not get bored. Thus the quality of their work is more likely to be high. As to teleoperated equipment, there will be many chores which cannot be done into their manipulation tools, one of a kind chores, that could not be foreseen, or which will be so uncommon

that it would not be cost-effective to further specialize those tools and programs. A robonaut with hands human-like in their degrees of motion, can use hand tools for a limitless list of special tasks. Robonauts can do things to dangerous or risky to be assigned to human crews. In the lead article in this issue we show how these companions can relieve humans of all sorts of risky and tedious chores.

Implications for the "High Frontier Scenario"

[Space Settlements for workers building Solar Power Satellites]

In his article "O'Neills High Frontier Revisited and Modified" pages 7-8 in this issue, MMM #242, Dave Dietzler shows how the emergence of robotic technologies also radically changes that scenario of how solar power satellites will be produced and deployed. We may not need the extremely expensive Space Settlements, a requirement that could delay the construction of SPS systems by many decades. Humans will still be involved, but in lesser numbers, and with far lower thresholds of support.

To sum up, lunar resources are still a best bet to lower SPS construction and deployment costs, but the cost of accessing those resources will fall by an order of magnitude or more by reducing the amount of human workers involved.

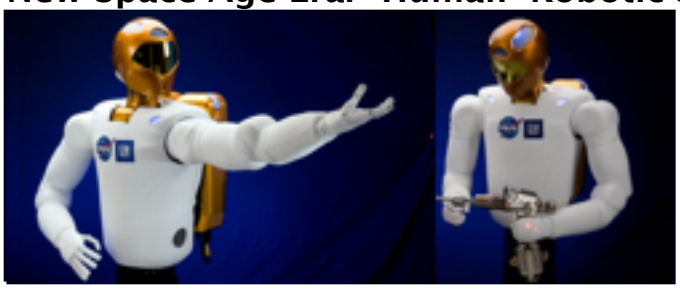
- Consider that a lunar settlement can begin very small and grow as needed, module by module.
- In Contrast, a Space Settlement has to be built to a set size, whether it is occupied by a starter crew, or at full capacity. Space Settlements have a built-in high threshold, greatly exacerbated by the insistence on Earth-normal gravity levels.
- We have previously attempted to remediate these problems in our paper, "**Reinventing Space Oases**."

http://www.moonsociety.org/publications/mmm_papers/reinv_so.htm

Just as the cyber-revolution has vastly increased human productivity, so will the robotics revolution. We have nothing to fear! PK

MMM #243 - March 2011

Dawn of New Space Age Era: "Human-Robotic Synergy"



in late, 2004, after having just been elected President of the Moon Society, I brought up the idea of the Society sponsoring a workshop on "**Human-Robotic Synergistics**" only to be ridiculed by a newly elected director. Shortly after, he resigned. The point was, and is, that the debate over whether humans or robots should explore space is pointless and absurd. Our respective assets are complementary!

Robotics has come a long way in the past six years! And the promise is becoming real. Robotic assist-ants can relieve humans of tasks that are dangerous, boring, tiring, repetitious, etc. And they do not need life support, rest, entertainment, or socializing. They will not only pave the way for humans, but work side-by-side with humans after crews arrive, with future settlers also.

Whether the word "robonaut" sticks, or becomes replaced with the earlier "'droids" (short for androids) is immaterial. The evolution of humans and robots working together is now well underway. Robotic assistants can take care of chores that are boring, tedious, repetitious, and/or dangerous. They do not need food, rest, sports, relaxation, or entertainment. They do not require life-support in transit or on the job. They do not produce wastes that need to be treated and recycled.

As for **R2, now aboard ISS**, the coming year will see it undergoing tests to make sure the trip to the space station caused it no trouble. Astronauts aboard the station will have a chance to get used to R2 and learn to work with it/him. In time, both will become comfortable working together. We need to get to the point where we can trust robonauts as reliable helpmates. No one can predict how long that will take, as adjustments in the robonaut's capacities and abilities may be needed. In the real world, needs emerge which might not have been foreseen.

One big challenge for NASA engineers has been to retrofit all of the robot's electronics to withstand radiation in space. They also worked to make Robonaut 2 as "smart" as possible. R2 has some 38 Power PC processsors, including 36 embedded ones. The embedded chips are running in the machine's joints: its hands, shoulders, waist, elbows, neck and five large joints in each arm.

NASA also plans on periodically upgrading R2, it will be attached to a pedestal on the space station and it will work in place. By year's end, one or two legs may be installed to allow R2 to move around the station. A single leg could be easily attached to the robotic arm outside the space station so it can assist astronauts during spacewalks. In time, R2 could relieve astronauts of EVA assignments. Unlike humans, robonauts will not have to go through time-consuming pre-breathing steps. EVAs are risky and tiring.

What's ahead?

We can expect to see robonauts fully integrated into ISS crews, becoming comfortable and reliable as partners, with a significant increase in overall mission productivity. Meanwhile, we will probably see robonauts become common in upper income households (as in the Jetsons cartoon series.) The "humans vs. robots" debate will become a curiosity of history. Both sides will have won, and the future of space activities will unfold more quickly and at less expense.

Some science fiction scenarios foresee humans in danger of replacement. Some see "Borg-like" transformations of humans. We see robonauts becoming faithful and enabling companions to humans, a path that dogs have been down long ago. Robonauts will hasten and deepen the pioneer settlement of space frontiers. Science-fiction stories that do not include this partnership will become dated. We have lived to see the day when this brighter, more promising future was introduced! PK

MMM #244 - April 2011

The Achievements and Excitement of MIR Remain as a Legacy

MIR was a Soviet/Russian space station, in orbit from 1986 to 2001. Heavier than that any previous space station, Mir had a modular design, and was the largest satellite until its deorbit on March 21, 2001. For most of us, its highlight was **the "Shuttle to MIr" Program**.

http://en.wikipedia.org/wiki/Shuttle-Mir_Program

Shuttle-to-Mir

During the "Shuttle to MIR" program, Russian cosmonauts arrived on the shuttle while an American astronaut flew aboard a Soyuz spacecraft to engage in long-duration expeditions aboard Mir. The

plan allowed NASA to learn from Russian experience with long-duration spaceflight and to foster a spirit of cooperation between the two nations and their space agencies.

The first such mission started in 1994 and the project continued until 1998. Eleven Shuttle missions, a joint Soyuz flight and almost 1000 cumulative days in space for American astronauts occurred over seven long-duration expeditions.

We encourage all readers who have never seen the inspiring **IMAX** film "**Mission to Mir**" to purchase a VHS or DVD copy. It was a thrill to see a Russian cosmonaut "fly-swimming" (for want of a better word) through the Mir complex as if he were born to do so, and hear a succession of Russian folk songs while Shannon Lucid of Oklahoma played American country music! Wonderful!

Rag-tag glory

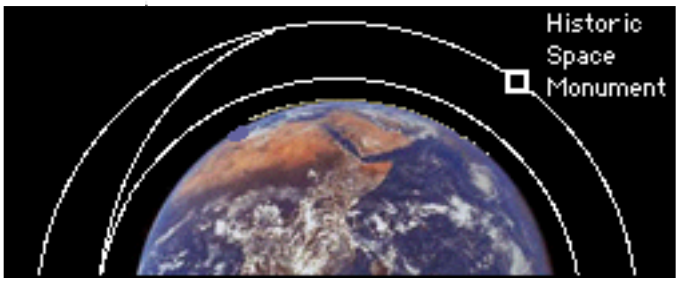
MIR was frequently put down by overly haughty American space enthusiasts as "a ragtag crude station held together by bubble gum and duck tape" etc. To us, this was MIR's glory, and its hope: proof that millions coupled with ingenuity could allow ordinary people to settle the space frontier without the billions that the NASA High Priesthood and its hand-in-glove contractors wanted all of us to believe was needed.

But then, as the Russians had agreed to partner with the US in building an international space station (we can thank Bill Clinton for convincing Congress that this was the only way to keep out-of-work Russian scientists out-of-mischief) NASA, to be sure that Russian attention was not divided, insisted that MIR be deorbited. Given that there were more constructive options, this bit of high-handedness will one day be seen as all but criminal.

A free-enterprise group put together by Eric Anderson and leaders from the Space Frontier Foundation had already given the Russians one-third down towards a purchase of Mir to be uses as a commercial station. Buy or rent the video "**Orphans of Apollo**," to hear the story.

http://www.orphansofapollo.com/

Another option would have been using the rocket sent to deorbit Mir, to boost it to a safe higher parking orbit and declare it the First International Space Monument. Both of these options would have put Mir to further constructive use. Nothing was gained by deorbiting Mir other than childishly showing the world that NASA was "da boss."



Would'a, Could'a, Should'a – MIR Monument →

On March 21, 2001, the fabled Soviet/Russian MIR space station was deorbited to force RosCosmos to turn its undivided attention to the construction of a joint-sponsored International Space Station. One of the alter-natives to deorbiting would have been to use the same engine to apply its thrust in the opposite direction, and boost Mir to a safe high parking orbit to serve as the world's first space monument.

I am sure that many people, and most NASA employees, do not see it this way. But if I were one of them, there would be no non-compliant rag like MMM!

We need to remember Mir. It is part of our lore, one small proud part of the long epic march of mankind "out of Africa" and someday "to the stars." We celebrate Yuri's night.

Perhaps we should also honor the death of Mir – 3 weeks earlier in the calendar.

Yuri was a hero. Mir was a martyr if you will. May both be remembered forever as we gradually overcome our barriers in our drive to become the starfolk we were born to be. **PK**

MMM #247 - August 2011

Why it was necessary to end the Space Shuttle Program

Personal opinion by Peter Kokh

The Space Shuttle seemed like a great idea when we first heard about it. Then it was a proposal of Wernher von Braun, legendary rocket scientist at Peenemunde in Germany, behind the V-2.

But the space shuttle and station we got bore little resemblance to what he had in mind.

The Shuttle we got was "redesigned" by a political committee, not one of space engineers and scientists. Worse, Congress demanded it be designed so that the US Air Force could use it as well, and this demanded further expensive compromises. What we got was a mule not a thoroughbred horse.

The Shuttle sales pitch plugged its "economy." Wisconsin Senator William Proxmire warned that "the cost to build and cost to fly figures" were fiction. Back then many of us resented Proxmire, especially those of us from Wisconsin. But Proxmire had been right on.

> "The shuttle did not turn out like we planned," Dr. Story Musgrave told The Huffington Post. "It was going to [fly] 66 times a year and it ended up with about five times a year. It was going to cost $10 million a flight, and two months ago, an independent study showed that it cost $1.2 billion a flight. It was massively fragile, difficult to operate and exceedingly dangerous."

The idea that crew & cargo should fly together in one conjoined vehicle was also intrinsically flawed. Cargo on the shuttle flew at a much higher cost due to the extra expense of man-rating. Crew flew at extra expense because they were carrying a one-size-fits-all cargo hold/payload bay. That all new crew vehicles in development will carry crew only, says enough. The modular language is always best, compatible units with each having a number of versions tailored for the specific mission, brings maximum economy.

The big lie was that the shuttle was reusable. In truth, the shuttle was "overhaulable" not "reusable," requiring 10,000 man-hours to turn around. Can you imagine how much a flight would cost you if at each intermediate stop your plane required 10,000 man-hours to get ready for take off to the next airport?

All these man-hours were necessary because the Shuttle main engines, once fired, need a complete overhaul, and because we needed to rebuild the shuttle tile protection system, as labor-intensive a system as could be devised, one necessary only because NASA preferred a particular angle of attack on reentering the atmosphere, one considered unnecessary by others.

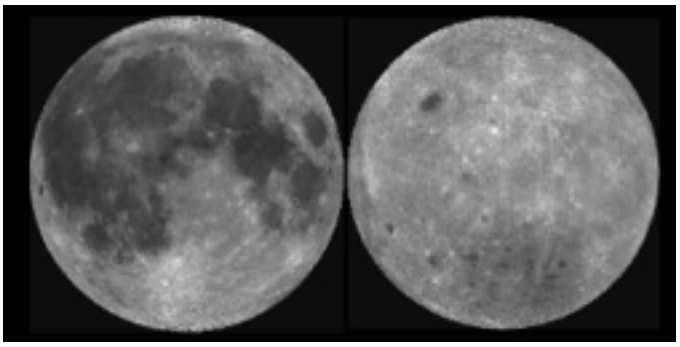
Space enthusiasts wanted the External Tanks put in a safe parking orbit for future use. Congress ordered NASA to do so. NASA found an out - they would do so only if someone contracted them to do so. "We'll show you who's the boss!" Each ET cost $50 to start with, this figure growing to over $173 million over time – Wbat was that about each Shuttle launch costing only $100 million dollars?

The throwaway mentality has ruled long enough.

The Shuttle worked, **yes!** It did great things, **yes!** We are proud of it, **yes!**. No one else has built such a capable transport system, **yes!** But NASA did so in a way that made no sense and which would be unsustainable in the long run. Not learning its lesson, NASA was on its way to build the Constellation system. The NASA program is a socialized space program: Not exactly "as American as Apple Pie." It's time to let the Commercials have at it. Americans have gloried in the Shuttle. But the Shuttle did not make use of the best of the American way. The real future is ahead of us. **PK**

MMM #248 - September 2011

The Moon: What's in it for Earth?



By Peter Kokh

, To most people, the Moon is a pretty sight, even romantic, but otherwise quite irrelevant. We need to show them how and why it isn't so, that opening the Moon is very relevant to us all.

To do this, we need to we need to firm up our own understanding of "**What's in it for Earth?"** Below are some key talking points. We may add to this list, and we will expand on each in upcoming articles, starting in this issue.

- **Continuing our Frontier-opening saga:** Humanity's "home world" is Africa. Over more than a hundred thousand years, we have expanded to one continent after another. This expansion has increased our cultural diversity, and, more importantly, our capacity to adapt to frontiers with differing sets of resources, and different plant and animal species. This Epic has demonstrated the all but unlimited capacities of the human endowment to adapt. In many ways, the Moon is just another continent across another kind of sea, and it is part of Greater Earth. Not to open the Moon would become humanity's first significant failure.

All past generations of youth have enjoyed the options offered by new frontiers. Do we have the right to close the frontier door for generations of youth to come?

- **Booster shot for World Economics:** The Moon is the ideal and most environmentally friendly source of raw materials with which to realize the maximum economic potential of GEO, already a significant contributor, nearing $300 Billion a year, to the world economy, through various kinds of satellite operations.

It would take 1/23rd the rocket fuel to bring needed materials down the gravity well to Geosynchronous orbit as it would to bring them up the well a much shorter distance from Earth – and without the air pollution so many rockets might create.

- **Technologies for Healing our Environment:** Sadly, to many people, the ever-increasing degradation of our environment is not a pressing concern. Yes, we worry about passing on to our children a shattered economy, but not about passing on a shattered environment.

There are several ways in which opening the Moon can help on both fronts. On the Moon, pioneers will live "downwind and downstream of themselves." There will be nobody else's back yard to dump in. The pioneers will have to learn to live in harmony with nature within their mini-biospheres under pain of death. We can learn from them what we would never bother to learn for ourselves because we do not feel the ill effects of our bad stewardship in the near term.

- **Zero-G Exports from Lunar bases and settlements:** Some, many in fact, doubt the economic feasibility of developing usable construction materials from moon dust. Not only has most needed research into lunar on location materials languished in the early theoretical stage, but little homework has been done on a step-by-step process to "bootstrap" lunar industries, except by the Moon Society's St. Louis Think Tank.

Be that as it may, there are some "Lunar Exports" that are immaterial but still of significant economic value. And we take this up in this issue.

The bottom line is that the answer to "the Moon, what's in it for Earth?" is "one heck of a lot!"
PK

MMM # 253 - March 2012

Turning the Detours along the Road to Space into Opportunities

Many "**Return to the Moon**" **Enthusiasts** lament the policy change taken by the Obama Administration. But stop and consider! The overly expensive "socialized and bureaucratic" NASA program was going nowhere, and any partial steps along that now (temporarily?) abandoned path would most likely to have led to "Flags & Footprints 2" - something that may have been temporarily exciting but have at best left the ruins of an outpost, a lunar "ghost town" to the relics of Apollo now dotting the Moon's nearside. NASA is set upon outdated, ill-conceived brute force rocket technologies.

Meanwhile, the new "Flexible Path" can advance technologies to serve a "Triway" of destinations:
(1) To the Asteroids (for planetary defense, science, and resources),
(2) To Mars to answer the questions about life long ago, and perhaps even today, to learn more about that fascinating world, and to prepare for establishment of a second "basket" for humanity, good in itself, but especially as humanity's insurance policy if something were to go terribly wrong on Earth: some environmental disaster, or a significant asteroid impact, and
(3) Back to the Moon, for scientific exploration of course, but also because anything pioneers could make for themselves out of lunar materials, could be shipped for 1/23rd the fuel cost to "markets" in Geosynchronous Earth Orbit, **GEO** for constructions of giant platforms hosting hundreds of satellites in the too few allocated spots (180 - 2° apart) and possibly solar power satellite arrays - and to Low Earth Orbit **LEO** - for the construction of large space stations, tourist hotels and more.

What is really exciting about the "Flexible Path" is that it would prioritize development of technologies needed to pursue each of those paths "successfully"

So time and resources sent to develop life support and transportation technologies (but 2 of a long long list of technologies needed in common) and in that sense, any "delay" encountered on this "Triway Detour" path will be a very productive and fertile one.

When we do "do" the Moon, it will be "done right, done for keeps," and same goes for the Asteroids, and for Mars.

Pouting by dedicated but "horse-blindered" Moon and Mars advocates is a waste of their time. **Get with it!** Yes, we may not get to your favorite destination as soon as you would like, and maybe **not in your lifetime**. Letting such highly personal goals get in the way of humanity doing in right, doing it for keeps, would be bogus. The priority of each and every one of us, and of the various destination-focused groups to which we may belong, is best served by doing it right, doing it for keeps. And as the key technologies needed to pursue each of these destinations are developments needed in common.

Nor should any of these Triway goals be pursued by any "national" space agency, as opposed to by an international effort. The experience of ISS is clear. As long as America (Congress and NASA) were proposing this goal separately, Congressional support was weak, unfocused, and ephemeral. Once President Clinton proposed that we build a station together with the Russians (to keep their scientists "out of mischief") Congress was motivated to give the go-ahead. And as we took on more and more "international partners" ISS took on a certain immunity to cancellation. We are all "human from Earth." And our individual histories are but local "episodes" of one shared epic: the Epic movement "out of Africa" to become an "Intercontinental" species.

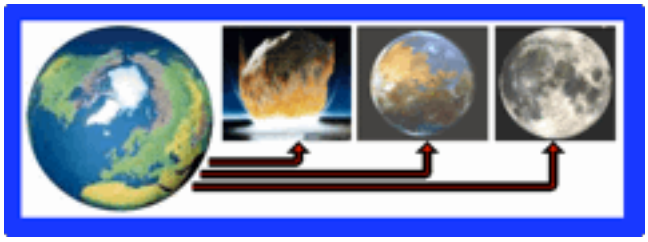
It has taken many thousands of years for this "intercontinentalization" to mature and ripen as it has in the past century. Yes, "ripen" is the right world as we now "bloom and seed" to "birth" a second "epic chapter" - we are about to become "Interplanetary."

Many, if not most people. are slow to see this, but crossing thresholds are always like this. We do not realize that we crossed one until we are well on the other side. The Moon is the nexus between our "intercontinental habitat" and our much larger "interplanetary" one. Nor, I am sure, will that be the

end of our "Out of Africa" epic. It is just a dream right now, but someday, if we play it right and do not selfishly destroy ourselves first for short-term economic advantages, some day, possibly less far in the future than we could reasonably expect, there is another "inter" level of "the beyond" out there. Someday we could, we might, we should become "interstellar."

Not to long ago, we Americans could delude ourselves into thinking that the future belonged to us, or would be led by us. But given the "globalization/intercontinentalization" of the "world economy" in the past decade or so (beginnings commonly go unnoticed) it is no longer possible to pretend that we are not all in this together.

The "flexible path" more aptly called the "Triway to Space" is pregnant with success.



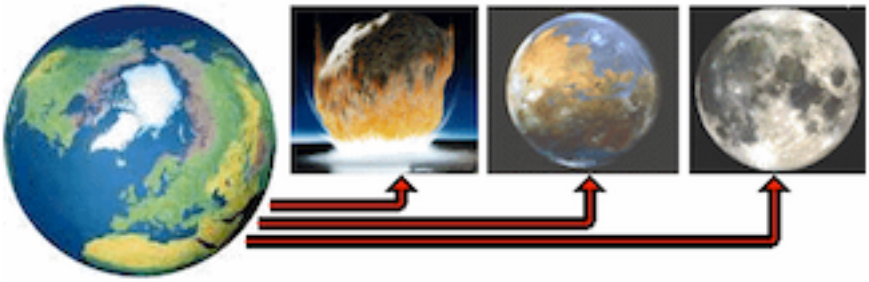
http://www.moonsociety.org/presentations/pdf/Triway1.pdf

We each owe it to our own dreams, to push this path forward. Moreover, it is a path tailor made for significant commercial contribution.

If you listened to the sorry debates by this year's crop of Republican presidential candidates, none of them is aboard the train to the future we all want. Gingrich alone seems pro-space. Romney dismisses space, The others ignore it. But the international approach will project a pro-space force that cannot be ignored, and a "Triway" approach will allow us all to reach our goals at a steadily accelerating pace, not the steadily decelerating pace that has prevailed since Apollo 17 boosted off the Moon 50 years ago next December. Take heart! **PK**

MMM #256 - June 2012

The Triway to Space



There are three principal human space expansion pathways

Each is focused on one or three principal imperatives in which space is key to the ultimate challenge facing humanity: **Survival!**

1. **Planetary Defense of our homeworld from potential impactors (Near Earth Asteroids)**
2. **Establishment of a viable exclave of human civilization on another world (Mars)** to guarantee human surveil should civilization on Earth fall victim to an impacting object, or to some other natural disaster, to implode through overpopulation and human-caused environmental degradation.
3. **Using space resources to halt and ultimately reverse environmental on Earth** through overuse of fossil fuels, and to make possible a more equitable global economy (**The Moon**)

By Peter Kokh and Al Alzandua (Moon Society Board Director)

For several months, Al and I have been working on a paper about destinations for Human Space Exploration. This project started when Al approached me, saying that he was impressed by our Triway Presentation.

http://www.moonsociety.org/presentations/ppt/ or http://www.moonsociety.org/presentations/pdf/

We decided to turn this into a paper for publication and widespread dissemination among the various space enthusiast groups. When we had something with which we were both happy, we presented it for review to David Brandt-Erichsen (former L5 Society leader) and to Moon Society Board member Ben Nault (both of Tucson, where Al also lives) both of whom made some helpful suggestions.

This paper has now been published by Space Review, and has received very positive reviews.

http://www.thespacereview.com/article/2078/1

We intend to seek publication it in as many other publications as possible.

The gist of the article is this: The Moon, Mars, and Asteroids are all important destinations, all three aimed at preservation of Humanity and of our home planet Earth. Rather than focus on rivalry and winning a pointless battle – we need to do all three – we should concentrate on development of the technologies needed in common for all three initiatives. This creates a united front that can convince Congress and the Administration that "we space enthusiasts "do have our act together." Without these technologies, we can do neither of the three. **PK/AA**

MMM #264 – April 2013

In Focus: Matching Research needs on Earth to those on the Moon, Mars.

Research in Hawaii Lays Groundwork for Developing Lunar Construction Materials

Report by Peter Kokh

On March 18, 2013 Space Age Publishing reported:

"A ... proposal by the Hawaii-based Pacific International Space Center for Exploration Systems (PISCES) is to **"develop "sustainable basalt concrete utilization" and "3D additive building techniques."**

This would provide Hawaii with a low-cost locally sourced alternative to imported (fossil) calcium carbonate-based concrete and facilitate analog experimentation for future Luna / Mars development." (Towards end/bottom of 1st of 2 reports for issue linked below)

http://www.spacecalendar.com/march-18-24-2013-vol-32-no-11-hawaii-island-usa/

Editor's Comment:

What is most interesting is that our member Steve Durst (Editor/author of these SpaceAge Publishing reports) **links this lunar and Martian need to an economic plus for the state of Hawaii**. That bodes well for these projects getting real support from the state of Hawaii.

I had long ago thought of using "technology needs" here on Earth as a driver for ISRU technology development. I had even thought of using technology needs in specific places here on Earth as opposed to terrestrial needs in general. We think of the concrete industry as being universal here on Earth. But that assumption is not true on Hawaii! or on/in other locations "happily unblessed" with the needed ingredients.

Applying this lesson to other Lunar Technology Problems

We had already noted in an early 1987 article about the possible terrestrial market for glass-glass fiber composites, a technology, if developed, could be most useful on the Moon, "replacing wood" for example, would also be marketable in desert or other areas without forests, if we learned how to supply many furniture needs.

Check: http://www.moonsociety.org/publications/mmm_papers/glass_composites_paper.htm

And maybe that is how we should try to "sell" additional ISRU ("on location" i.e on the Moon) technology developments: alternative building and manufacturing materials, but also in many other technology areas in which operations on the Moon will present a challenge. We have noted many times

that “lessons learned on the Moon” will pay for their development by application to special problems on Earth.

In anticipation that we will find this so, we might look around our well-blessed planet for

“Areas less blessed” to the point of being “Moon-like” or “Mars-like”
in the sense of being deficient or challenging in one respect or another.

This gives us **terrestrial market incentives** for pre-developing technologies we will need on the Moon. This reverse process we had dubbed “Spin-Up” as opposed to “spin-off,” finding a strong market here on Earth for the off-planet technology in question.

In "**spin-up**" a private enterprise, motivated by profit, examines a technology needed on the space frontier and endeavors to identify potentially profitable terrestrial applications.
He then develops the technology, specifically for those terrestrial applications, with the **consumer** paying the bill.

As a result, when the technology is needed on the space frontier, it is already "on-the-shelf", at least in an analogous form in need of relatively inexpensive adaptation only.
Taxpayers and consumers are materially the same people, but unwilling in the first instance, and willing in the second. - http://www.moonsociety.org/publications/m3glossary.html

More examples:

- **Needed Here:** A light, fast-deploy extendible-collapsable "ladder" into fresh sinkholes for rescue purposes.
- **Use on Moon & Mars:** quick lightweight, easily deployed access into lunar and Martian lavatube sky-lights.
- **Needed here:** organized army of heat-resistant robot “insects” that can survey places too dangerous to enter for survivors, or to report on damage in detail
- **Use on Moon & Mars:** report to surface rover on lip of a lavatube skylight about conditions inside the tube: map the tube; identify talus debris piles, etc. etc.

Needed Here: ???

Useful also on Moon & Mars: ???

Moon Miners’ Manifesto wants to pick your brains

- **Look for other matches** for **local terrestrial needs** vs. **technology needs on Moon and/or Mars**
- **Write up your idea for an Earth-Moon/Mars technology need match** and send it by email to **mmm@moonsociety.org** subject line **“technology match”**
  or by postal mail to: **Moon Society Publications, PO Box 395, Milwaukee, WI 53208**
- **No deadline:** This is an open-ended invitation Help us brainstorm the future and thus help us make it happen. “**sooner, better, stronger, cheaper**” etc. After all, that is what MMM is all about.

MMM #267 - August 2013

In Focus: Radiation Risk on Trips to Mars and Back - so?

It seems that we will encounter "discouragingly high" radiation en route to Mars and Back.

So what? There will always be a surplus of volunteers to take this risk, people who already have cancer in early stages, people who feel that such an opportunity would be the crowning jewel of their lives no matter what, smokers who look the other way on cancer as it is, etc.

The **risks taken by Columbus, Shackleton and many other explorers through the ages** has been order of magnitudes greater. What we see here in NASA’s (and the public’s) assessment is a “play-it-safe” “political timidity” where we let the lowest common denominator set the rules - a certain path to irrelevance. Political timidity didn’t create the world we live in today.

Frontiers have always been created by people who dared the odds, accepted the risk, for the chance at a life that would be more meaningful than the one they left behind. We’d like to think that NASA still has “the right stuff,” and is playing it safe in the hopes that there will be a strong reaction “to

go ahead anyway." In other words, they want the decision to be made for them. But the public at large is risk averse also. Thus it is up to individuals to dare the risks

MMM #269 - September 2013

In Focus: Turning the Annual Shrinkage in NASA's Budget into "a Good Thing"

If there is anything I have learned in my seventy-five years, it is that **anything "bad" can be turned into "something good" with the right attitude.** Year after year for some time now, NASA has seen its budget cut by amounts that "really hurt." The cuts have been translated into downsized and cancelled missions. That is how those with frozen attitudes and fixed habits react to less money.

Fortunately, there are those in NASA, in aerospace industry, and in academia who have used each such budget shrinkage as an opportunity to think and design "smarter" and "less expensive" equipment, instruments, and methods to achieve the same goals, and sometimes even more! Budget crunches have also meant opportunities for commercial contractors outside the usual NASA Corporate Cabal.

Space scientists have turned their frustration into ingenious designs of smaller, lighter instruments. The Cube Sat movement is showing surprising ingenuity. Piggyback packages are the in vogue. Almost every time a big science mission is cancelled, a re-thought, re-designed, replacement soon emerges that will achieve almost as much, if not even more science.

Less expensive launchers such as Space-X Falcon series are getting more orders.

Easy funding is the death of ingenuity and efficiency. As long as there is a will, we will keep finding ways to do not only what we had wanted, but even more than we had thought possible.

"**Praise the Darkness, and Creation Unfinished**" - Ursula K. LeGuin in "The Left Hand of Darkness." PK

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