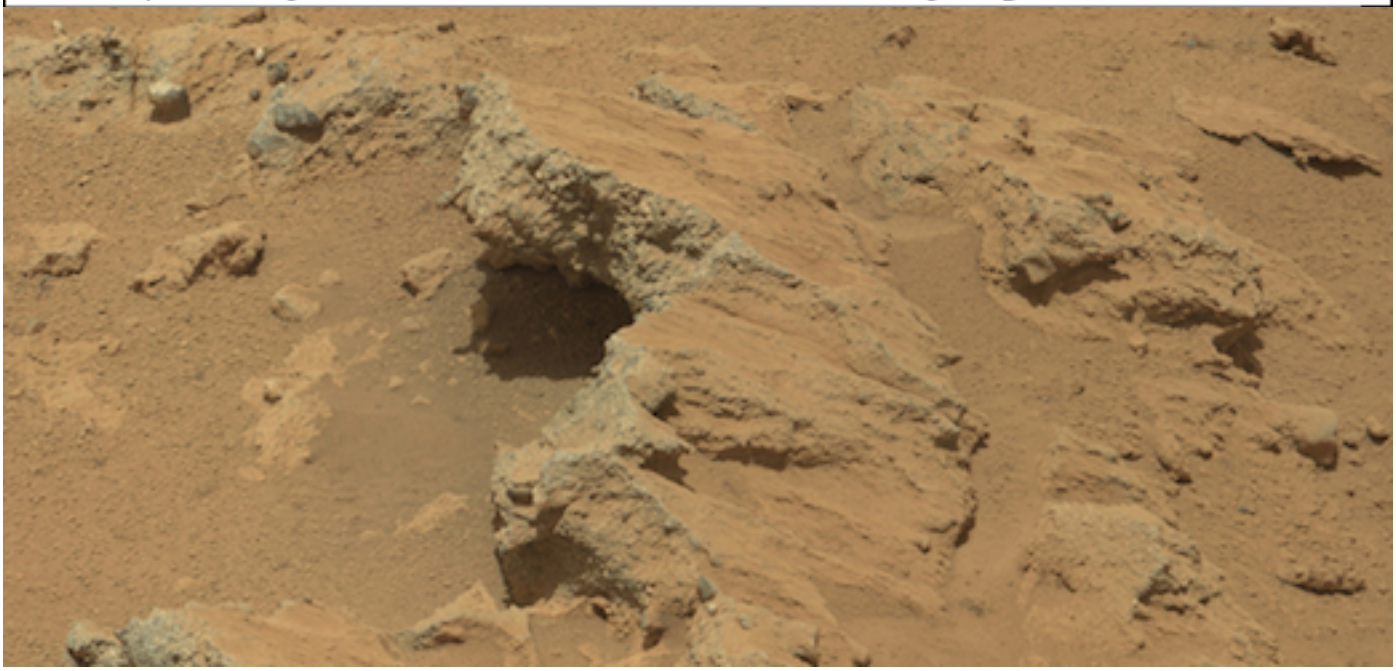
"Towards an Earth-Moon Economy - Developing Off-Planet Resources"

Moon Miners' Manifesto

India Quarterly Edition www.moonsociety.org/india/mmm-india/



Above: Photo of the Century? (so far!) The newly arrived Mars Science Laboratory **"Curiosity" finds rock formations that have been carved by swift running water over centuries.** (more p. 16) This means that the Cold Dry Mars model is no longer tenable. Two scenarios for Early Mars still remain: Cold-Wet Mars and Warm-Wet Mars. Of the two, given that the Sun is known to have not put out as much light/heat 3-4 billion years ago as it does now, the Cold-Wet Mars scenario would seem to have the betting edge. But is there, has there ever been life? Scientists hope that Curiosity may be able to find evidence of life, however primitive. if ever it existed on Mars

This issue has **special coverage of Mars-relevant material**

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About The Moon Society - http://www,moonsociety.org

Our Vision says Who We Are - We envision a future in, which the free enterprise human economy has expanded to include settlements on the Moon and elsewhere, contributing products and services that will foster a better life for all humanity on Earth and beyond, inspiring our youth, and fostering hope in an open-ended positive future for humankind.

Moon Society Mission - Our Mission is to inspire and involve people everywhere, from all walks of life, in the effort to create an expanded Earth-Moon economy that will contribute solutions to the major problems challenging our home world.

Moon Society Strategy - We seek to address these goals through education, outreach to people of all ages, through contests & competitions, workshops, ground level research and technology experiments, private entrepreneurial ventures, analog research and other means. ***We collaborate with Mars-focused and other organizations.***

About Moon Miners' Manifesto http://www.moonsociety.org/chapters/milwaukee/mmm/

MMM is published 10 times a year The December 2011 issue began its 26th year of continuous publication.

Most issues deal with the **opening of the Lunar frontier**, suggesting how pioneers can make best use of **local resources** and learn to **make themselves at home.** This will involve psychological, social, and physiological adjustment**.**

Some of the points made will relate specifically to **pioneer life** in the lunar environment. But much of what will hold for the **Moon**, will also hold true for **Mars** and for space in general. We have one Mars theme issue each year, and occasionally **other space destinations** are discussed: the asteroids, Europa (Jupiter), Titan (Saturn), even the cloud tops of Venus.

Issues #145 (May 2001) forward through current are as pdf file downloads with a Moon Society username and password. International memberships are $35 US; $20 students, seniors – join online at: http://www.moonsociety.org/register/

MMM Classics: All the "non-time-sensitive articles from past issues of MMM have been re-edited and republished in pdf files, one per publication year. A 3-year plus lag is kept between the MMM Classic volumes and the current issue. These issues are freely accessible, no username or password needed, at: www.moonsocietyorg/publications/mmm_classics/

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About MMM-India Quarterly - http://www.moonsociety.org/india/mmm-india/

This publication was launched with the August 2008 issue. The Moon Society was founded as an International organization, but it has few members outside the United States, mostly solitary and unorganized.

Looking Outward, Looking Back - When Dr. Abdul Kalam addressed the ISDC electronically from new Delhi in May 2010 in Chicago he made the statement: "India is a nation of 600,000 villages. ISRO has also pioneered the development of innovations in applications of satellite technologies in Earth observation to help people in rural India improve their agriculture, education, and health services. At the 2012 International Space Development Conference, held this past May in Washington, DC, US, student voices were concerns raised about the need to have a better balance between the emphasis on looking outward with space missions to the Moon and Mars and looking back at Earth to learn more about our home planet.

Why an MMM - India Quarterly?

India is a very populous country, and one in which, English is the almost universal medium of higher education. And – ***India has gone to the Moon!*** **Chandrayaan-I** was a very successful mission, one which has opened a new chapter in low cost exploratory missions and will be followed by string of Chandrayaan's that ISRO is developing.

We want to share with space-interested and space-enthused people in India, our vision of the possibilities for exploration and utilization of the Moon, development of lunar resources, not just to support a permanent population on the Moon, but to help better address chronic clean energy supply problems on Earth and to help slow and reverse our home planet's environmental degradation in the process. In short, we would like to share our glimpse of an emerging greater Earth-Moon Economy.

This vision was well-expressed by the former President of India, Dr. A. P. J. Abdul Kalam in a speech at The Symposium on "The Future of Space Exploration: Solutions to Earthly Problems" to mark the occasion of the 50th Anniversary of the dawn of Space Age, Boston University, Boston, MA, April 12, 2007. In this speech, Dr. Kalam made the point that to fully industrialize and become an equal partner in the future of our planet, India needs to access the unlimited clean undiluted solar energy available in space. We agree with this bold vision and want to share it with the forward-looking people of India.

Free Access: MMM-India Quarterly issues are available as a free access pdf file, downloadable from the address above
We encourage readers to share these files with others freely, and to use this publication to grow and cultivate wide-spread interest in the open-ended possibilities of space among the people of India, and to encourage the rise of additional citizen support space organizations within the country.

Indian Space News

ISRO launches historic "100th Mission" - 2 commercial payloads on board

http://www.hindustantimes.com/India-news/AndhraPradesh/**ISRO-scores-on-100th-mission-PSLV-rocket-launch-successful**/Article1-926906.aspx

September 9, 2012 **Bangalore:** ISRO successfully launched its 100th mission with the commercial launch of two foreign satellites from the spaceport of Sriharikota in Andhra Pradesh.

- The 720-kg SPOT-6 remote sensing satellite from France (built by ASTRIUM SAS)
- The 15-kg Japanese spacecraft Protieres. PROITERES is a landmark mission. It stands for Project of Electric-Rocket-Engine onboard Small Space Ship (PROITERES). If you're interested in the satellite specs, this is what the Earth2Orbit website offers - http://earth2orbit.com/portfolio/portfolio.html
- Osaka Institute of Technology built Protieres, and the Institute is Susmita Mohanty's company Earth2Orbit first customer, facilitating the launch via ISRO.

A recent press article in July, 2012 - http://www.indianexpress.com/news/isro-mulling-hiving-off-satellite-production-to-industry/966138/ notes that ISRO is capitalizing on the commercial space satellite industry, both satellites mentioned above, being commercial efforts.

Both were on board India's Polar Satellite Launch Vehicle (PSLV-C21.)

ISROs 3400-kg communication satellite GSAT-10 was also successfully launched between September 29 by European space consortium Arianespace Ariane-5 rocket from Kourou in French Guiana.
http://zeenews.india.com/news/space/**indias-heaviest-satellite-gsat-10-launched-successfully**_802598.html ◘

Sunita Williams flies India's tricolour flag on International Space Station on the occasion of India's 65th Independence Day celebration, August 15th

http://www.asianscientist.com/topnews/nasa-astronaut-**sunita-williams-displays-indian-tricolor-iss-2012/**

http://www.newsbullet.in/world/52-more/33867-**sunita-williams-unfurls-tricolour-in-space**

Sunita's father, Dr. Deepak Pandya, came from Gujarat. She visited Gujarat and Ahmedabad in 2009.

More on Sunita Williams

http://www.jsc.nasa.gov/Bios/htmlbios/williams-s.html
http://en.wikipedia.org/wiki/Sunita_Williams
http://www.monstersandcritics.com/news/india/news/article_1360270.php/Sunita_Williams_is_Gujarats_most_admired_personality
http://www.space.com/17624-female-astronaut-sunita-williams-commands-station.html ◘

Bangalore lab to develop Space Suit for ISRO Vyomanauts

http://www.asianscientist.com/in-the-lab/isro-debel-lab-design-space-suit-2012/
http://www.indiandefence.com/forums/indian-strategic-forces/14799-bangalore-lab-suit-up-indian-vyomanauts.html

[**vyomanaut**: an Indian astronaut **-** from Sanskrit (*vyoma*, "sky") + *-naut*]

July 30, 2012 ISRO hopes to launch its first Manned Space Capsule in 2016. But the capsule hardware is only part of the development effort. Indian astronauts will need "Space Suits." Rather than buy or adapt any suit used by the American, Russian, or Chinese space agencies, ISRO wants to develop its own "indigenous" space suit. To date, each spacefaring nation has developed its own suit(s) and not shared the technologies involved. It is fitting that India follow suite and develop its own suits.
http://en.wikipedia.org/wiki/Space_suit

Suits must hold pressure, keep the person inside comfortable through a range of temperatures outside. They must be designed to allow easy movement and function of the arms and legs. The helmet alone will be a major design and engineering project.

"(ISRO) has entered into an agreement with the Bangalore-based Defense Bioengineering and Electromedical Laboratory (DEBEL), which focuses on research and development in the area of aeromedical equipment, human engineering related to aviation, biomedical engineering, and life support system for the armed forces." DEBEL "is part of the state-owned Defense Research and Development Organization (DRDO). ◘

India may be only the 3rd* nation to reach Mars

While "**Curiosity,**" NASA's most ambitious Mars rover yet, does its work on the Martian surface, in little more than a year, if all goes as now planned, **India's Mangalayaan**-1** **Mars orbiter** will be on its way to Mars to learn more about Mars from above, in an eccentric orbit that ranges from 500 x 80,000 km above the surface. The probe will take about 10 months to reach Mars orbit in 2014.

http://space.skyrocket.de/img_sat/**mangalyaan__1.**jpg
http://4tvhyd.com/4tvnews/index.php/2012/09/india-to-launch-mars-mission-in-2013/

(China's Yinghuo-1 probe was launched on November 8, 2011, piggybacking a ride with the Russian Phobos-Grunt probe. While there was no problem with either probe, once in Earth orbit, the second rocket stage failed to ignite and both probes disintegrated in Earth's atmosphere as the initial orbit degraded.)

***** The Soviet Union (space agency now Russia's Roscosmos) Mars 2 crash landed on Mars in 1971. US NASA Mars probes reached Mars as flybys, orbiters, and landers 1973-76. - http://en.wikipedia.org/wiki/Exploration_of_Mars

** Hindi for Mars is मंगल or Maṅgala. ◘

Chandrayaan-2 Moon Lander/Rover Mission Update

http://www.ndtv.com/article/india/**india-s-next-moon-mission-depends-on-russia-isro-chief**-264928

According to ISRO Chairman K. Radhakrishnan. According to the original plan India will build the Orbiter and the Rover, and Russia is to supply the Lander. If Russia fulfills its part in time, the mission could still fly in 2014.

But given recent Russian failures with the Phobos-Grunt mission and other launches, there is real uncertainty about Russia's ability to do its part. However the mission does not depend on a Russian launch. ISRO has from the very beginning planned to use its heavier rocket - the Geosynchronous Satellite Launch Vehicle (GSLV) for this mission. Accordingly, for now, there seems no reason to presume the launch would be delayed. ◘

Renjith Kumar - The Indian Businessman who landed Curiosity

http://timesofindia.indiatimes.com/photo/15455733.cms

http://articles.timesofindia.indiatimes.com/2012-08-12/special-report/33166917_1_**mars-science-laboratory-mars-rover-mars-pathfinder**

> **"**The world watched as Curiosity, the Mars rover, triumphantly landed on the red planet this week. There were whoops of joy and euphoria among those who had toiled for years to make this possible. But for one Virginia-based Indian entrepreneur and engineer, it was a moment of quiet elation.
>
> Dr. Renjith Kumar, 49, is the CEO of a company which was closely involved with the rover's Entry, Descent, and Landing (EDL), or what is now being famously called the "seven minutes of terror."
>
> "Few in India know Kumar. This Thiruvananthapuram boy has come a long way from his palm-fringed state. "
>
> Kumar has been watching India's own forays into space and hopes its planned November 2013 mission to Mars is a success. Would he like to be part of it? "If Nasa is in collaboration with ISRO, say, through an MoU, we will be happy to be a part of this mission," he says."

More: http://www.indiaafricaconnect.in/index.php?param=news/4797

"Analytical Mechanics Associates (AMA), Kumar's company, has been in the forefront of the Mars mission since its inception. But then, AMA is an old hand at Mars missions, be it the Mars Pathfinder, Mars Exploration rovers Spirit and Opportunity, or the Mars Science Laboratory.

"AMA's dedicated work for NASA finally paid off. On February 13 this year, just as it turned 50 years, the company bagged a five-year contract worth a whopping $327.5 million with NASA's Langley Research Center. Nasa also conferred its highest honour for Quality and Performance, the George M Low Award, to AMA in 2010. It was named after Nasa's former deputy administrator and a leader in the early development of space programmes like Mercury, Gemini and Apollo."

"In the case of Curiosity, AMA had computer-simulated the dynamics of the spacecraft after it enters the Martian atmosphere. This included accurately modeling the Martian atmosphere and coordinating between various parts of the spacecraft such as the parachute, bridles, heat shield.

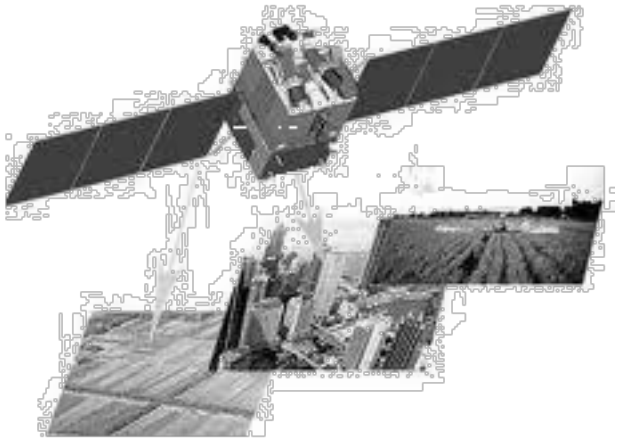
"We predict what the spacecraft is going to do during the actual mission," explains Kumar. "We were also involved in the spacecraft instrumentation called MEDLI (Mars EDL Instrumentation), which will measure aerothermal environments , vehicle orientation and atmospheric density. We are eagerly awaiting data from Curiosity to do postflight analysis which will be useful for future manned missions." ◘

Elsewhere in Asia

Chinese National Space Agency

Ziyuan III, China's 1st high-resolution, remote-sensing civilian satellite, begins service

http://www.chinadaily.com.cn/china/2012-07/31/content_15633168.htm



Launched on Jan 9, the satellite has now been turned over to the National Administration of Surveying, Mapping and Geoinformation. "Ziyuan" is Chinese for "resources." unlike its predecessors, Zihuan=3 can produce three-dimensional imagery with the three cameras attached to it at different angles.

Other improvements:

- The images' resolution is 2.1 meters, an improvement over 3 meters.
- Its multispectral camera designed to look for mineral resources, has a resolution of 6 meters,
- Ir transmit data at a speed four to five times of previous satellites.
- Its life expectancy is 5 years, up from 3 ◘

China to attempt its first Moon Landing 2nd half of 2013

http://www.telegraph.co.uk/news/worldnews/asia/china/9440125/China-to-attempt-first-moon-landing.html

July 31, 2012 - China's ambitious Chang'e-3 mission, which includes both a lunar lander and rover, appears to be on schedule. **There has been no soft-landing on the Moon of any kind since** the Soviet Union's successful Luna 24

lander sample return mission touched down in Mare Crisium on 22 August **1976**, a gap of 37 years (by same date 2013) If successful, this mission will boost China's prestige significantly.

It appears unlikely that any of the Google Lunar X-Prize Moon lander teams will successfully reach the lunar surface in operating condition before 2014 at the earliest. But that too will be a significant feat, perhaps even more so, as it will demonstrate significantly more economical ways of achieving our goals in space. ◘

China seeks to Cooperate Globally on Chinese Space Station

Visitors to Air show China exhibition visitors look at a model of **Tiangong-1** space station. Photograph: Ranwen/ Imagine china

http://www.asianscientist.com/topnews/china-cooperate-globally-to-build-chinese-space-station-2020/

Read the full report by M3IQ co-editor Srinivas Laxman (linked above).

Cheng Jingye, China's permanent representative to the UN made this announcement, while addressing the 55th session of the UN Committee On The Peaceful Uses of Outer Space at Vienna on June 6, 2012. Station construction is tentatively scheduled to begin in seeks. That is about the time when the current ISS may be dismantled and de-orbited, though pressures are building, especially among the ISS partners (other than US-NASA) to extend the station's lifetime for several more years.

According to Cheng, this program will prove beneficial to different **countries**, particularly those **that do not have space capabilities**. While the main partners in the US led International Space Station have space transportation capability, several other nations have participated both by contributing equipment and experiments and through their own astronauts, trained either by NASA or Roscosmos.

Germany is the first nation to show interest in the proposed Chinese "I"SS.

China already collaborates with **Peru**, **Bolivia**, and **Brazil** in South America, and has had collaboration feelers from **Argentina**.

In Asia, China collaborates with **Iran**, **Mongolia**, **Thailand**, **Bangladesh**, and **Pakistan**, and has had collaboration feelers from **Malaysia**, the **Philippines**, and **Sri Lankha**.

[While ISS partners **Russia, Canada, Japan, and ESA** are ready to welcome China to participate in the existing ISS, US legislation prohibits that. The US political climate is not yet favorable to a reconsideration. Both major parties seem to support the present policy, and that is shortsighted and discouraging. PK]

http://nasawatch.com/archives/2012/03/china-as-a-new.html ◘

Japan Aerospace Exploration Agency

SPIE Asia-Pacific Remote Sensing 2012 Symposium, Kyoto, Japan, 29 October - 1 November, 2012

The Symposium will focus on recent research in:

- Remote sensing of the atmosphere, clouds, and precipitation
- Land surface remote sensing
- Remote sensing of the ocean environment
- Lidar remote sensing for environmental monitoring
- Multispectral, hyperspectral, and ultraspectral remote sensing technology, techniques and applications
- Earth-observing missions and sensors: development, implementation, and characterization
- Remote sensing and modeling of the atmosphere, oceans and interactions

Symposium Chairs are **Upendra Singh,** NASA Langley Research Center. and **Toshio Iguchi,** National Institute of Information and Communications Technology (Japan)

Sponsors, in addition to JAXA and NASA, include ISRO

Location: Kyoto International Conference Center

SPIE is an international society advancing an interdisciplinary approach to the science and application of light, through interdisciplinary information exchange, continuing education, publications, patent precedent, and career and professional growth. ◘

Russian Space Agency

ROSCOSMOS

Russia Prepares to launch second Remote Sensing Satellite

http://www.interfax.com/newsinf.asp?y=2012&m=8&d=3&pg=7&id=352044

Roscosmos plans to orbit its second Remote Sensing satellite, Resurs-P environmental satellite N2 on October 25, 2012, on a Soyuz-2.1b carrier rocket. The **Resurs-P** series of Russian Earth observation satellites will be the successors of the Resurs-DK 1 satellite. This satellite will transmits data via a high-speed radio link to Russian ground stations. The status of natural resources, natural disasters, sea ice conditions and polar weather are available within a few hours to national and international organisations, as well as to private commercial customers. ◘

Russia tests "Quick Trip" to ISS

http://spectrum.ieee.org/aerospace/space-flight/russia-tests-quick-trip-to-space-station - an article by James Oberg

"What traditionally has been a two-day trip is now compressed to just 6 hours—but it might complicate international cooperation" - The complexity of the "**fast rendezvous scheme"** and of its options is such that the M3IQ editor would risk significant errors in any attempt to post a "synopsis." If Orbital Mechanics interests you, do read the article by James Oberg in the link given above. ◘

Russian launch of Indonesian Satellite fails

http://www.space.com/16969-russian-proton-rocket-launch-failure.html

http://www.RussianSpaceWeb.com/

Aug. 6, 2012 A pair of communications satellites was left in a wrong orbit by a launch from Baikonur spaceport in Kazakhstan that went wrong. The vehicle carried a 1,903-kilogram **Telkom-3** for Indonesian company PT Telekomunikasi Indonesia Tbk and a 1,140-kilogram Russian **Ekspress-MD2** communications satellites.

While the payload section successfully reached its initial orbit, the third out of five planned maneuvers failed. The engine had fired for only seven seconds instead of planned 18 minutes plus. The launch was insured.

Russia Starts Building Manned Moon Ship

http://www.space-travel.com/reports/**Russia_starts_building_Moon_spaceship_eyes_Lunar_base**_999.html

July 24, 2012 Aiming at a test flight in 2015, Roscosmos has begun design of a spacecraft capable of taking a manned capsule to the Moon. A first manned Moon landing would not occur before 2018, hopefully winning the race to "be next" after the American feat in 1969, some 49 years earlier.

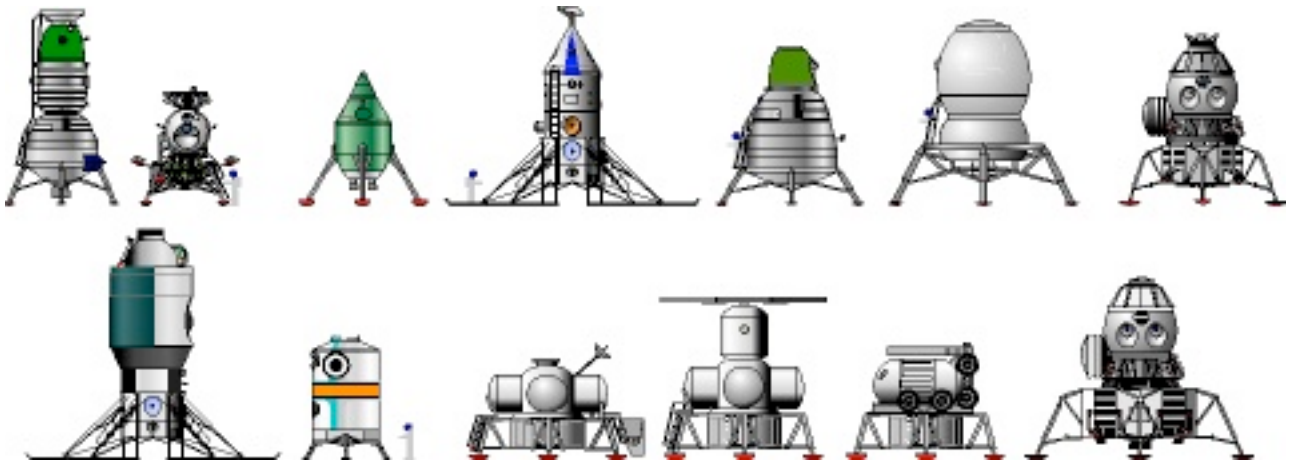
This project requires construction of a whole system: perhaps 3 rocket stages, a manned lunar orbiter which would bring the cosmonauts back to Earth, and a 2-stage landing/departure craft - if the architecture of the NASA Moon missions is followed. Russia could, however, revisit the old Soviet Union plans for manned Moon landings dating from the 1960s.

http://en.wikipedia.org/wiki/Soviet_manned_lunar_programs

http://www.fas.org/spp/eprint/lindroos_moon1.htm

http://www.zmescience.com/science/astronomy/lk-lander-the-soviet-moon-landing-program-photos/

http://www.astronautix.com/craft/lk.htm



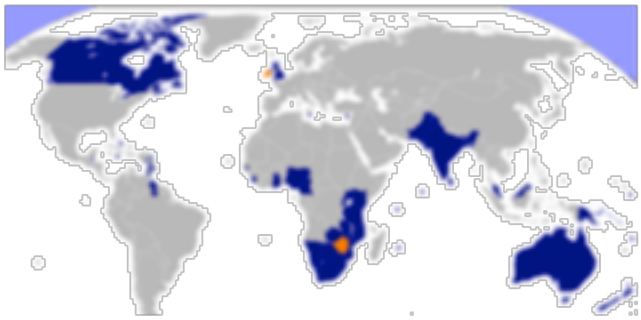
Past Soviet Moon Lander Design Sketches

The "final" moon lander module design? - http://www.astronautix.com/graphics/l/lkoverhd.jpg

Much depends on whether Russia's commitment to support the International Space Station is to be extended past 2020, when current international commitments expire. "It is necessary to determine the main direction of manned cosmonautics development. Current strategy envisages focusing on the manned flights to the Moon, including the creation of a base on its surface," said head of the Central Research Institute of Machine Building Gennady Raikunov.

Long range Roscosmos plans include manned Moon landings as a stepping stone to a manned mission to Mars. It must be kept in mind, however, as a reality check, that Russian funding for Roscosmos is very minimal. But with China hoping to land a Taikonaut on the Moon in 2020, Russian pride may force a funding sea-change Having lost the first "Moon Race," Russia would not want to lose a second time. That said, China's space program is in high gear, Russia's just hobbling along in paper studies. ◘

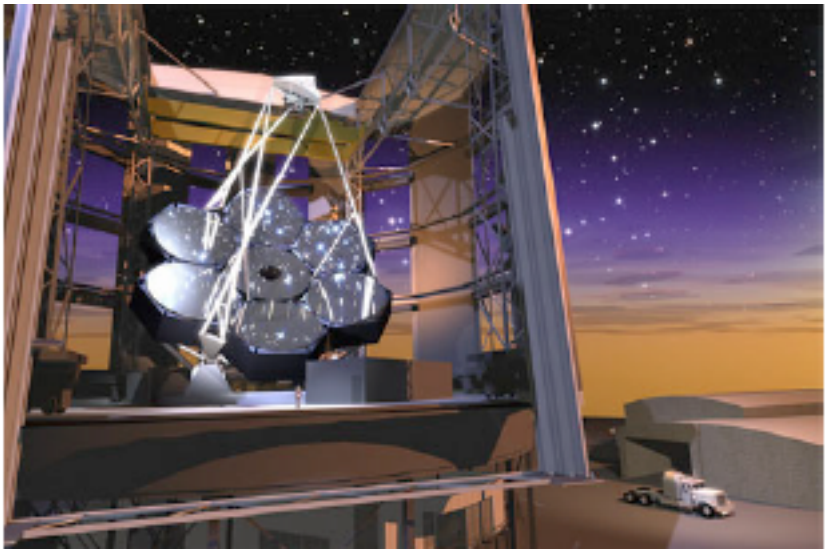
Elsewhere in the Commonwealth



Australia to build "Super Telescope" in Chile

http://www.asianscientist.com/topnews/australian-scientists-build-super-sized-telescope/

April 18, 2011 Researchers at the Australian National University are helping to build a super-sized telescope that will allow scientists to see deeper into space in the visible light range. Called the Giant Magellan Telescope (GMT), it will have a primary mirror 24.5 meters in diameter and produce images up to 30 times sharper than existing ground-based telescopes. The GMT will be built, not in Australia, but in northern Chile's Atacama Desert, the world's premier observing site for clarity and dryness of the air.



The instrument should be operational by the end of the decade (2020). Australia is contributing enough money to build the instrument and to "buy observing time" for Australian astronomers.

Australian National University - http://anulib.anu.edu.au/

Chile's Atacama Desert - World's Space Observatory Mecca:

http://www.dailygalaxy.com/my_weblog/2007/08/the-driest-plac.html ◘

Canada Space News

http://spaceref.ca/organizations/canadian-space-society/**annual-canadian-space-summit-to-be-held-in-london-ontario-in-november-deadline**-for.html - last year's summit was held in Calgary, Alberta

http://www.montrealgazette.com/business/Quebec+astronaut+unconventional+assignment/7212428/story.html

(to participate in European Space Agency "Caves" analog exercise) ◘

South Africa to launch "mini" nano-satellite into space

http://allafrica.com/view/group/main/main/id/00018802.html

A mini satellite weighing 1.2 kilograms, will be launched from the Cape Peninsula University of Technology (CPUT) in November to collect information about space weather. To run on the same amount of power used by a 5-watt light bulb, "**ZACUBE-1**" cost much less and was 84 times smaller than Sputnik. I will be launched from Russia. ◘

36 Dishes of the Australian Square Kilometre Array begin Searching Universe

www.smh.com.au/technology/sci-tech/**mighty-telescope-begins-scouring-universe**-20121005-273mp.html

The Australian Square Kilometre Array Pathfinder is the world's most powerful telescope system.
October 5, 2012 – In remote Murchison, 315 km NE of Geraldton, Western Australia, the complex opened today.

"The $400 million project has already been booked out for its first five years by 350 international researchers, who will conduct projects including a census of galaxies within several billion light years of Earth, and studies of magnetic fields and black holes. .... part of the science program would be the search for intelligent life."

36 dishes will in time be joined by 60 more, all incorporated into phase one of **the international SKA project, hosted jointly by Australia-New Zealand and South Africa**. The project is capable of detecting low and middle-level frequencies, while a sister project in South Africa will focus on high frequencies.

The Australian SKA would be able to detect 40 gigabytes per second. "In the first full day of operation, ASKAP will generate more information than exists in the US Library of Congress. That is more information than all the radio astronomy archives around the world today ... In one day the SKA will generate more information than the equivalent of all the words spoken by the human race." ◘ For news on South Africa's component, see p.

Elsewhere in the World

EUROPE-ESA

Ukraine Symposium Focuses on Mitigating Threats to Humanity

http://www.spacecalendar.com/september-3-—-9-2012-vol-31-no-36-hawaii-island-usa/

The Fourth International Specialized Symposium: Space and Global Security of Humanity took place September 3-7 in Yevpatoria, Ukraine. The focus was on creation of systems that provide the international community with early warning of global risks and threats,. That includes dangers originating in space.

The conference is organized into three sections.

1. Modern Space Exploration Strategy and Security, focused on the "social, philosophical and long-term objectives of modern space exploration with respect to security, the role advanced space technologies play in mitigating natural and industrial hazards and space-awareness regarding natural and industrial emergencies."
2. Results of the International Global Monitoring Aerospace System (IGMASS) Design, a project that seeks to discover precursors to natural and man-made calamities through the simultaneous use of space, air and land-based equipment to forecast disasters and other emergencies.
3. Utilization of IGMASS Navigation and Telecommunications Resources for Development of a Unified Information Security Field, focusing on warning systems for potential planetary hazards from space, the prevention of near-Earth orbit obstructions, training specialists for space research and the application of space activity outcomes. (Image Credits: IGMASS, **SpaceAgePub find other sources**

4.

ESA's EXO-MARS project Advances

http://www.marsdaily.com/reports/ExoMars_program_gathers_strength_999.html

July 23, Moscow - Exo-Mars was initially an ESA-NASA collaboration, but when, under acute budget pressures, NASA withdrew, in February of this year, Russia's Roscosmos eagerly stepped in to restore the viability of this exciting Mars exploration project. The two agencies are expected to sign an agreement on the implementation of the second stage of the ExoMars program this fall, headed for a 2018 launch window. Russia would assume half of the work load. "Several spacecraft elements to be sent to Mars on two launches. The launch of Entry, Descent and Landing Demonstrator Module (EDM), as well as the Trace Gas Orbiter (TGO) is scheduled for 2016."

ESA will be responsible for the EDM, Roscosmos for the TGO. Russian made instruments "will include three infra-red spectrometers, designed to study Mars' atmosphere for sources of methane, carbonic dioxide and water.

spectrometers will also help monitor temperature in the atmosphere," Zakharov says. "The Russian equipment on the ExoMars will also include a neutron detector to study water distribution under Martian ground up to 1 meter deep."

Scientists want to find out how Methane originated on Mars as there are no volcanoes on Mars which are one of the sources of this gas and it could have a biological origin. NASA's Curiosity, now on Mars, will be monitoring Methane levels as well.

The landing platform, which was designed by Russia's Lavochkin scientific development and production center, will deliver the European mars rover to the planet's surface.

ESA Exo-Mars Site: http://exploration.esa.int/science-e/www/area/index.cfm?fareaid=118

◘

SOUTH AMERICA

Ukraine and Brazil collaborate on Cyclone-Alcantara Spaceport Project

Above Left: Cyclone-4 **Above Right:** Map showing proximity of the **Kourou** and **Alcantara** space ports to the Equator

http://eng.obozrevatel.com/ukraine-and-the-world/**ukraine-ready-to-invest-in-alcantara-cyclone-space-joint-project-with-brazil**.htm

A joint venture to build the capacity to launch Ukraine's Cyclone-4 rockets from Brazil's Alcantara Spaceport has been resumed, aiming at a first launch in 2013.

At just 2.3 degrees south longitude, the closest to the equator of any spaceport, Alcantara is ideal for launching to geostationary orbit.

http://en.wikipedia.org/wiki/Alcântara_Launch_Center

"Brazil has the most advanced space program in Latin America, with significant capabilities in launch vehicles, launch sites, and satellite manufacturing."

The Ukraine does not have a launch site for its rockets. Brazil does not have rockets of its own, other than sounding rockets (the Sond and VS series) so this is an ideal partnership for both nations.

http://www.npointercos.jp/Cyclone4.html - http://en.wikipedia.org/wiki/Tsyklon-4

Cyclone-4 can launch satellites (either single or cluster) with a total mass of up to 5,300 Kg to the equatorial low earth orbit (LEO) or a 1,600 Kg satellite to geostationary transfer orbit (GTO)

http://www.globalsecurity.org/space/world/brazil/facility.htm

http://www.hobbyspace.com/nucleus/index.php?itemid=30291

http://www.hobbyspace.com/AAdmin/Images/Transport/Brazil/BrazilLiquidPropulsion.jpg ◘

NORTH AMERICA - USA

NASA: Dawn probe departs Vesta for Ceres

http://www.allvoices.com/contributed-news/12925489-nasa-probe-dawn-departs-from-asteroid-vesta-en-route-to-dwarf-planet-ceres

September 6, 2012 - After mapping and studying the amazing asteroid Vesta for 13 months, Dawn left its orbit around this fascinating mini-word on a new trajectory bound for the largest asteroid, now considered a "dwarf planet," Ceres. Vesta may have originally been spherical, but impacts have flattened it considerably, but Ceres which is half again as large in diameter, is expected to be more spherical in shape. Scientists also expect it to have an ice-rock crust which might be hiding an ocean underneath, much like Europa. That opens the door for the possibility that life may have originated on Ceres, then possibly have spread to Mars, then Earth, as Ceres would have reached a stage where it could give rise to life, before Mars, which in turn could have harbored life before conditions were ripe on Earth.

Dawn is expected to arrive at Ceres in 2015, and go into orbit around it. Meanwhile, the New Horizons probe should be reaching Pluto and its sister world Charon that same year, but just for a flyby.

Some Vesta links: http://en.wikipedia.org/wiki/4_Vesta

http://www.space.com/17389-take-a-tour-of-vesta-the-giant-asteroid-explored-by-nasa-s-dawn-spacecraft-video.html

http://news.discovery.com/space/protoplanet-vesta-asteroid-dawn-120510.html

http://www.time.com/time/health/article/0,8599,2114774,00.html

http://www.nasa.gov/mission_pages/dawn/news/dawn20120425.html

Some Ceres Links:

http://en.wikipedia.org/wiki/Ceres_(dwarf_planet)

http://www.britannica.com/EBchecked/topic/103501/Ceres

http://www.solarviews.com/eng/ceres.htm

http://www.lpi.usra.edu/decadal/sbag/topical_wp/AndrewSRivkin-ceres.pdf

Ceres, Vesta, and Europe Size comparison

Ceres' surface slightly is larger than Argentina, slightly less than India, comparable to the US East of the Mississippi. Ceres' gravity is ~2% Earth normal or 1/6th that of the Moon (which is 1/6th that of Earth) ◘

Space-X tests "grasshopper" technology needed for "first stage rocket reusability"

http://www.space.com/17868-**spacex-grasshopper-reusable-rocket-test**.html

Photo: http://i.space.com/images/i/22369/original/**spacex-grasshopper-reusable-rocket**.jpg?1349217055

NASA (US) & CSA (Canada) Lunar Analog Exercise in Hawaii

http://www.nasa.gov/home/hqnews/2012/jul/HQ_12-237_NASA_Hawaii_Missions.html

Hilo, Hawaii Island, HI, USA July 19, 2012 - This month, NASA conducted **a nine-day field test** outside Hilo, **to evaluate new exploration techniques for the surface of the Moon.** Analog mission simulations are conducted in terrain that in some ways resembles that of the Moon, or Mars as the case may be. Analog locations are often in remote areas. The top analog sites in North America are the SE deserts (NASA Desert RATS), in Utah (Mars Desert Research Station, on Canada's far north Devon Island (Mars Arctic Research Station and the Haughton-Mars Project) and here on Hawaii Island (PISCES.)

This Mission was a collaboration with the Canadian Space Agency and with the Pacific International Space Center for Exploration Systems (PISCES) whose members include State of Hawaii, Canada, Japan, and Germany.

Previous articles on PISCES in M3IQ

M3iQ #11 p. 29 "International Lunar Research Park Proposed'

M3IQ #13 p. 41 "Creating a Foundation in Hawaii for "The Next Giant Leap" Pisa, Pisces, and ILRP" - Dave Dunlop

Canadian Space Agency (CSA)'s **Artemis Jr. rover** holds the Regolith and Environment Science and Oxygen and Lunar Volatiles Extraction (RESOLVE) instruments to drill for water ice and other resources during a simulated mission. Photo: NASA/Joe Bibby

The test area has lava-covered mountain soil similar to the 3+ billion years old volcanic plains ("mare" singular, "maria" plural) on the Moon. The rover and its onboard instrumentation are c. 79 cm tall and weigh about 300 kg, three times more than equipment to be used on an actual mission.

Most PISCES analog activities are set on the slopes of Mauna Kea, a dormant shield volcano.

The two main tests are the Regolith and Environment Science and Oxygen and Lunar Volatile Extraction (RESOLVE) and Moon Mars Analog Mission Activities (MMAMA), a group of small projects and tests to define the requirements for navigation, mobility, communications, sample processing, curating and other critical elements in future science/exploration missions.

The ultimate goal is to be able to use local resources on the Moon and Mars in order to lessen the mass of tools and materials that must be brought from Earth at great expense. This avenue of research is called "In SITU" meaning on site resource usage. If we are to explore the Moon and Mars more extensively, and go on to establish permanent outposts, such use of local resources and the materials that can be made from them is absolutely critical.

When it is fully developed, PISCES will feature a simulated lunar outpost (robotic and human) on the Island of Hawaii. PISCES is leading the effort in the **International Lunar Research Park** concept by laying the foundations for integration, testing, validation and verification of technologies and systems for this global project.

links: http://pisces.uhh.hawaii.edu/ - https://sites.google.com/site/internationallunarresearchpark/ ◘

UNITED STATES - **Mars Science Lab "Curiosity" lands successfully!**

Report by Peter Kokh

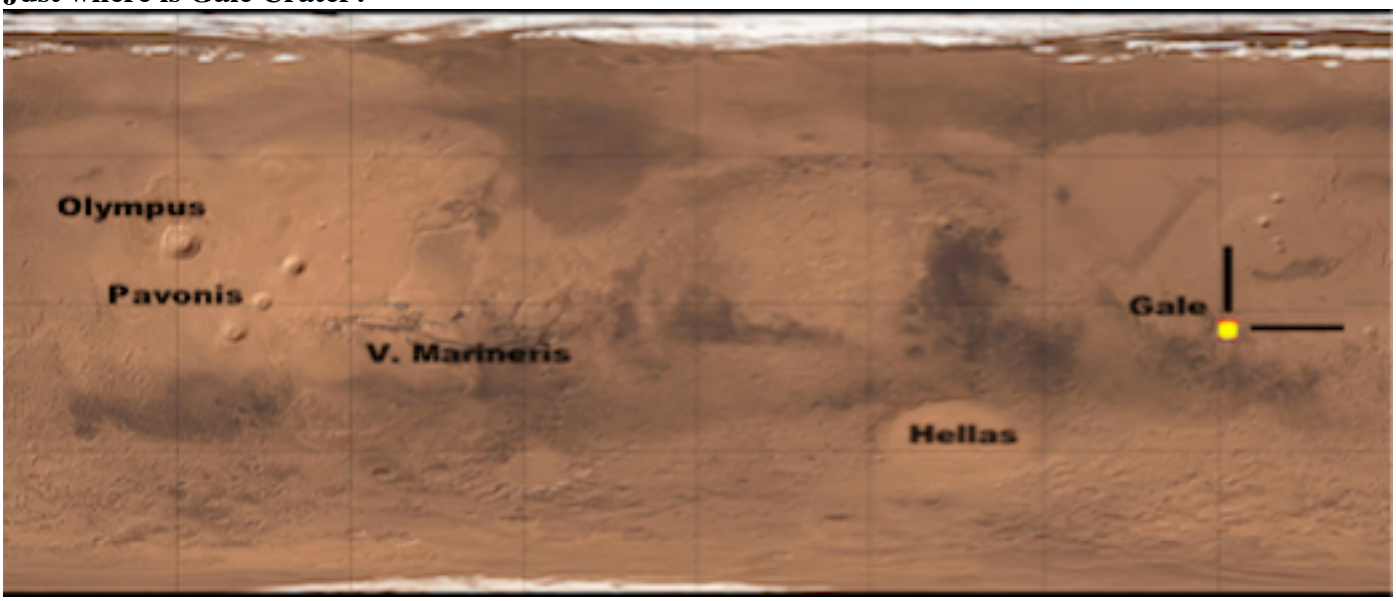
In the control room at NASA's Jet Propulsion Laboratory in Los Angles, California, it was pandemonium, 10:23 pm Pacific Time, August 5, 2012 as the feed came in confirming that Curiosity had landed safely, in operating condition, right where it was intended to land, in by far the most complicated landing procedure ever attempted.

Watch **Control RoomVideo** (landing sequence animated) **http://www.youtube.com/watch?v=N9hXqzkH7YA**

Links: http://www.space.com/16801-**mars-rover-curiosity-science-instruments-infographic**.html
http://www.marsdaily.com/reports/**Mars_rover_takes_cool_detour**_NASA_999.html
http://www.space.com/17243-**mars-rover-curiosity-test-drive-coded-tracks**.html
http://www.space.com/17238-**mars-rover-curiosity-ray-bradbury-memorial.**htm

Videos: http://www.space.com/17235-**curiosity-s-first-drive-on-mars**-video.html
http://www.space.com/17608-**was-ancient-mars-a-wetter-place-curiosity-will-look-for-the-evidence-video**.html

Just where is Gale Crater?



http://en.wikipedia.org/wiki/Gale_(crater)

"**Gale** is a crater on Mars near the northwestern part of the Aeolis quadrangle at 5.4°S 137.8°E.[2] It is 154 km (96 mi) in diameter[1] and estimated to be about 3.5-3.8 billion years old.[3] The crater was named after Walter Frederick Gale, an amateur astronomer from Sydney, New South Wales, Australia, who observed Mars in the late 19th century.[4] Aeolis Mons is a mountain in the center of Gale Crater and rises 5.5 km (18,000 ft) high.[5][6] Aeolis Palus is the plain between the northern wall of Gale Crater and the northern foothills of Aeolis Mons.[5][6] The NASA Mars rover, *Curiosity*, of the Mars Science Laboratory (MSL) mission, landed in "Yellowknife" *Quad 51*[7][8][9][10] of Aeolis Palus in Gale Crater at 05:32 UTC August 6, 2012.[11] NASA named the landing location Bradbury Landing on August 22, 2012.[12] *Curiosity* is expected to explore Aeolis Mons and surrounding areas."

How Curiosity Works - http://science.howstuffworks.com/mars-curiosity-rover.htm

Curiosity's Rocker-bogie 6-wheel suspension - http://en.wikipedia.org/wiki/Rocker-bogie

Slow crawl - http://www.space.com/17220-mars-rover-curiosity-martian-driving.html

> **"**Curiosity's drivers guide the six-wheeled robot — not with a joystick, but via commands uploaded on a daily basis." "The rover may be powered off while we're actually doing our planning, and so we'll have eight or more hours to do our sequencing," said Jeff Biesiadecki of NASA's Jet Propulsion Laboratory in Pasadena, Calif. "Then we'll send up a command load to the rover and tell it step-by-step what it needs to do."
>
> **http://www.guardian.co.uk/science/blog/2012/aug/05/mars-curiosity-rover-slower-speeding-snail**
>
> "20 meters per day" Note that while it takes less than 3 seconds to get a signal to the Moon and back, it takes from 6-40 minutes to get a signal to get a signal to Mars in back. Why? The Moon orbits Earth at a distance that varies little over the month. Mars orbits the Sun independently of Earth, on its own pace so that the Earth - Mars distance varies enormously.

Science goals - http://science.nasa.gov/science-news/science-at-nasa/2011/26nov_msllaunch/

"Curiosity's ambitious science goals are among the mission's many differences from earlier Mars rovers. It will use a drill and scoop at the end of its robotic arm to gather soil and powdered samples of rock interiors, then sieve and parcel out these samples into analytical laboratory instruments inside the rover. Curiosity carries 10 science instruments with a total mass 15 times as large as the science-instrument payloads on the Mars rovers Spirit and Opportunity. Some of the tools are the first of their kind on Mars, such as a laser-firing instrument for checking the elemental composition of rocks from a distance, and an X-ray diffraction instrument for definitive identification of minerals in powdered samples." "To haul and wield its science payload, Curiosity is twice as long and five times as heavy as Spirit or Opportunity."

http://mars.jpl.nasa.gov/msl/mission/science/goals/

Goal 1: Determine whether life ever arose on Mars

Goal 2: Characterize the climate of Mars - for details check link above

Goal 3: Characterize the geology of Mars - for details check link above

Goal 4: Prepare for human exploration - for details check link above ◘

Curiosity finds Proof that there was once Running Water, for Long Periods, on Mars

FLASH: September 27, 2012 - http://www.nasa.gov/mission_pages/msl/news/msl20120927.html

"The Curiosity Rover has found evidence of an ancient stream that flowed vigorously on Mars where the Rover is now exploring," NASA said on Thursday. "This is "definitive proof" that water once existed on Mars. ... Stream bed gravels were observed among the rocks on the surface of Mars."

"From the size of gravels it carried, we can interpret the water was moving about 3 feet per second, with a depth somewhere between ankle and hip deep," said Curiosity science co-investigator William Dietrich of the U. of California, Berkeley. "The rock outcrop was named "Hottah" after Hottah Lake in Canada's Northwest."

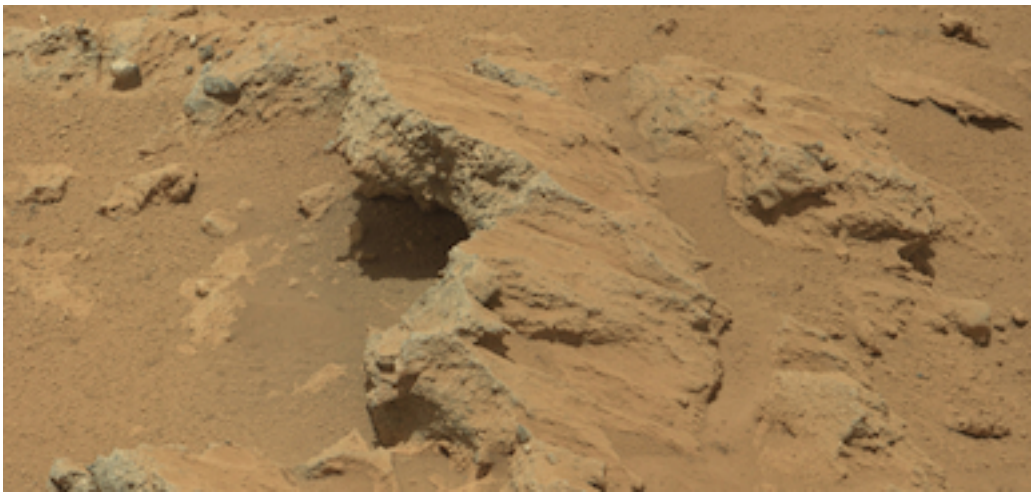
Additional images: http://www.huffingtonpost.com/2012/09/27/**mars-stream-photos-images**_n_1920770.html

Helpful Infographic: http://www.space.com/17805-**mars-water-streambed-curiosity-rover-infographic**.html

Video: http://www.space.com/17797-**water-rushed-on-mars-curiosity-finds-video**.html

Wind in Mars' feeble atmosphere, could not have shaped this landscape. It was just the hope of such a discovery that led to Curiosity being directed to an "alluvial fan" like area in Gale Crater.

One of Curiosity's primary goals has been to determine whether or not water once flowed on Mars surface, and if so, for how long. There have been two "camps" one postulating a wet Mars, another a dry cold Mars. This find is a long way from being evidence that Mars once supported life, but it means that the emergence of life on Mars cannot be ruled out. Curiosity's findings in the months to come, may provide powerful motivation for a carefully directed "Sample Return Mission," and indeed for future human exploration missions to Mars. It is also encouraging information for those who believe that a sustainable human presence on Mars is possible.



Another amazing photo: http://www.nasa.gov/images/content/692229main_pia16156-673.jpg

Other NASA space probes in operation or en route

GRAIL Gravity Recovery and Interior Recovery

http://en.wikipedia.org/wiki/GRAIL - http://www.nasa.gov/mission_pages/grail/main/index.html
http://solarsystem.nasa.gov/grail/home.cfm
http://www.jpl.nasa.gov/news/news.php?release=2012-273&rn=news.xml&rst=3502

August 31, 2012 - the original mission completed, and both craft "**Ebb**" and "**Flow**" in good condition, NASA has extended the mission from August 30 to December 3. Both craft have descended to a lower altitude above the Moon so that gravity and density measurements can be taken at higher resolution, yielding information about the surface and subsurface beyond expectation for the original mission. "deriving the gravitational influence of surface and subsurface features as small as simple craters, mountains and rilles," "flying at the lowest altitude that can be safely maintained" "half of the original altitude" above the surface."

There is some hope that some of the larger near-surface lava tubes may be mapped. This would be an exciting bonus for this mission.

Juno - "unlocking Jupiter's Mysteries"

http://www.nasa.gov/mission_pages/juno/overview/index.html

On September 14th, Juno will get a gravity assist from a flyby of Earth on Oct. 9, 2013. Juno will arrive at Jupiter on July 4, 2016. "Once in orbit, the spacecraft will circle Jupiter 33 times, from pole-to-pole, and use its collection of 8 science instruments to probe beneath the gas giant's obscuring cloud cover. We will learn about Jupiter's origins, structure, atmosphere and magnetosphere, and look for a potential solid planetary core."

Cassini

http://www.nasa.gov/mission_pages/cassini/timeline/index.html
http://en.wikipedia.org/wiki/Cassini–Huygens_timeline

Cassini entered the Saturn system May 18, 2004. In its elongated orbit, the orbiter probe continues to probe Saturn's secrets (rings, atmosphere and more) ad well as its many moons, including perhaps the most intriguing world in the Solar System, **Titan.**

Recent Titan Updates:

http://www.nasa.gov/mission_pages/cassini/whycassini/cassini20120829.html - Titans true colors
http://www.nasa.gov/mission_pages/cassini/whycassini/cassini20120710.html - Titans seasons
http://science.nasa.gov/science-news/science-at-nasa/2012/28jun_titanocean/ - Titans sub-crust ocean
http://www.space.com/17829-**titan-lakes-boat-talise-mission**.html

June 28, 2012: Data from NASA's Cassini spacecraft have revealed Saturn's moon Titan likely harbors a layer of liquid water under its ice shell. The finding appears in today's edition of Lesshe journal *Science*. "Cassini's detection of large tides on Titan leads to the almost inescapable conclusion that there is a hidden ocean at depth," said Luciano Less, the paper's lead author and a Cassini team member at the Sapienza University of Rome, Italy. "The search for water is an important goal in solar system exploration, and now we've spotted another place where it is abundant."

Awards for Entrepeneurial Innovation given at "New Space" Conference in US

Report by Peter Kokh

In most nations, "space-related innovation" is the territory of national space agencies and of their contractors. But in the United States, for some time now, there has been a growing "New Space" movement pushed by The Space Frontier Foundation [http://spacefrontier.org/] at the annual New Space conferences [] held south of San Francisco, California near the NASA AMES center at Moffett Field, CA. "New Space" - http://en.wikipedia.org/wiki/NewSpace - is "an umbrella term for a movement and philosophy ... associated with relatively new aerospace companies working to develop **low-cost access to space or spaceflight technologies**."

The Space Frontier Foundation was organized in 1988 specifically to promote entrepreneurial development of space technologies outside of NASA, its Centers, and its primary contractors. SFF has been the driving force behind innovation by entrepreneurs in the two and a half decades since. SFF was the primary driver behind the effort that led to the Lunar Prospector mission in 1998-9, starting with a special conference in 1989.

http://www.moonsociety.org/publications/mmm_papers/lp_prehistory_paper.htm

At the Awards GALA dinner, six different awards were given for entrepreneurial innovation in various fields related to space. http://newspace.spacefrontier.org/Gala/ - This year the award for the "best New Space Business Plan" went to **Space Ground Amalgam** [http://spacegroundamalgam.com/] http://spacefrontier.org/2012/07/space-ground-amalgam-wins-competition/ The company has locations in Montana and Colorado and provides **inflatable satellite reflector components to meet and increase higher industry bandwidth demands, while reducing launch costs and increasing design flexibility.** Their technology can **also be used for booms and solar arrays.** The founders are Rick Sanford, Michael Potter, Chris Stott, Dr. Raz Itzhaki Tamir and Daniel Rockberger. They are seeking further funding of $3.5M and their market consists of satellite companies for HDTV, Mobile TV, high-speed Internet, bi-directional cellular, NASA, GPS, military, industry and academia.

Last year's winner was Jonathan Goff of Altius Space Machines [http://blog.altius-space.com/] Louisville, Colorado, near Boulder and the University of Colorado.

Jonathan had first caught our attention ten years ago as a student at Brigham Young University in Provo, Utah when he organized the Utah chapter of the Moon Society, then the Brigham Young University Moon Society Student Chapter. After graduation he joined Masten Space Systems {http://masten-space.com/} in Mohave, CA (a hot bed concentration of "New Space" startup corporations) but eventually left to form his own company. At New Space 2011, Goff and Altius were awarded to

You can watch a video of Jonathan's winning presentation at:
http://blog.altius-space.com/2011/08/biz-plan-pitch-video/

You can read about Altius' "**Direct 2 Station**" (**D2S**) Deliveries Program at:
http://blog.altius-space.com/2011/08/direct-to-station-d2s-deliveries-system/

The M3IQ editors would like to see the "New Space" movement and philosophy take root in other countries where private enterprise is valued. Europe (ESA) and India are ripe for this type of **entrepreneurial research and innovation**. The ultimate goal is to be able **to do more in space with less money through ingenious new approaches.** This is an area that opens vast horizons for students and young people ready to try new things. ◘

NASA-DARPA 100 Year Starship Symposium Kicks Off to Ponder Interstellar Travel

http://www.space.com/17568-**100-year-starship-symposium-kicks-off**.html

http://www.**youtube**.com/watch?v=1VvWNV6W89M - http://www**youtube**.com/watch?v=LDDRnrun2Ik

Report and Comments by Peter Kokh

The Challenge: The dream of traveling to the Stars has been around since we first realized that the stars were other suns, not just lights on a fixed firmament centered not on our Sun/Star, but on Earth. But as we realized how very far away even the closest stars are (**Sirius**, at 8.6 light years away is the closest star easily visible from northern latitudes. **Alpha Centauri**, at 4.3 light years is the closest so far discovered, but visible only from further south. Contrast this with **Pluto**'s distance which varies from 4-6 light hours! and the Moon's distance which is about 1.5 light seconds.

After 35 years, **Voyager 1** is now only 122 times further out from the Sun as Earth is, or less than 17 light hours out. If Voyager 1 had been aimed at Alpha Centauri, 272,000 times the Earth-Sun distance [1 Astronomical Unit or A.U.] it would reach it in another 78,000 year Now **if we could travel 1,000 times faster than Voyager 1, we could reach our neighbor in 78 years**, not counting time taken to reach that speed and then to decelerate from it.

For most people, star travel has remained exclusively within the domain of science-fiction.but to the British Interplanetary Society and people like Mark Millis and others who suspect that there may be a way to make and end run around the speed of light barrier, the dream is still alive.

The 100-year starship effort - http://100yss.org/initiative "The 100 Year Starship™ will make the capability of human travel beyond our solar system to another star a reality over the next 100 years. 100YSS™ will embark on a journey across time and space … If my language is dramatic, it is because this project is monumental. And our team is both invigorated and sobered by the confidence DARPA has in us to make interstellar flight a reality."

The 100-year starship project in the news

May 17, 2012 - **Mae Jemison and Team Establish 100 Year Starship® With Goal to Make Interstellar Space Travel Reality by 2112** - *http://100yss.org/wp-content/uploads/2012/05/100YSS-Press-release-0517.pdf*

- *May 23, 2012 -* ***DARPA, the U.S.*** **Defense Advanced Research Projects Agency, gives $500,000 grant to the 100 year starship project**- *http://100yss.org/wp-content/uploads/2012/06/Washington-Post-article-23-May-2012.pdf*
- http://www.space.com/17703-**interstellar-spaceflight-challenges-humanity**.html
- http://www.space.com/17619-**how-interstellar-travel-works-infographic.**html
- http://www.space.com/17617-**interstellar-spaceflight-100-year-starship**.html
- http://www.dailymail.co.uk/sciencetech/article-2199247/**The-100-year-Starship-project-plans-transport-humans-solar-system**.html
- http://en.wikipedia.org/wiki/**Hundred-Year_Starship** - http://www.centauri-dreams.org/?p=24888
- http://www.thespacereview.com/article/2161/1 – http://www.**tauzero.**aero/html/**human_impact**.html

Why Humans May Be the Biggest Hurdle for Interstellar Travel

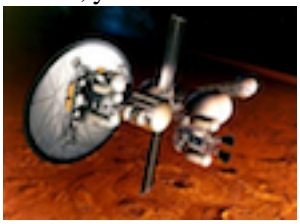
http://www.space.com/17703-**interstellar-spaceflight-challenges-humanity.**html

It is one thing, challenging as it is, to design and engineer a "starship probe" that could reach a nearby star within one century, let alone within one generation. It is quite another to design a "passenger starship" as that means keeping humans alive, or in suspended animation, over generations. If suspended animation is not used, would the descendants of the original crew want to debark, having lived in close quarters (however pleasant) all their lives?

Sending humans means building a much larger ship, equipped to maintain a biosphere to remain fully functional for generations, providing all consumables, recycling 100%, without the possibility of resupply.

A work-around would be to send only frozen human eggs and sperm, or inseminated eggs at an early stage, plus robots and nanny robots that, upon nearing a target star confirmed to have an Earth-like planet (oceans, continents, breathable atmosphere, vegetation, etc.) would unfreeze them, bring them to term, raise and educate them to the adult stage, etc. If the planet proved to be uninhabitable, the ship could be retargeted, the frozen embryos remaining frozen.

Images: Any current designs of starships are likely to be as "quaint" (once we are actually able to build one) as Jules Verne's visions of spaceships are to us today. So the wise advice would be not to take any of these designs seriously. That said, you will find some designs by doing a Google Images Search for "100 year Starship" >>>




Space-X First Operational Dragon Cargo Mission to ISS begins new Commercial Space Era

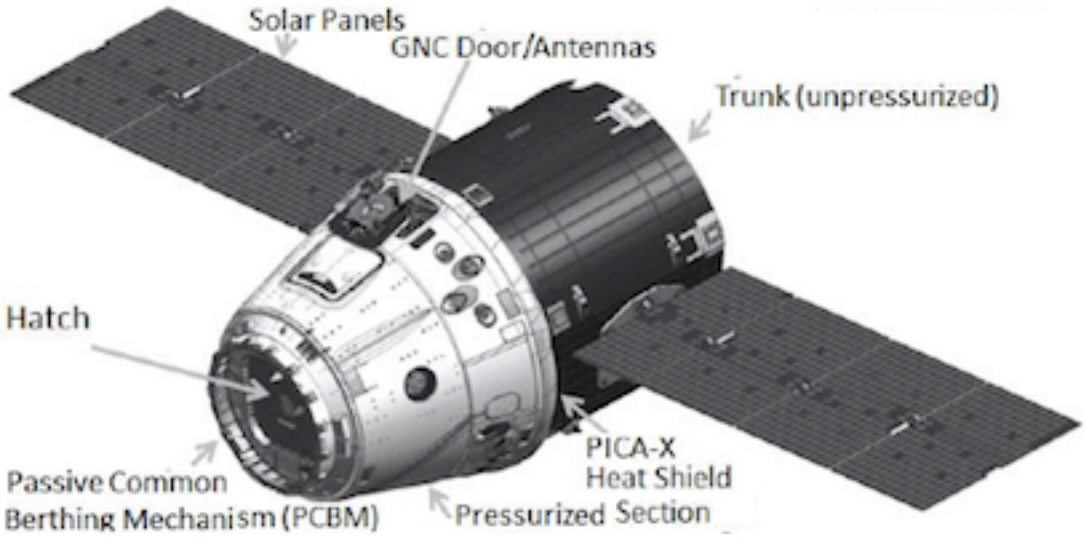
http://www.space.com/17943-**spacex-dragon-capsule-space-cargo-launch**.html

http://www.space.org/17945-**lift-off-spacex-cargo-mission-launches-to-iss-video.**html

October 7, 2012: The Falcon 9 rocket and its Dragon cargo carrier launched from Cape Canaveral Air Force Station in Florida as SpaceX "CRS-1." This was the first of 12 contracted flights of the Dragon capsule to the International Space Station. This follows a successful demonstration flight in May.

On this flight some 450 kg of supplies and critical materials were on board, needed for investigations planned by the Expedition 33 crew.

Dragon is the only cargo carrier capable of returning items to Earth safely. ESA's **ATV**, JAXA's **HTV**, and Roscosmos' **Progress** freighters burn up in the atmosphere after leaving the station. Previously, NASA Space Shuttles were able to do this. So **the Space-X Dragon cargo vessel restores full functionality to the Space Station.**



http://www.spacex.com/dragon.php - http://en.wikipedia.org/wiki/Dragon_(spacecraft)

The Dragon capsule has 3 main parts:

- The Nosecone protects the craft and the docking adaptor during ascent
- The Spacecraft proper houses the crew and/or pressurized cargo plus the service section containing avionics, the RCS system, parachutes, and other support infrastructure;
- The Trunk provides stowage for unpressurized cargo and supports the solar arrays and thermal radiators.

The NASA contract

In December 2008, NASA announced the selection of **SpaceX**'s Falcon 9 launch vehicle and Dragon spacecraft to resupply the International Space Station (ISS) after the Space Shuttle retired. The $1.6 billion contract represents a minimum of 12 flights, with an option to order additional missions for a cumulative total contract value of up to $3.1 billion. Also selected were

Non-NASA Business opportunities

As a free-flying spacecraft, Dragon also provides an excellent platform for in-space technology demonstrations and scientific instrument testing. SpaceX is currently manifesting fully commercial, non-ISS Dragon flights under the name "DragonLab."

Other Companies with Commercial NASA Contracts

http://en.wikipedia.org/wiki/Commercial_Orbital_Transportation_Services

Orbital Sciences and **Alliant Techsystems** (ATK) are also developing spacecraft to service ISS.

Orbital Sciences is developing the **Cygnus** spacecraft - **http://en.wikipedia.org/wiki/Cygnus_(spacecraft)**

ATK is developing the **Liberty Rocket** - **http://en.wikipedia.org/wiki/Liberty_(rocket)**

This program is developing on schedule but future funding is not assured, given the continuing recession in the US economy. For those of us who want to see space travel become fully commercialized, as the best way to produce the most activity for the least cost, that would be most disappointing. ◘

MMM-India Quarterly Editors



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Recent Articles by Srinivas Laxman appearing in AsianScientist Magazine

http://www.asianscientist.com/topnews/**nasa-astronaut-sunita-williams-displays-indian-tricolor-iss-2012/**
http://www.asianscientist.com/topnews/**taylor-wang-nasa-chinese-us-collaboration-on-mars-mission-2012/**
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http://www.asianscientist.com/topnews/**japan-announces-selene-2-lunar-mission-2017/**
http://www.asianscientist.com/topnews/**jaxa-kounotori-3-berths-with-international-space-station-2012/**

Read his report on the recent COSPAR 39 Conference in Mysore, Karnataka, India - *next page*

Monitor AsianScientist Magazine Daily for up to the minute space reports by Srinivas Laxman
http://www.asianscientist.com/

COSPAR 2012 Conference Report

http://www.cospar2012india.org/Default.aspx

http://www.cospar2012india.org/Pages/1037-About-Mysore.aspx

By Srinivas Laxman

Mysore, India - Cospar 39 was hosted by India in the Narayana Murthy Centre of Excellence, **Mysore** (**Mysuru**), Karnataka, India - 14 - 22 July 2012. I had the pleasure of attending this event.

American - Chinese discussions

During the nine-day conference, a meeting of a small group of scientists took place, unknown to many of the other delegates. This particular gathering had a scientific as well as political significance, and in a way perhaps was an example of backdoor space diplomacy. The reason? It was a much-awaited handshake between Chinese and American space scientists, who have traditionally viewed each other with suspicion and hostility.

Though specifics of the meeting were not available, but random interviews with a few US space scientists who did not participate in the session, but were familiar with the developments revealed that both the parties wanted to explore ways of collaborating for future space explorations.

The feeling at least among some of the American space scientists was that China's ambitious space plans should in fact provide an opportunity to the US to team up with China, and look for possible ways to cooperate in joint space exploration missions.

According to the American scientists, China's space achievements should not be viewed as a threat, but rather as an area for collaboration. They dispelled suggestions that if the US joins hands with China, it would be to the latter's advantage.

The US scientists, who spoke to this correspondent on condition of anonymity, however clarified that the meeting was a preliminary one and much more work had to be done before the US-China space collaboration became a reality.

The Mysore meeting assumes significance in the context of the US Congress banning US-China space co-operation in October 2010. Prior to this ban, NASA administrator, Charles Bolden, visited Beijing to discuss with Chinese space officials, areas where both the nations could co-operate. His trip evoked a lot of criticism among US officials triggering speculation that Bolden could be replaced.

The meeting took place in a room which adjoined the media section. Participation was restricted only to a select few. This correspondent managed to get a glimpse of the presentations by peeping through the large windows. One of the topics that came for discussion was intelligence.

A group of US lawmakers have always objected to Washington joining hands with Beijing to explore the stars together. But in fact recently, when China successfully carried out the docking of its manned spacecraft, Shenzhou-9 with the orbiting manned space laboratory, Tiangong, US space scientists praised the Chinese space achievement.

Iran's presence at COSPAR

In another development, again having political significance, Iran was the only country represented at a space exhibition organised as a part of Cospar 2012. The Iran chalet had a lot of posters displaying the achievements of the Iranian Space Agency and it attracted a lot of visitors.

Iran's presence at the Mysore space exhibition was being considered by many as a clear signal to those nations which are opposed to India's friendship with Iran.

Other topics discussed at COSPAR: Among the many topics discussed, these were a few: The Earth's Surface, Meteorology and Climate; The Earth-Moon System, Planets, and Small Bodies of the Solar System; The Upper Atmospheres of the Earth and Planets Including Reference Atmospheres; Space Plasmas in the Solar System, Including Planetary Magnetospheres; Research in Astrophysics from Space; Life Sciences as Related to Space; Materials Sciences in Space; Fundamental Physics in Space; Satellite Dynamics (PSD); Scientific Ballooning (PSB); Potentially Environmentally Detrimental Activities in Space (PEDAS); Radiation Belt Environment Modeling (PRBEM); Space Weather (PSW); Planetary Protection (PPP); Capacity Building (PCB); Education (PE); Exploration (PEX); Special events: interdisciplinary lectures, round table, etc. ◘

Space as a Mirror vs. Space as a Door - and a new "Sister" Publication: TSSIQ

By Peter Kokh

Recently, I've come to realize that the news coverage in M3IQ is one-sided. Yes it is multinational-international. But that's not what has got me thinking. We've been covering stories that relate to the Moon, Mars, Asteroids, and other planets in our Solar System. Yes, Space is a Door to what lies beyond. But Space is also a Mirror by which to get a much better, "higher resolution" look back at our home planet Earth and its problems.

Why is this omission something to rectify? Only a few nations and space agencies can afford to study "Outer Space" - United States/NASA, Russia/Roscosmos, India/ISRO, Japan/JAXA, China/CSNA, and Europe/ESA. Sending probes beyond Earth Orbit takes more powerful rockets and more money. Looking outward may be a universal desire, but such programs are a luxury for nations preoccupied with essentially "down to Earth" concerns.

Most nations must focus their space programs on using Space as a Mirror - using satellites in Earth Orbit to study their resources and land use from the vantage point of high flying eagles above. Now that preoccupation with "remote sensing" as a tool to better orchestrate national self-improvement programs in land use, agriculture, power systems, etc. does not mean that young people and students in those countries are not interested in the Solar System and Universe beyond Earth Orbit. They are! But their national space programs do not reflect that.

- **Broadening our coverage with this issue -** we have a several reports on remote-sensing programs and satellites.
- **Spinning off a new/not-so-new publication: "To The Stars International Quarterly"**

We have been asked by the National Space Society's International Committee, to help NSS reach out to space enthusiasts, particular young people and students, in other countries. The first suggestion was to change the name of this publication to Moon Miners Manifesto **International** Quarterly - it would still be M3IQ. But this suggestion did not sit well with me. I have had a lifelong special interest in India. Even though the M3 "International" Quarterly would go out to the same mailing list, I looked for another solution

NSS' glossy hardcopy magazine, published Quarterly, is named "**Ad Astra**" which is a Latin (ancient Roman language) phrase for "**To the Stars!**" The new publication - well not "new" in the sense of different - will be called "**To the Stars International Quarterly**" - **TSSIQ** for short. The contents of the two publications will be the same, with few exceptions. But the arrangement will be different. M3IQ's News Section is divided into 4 headings: India/ISRO, Elsewhere in Asia, Elsewhere in the Common-]wealth; Elsewhere in the World. In TTSIQ, these same articles will be arranged under the following headings: **Earth Orbit and Mission to Planet Earth**, **The Moon**, **Mars and the Asteroids**, **Outer Solar System**, **Starbound** - a nation-neutral arrangement. The masthead will be different as well. But because the content will be largely the same, the extra editing burden will be minimal.

Anyone now on the M3IQ mailing list who would like to get TTSIQ, even though they largely overlap, can let us know - mmm-india@moonsociety.org - and we will see that you get on the TTSIQ mailing list as well.

M3IQ issues are hosted on the Moon Society website at http://www.moonsociety.org/india/mmm-india/ Where TTSIQ issues will be hosted is yet to be determined. There are other issues: will TTSIQ be sponsored only by NSS? Or also by the Moon Society, and perhaps one or more Mars-focused groups and asteroid-focused groups?

What led to this development? Well, at the annual International Space Development Conference, sponsored by the National Space Society and cosponsored by the Moon Society and several other groups, students and their teachers come from around the world to see their entries into NASA's annual Space Settlement Design Contest receive awards. Year after year the clear majority of these student teams are from India! But runner up, again year after year, is the smaller nation of Romania. And there are smaller contingents from other countries. NSS has been acquiring email addresses for these international students and/or of their teachers. Now the NSS International Committee is seeking to help start chapters in other countries, and wanted a free web-based publication to send out.

NSS would like to see a host of International "chapters" - but that to us seems unrealistic. We have countered with our view that "our" goal should not be to "grow the International presence of the National Space Society" (or of the Moon Society) but to "spread our enthusiasm for space" and let young people and people in general in other nations start their own space-focused organizations. NSS may not accept that suggestion, but that will not change the focus of M3IQ nor of TTSIQ. Over the past four years, we have come to realize that an informal family of national space-enthusiast organizations must be our goal. The economics and currency exchange realities and different financial standards of living and legalities make widespread "international" memberships very unrealistic.

Again, if you would like to receive the "non-identical twin" publication as well, or rather receive notice of its publication and where/how to download it, just write us at mmm-india@moonsociety.org **PK**

"Mission to Planet Earth"

By Peter Kokh

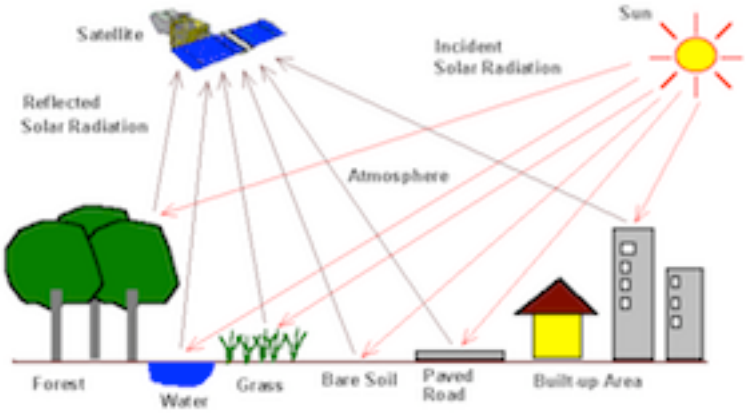
Even for the major space powers, United States, Russia, India, China, Japan, and Europe whose crowning achievements i space involve Missions to the Moon, Mars, Venus, Mercury, Asteroids, Jupiter, Saturn, Uranus, Neptune, Pluto and beyond - not to forget the Sun itself, there is another all important vector: Earth itself. From the vantage point of Earth Orbit, and with the assistance of specially tuned instruments, we can study Earth as never before, learning much that would be more difficult to learn from down on the surface itself.

We are talking about the wide family of remote-sensing satellites. Their instruments are designed to isolate and study in detail many things: forest cover and deforestation and desertification, growth or shrinkage of ice sheets, ocean surface temperatures, land use patterns, ozone buildup, and much much more.

For most other countries, exploration of "outer space" is not a financial feasible prospect. In Europe, however, many smaller nations pool their efforts and resources under the European Space Agency, to explore the Moon, Mars, asteroids, the Sun, etc. This is a very successful collaboration that nations in other parts of the world would do well to emulate. There are movements in both Africa and South America to do something similar.

Make no mistake, however, student and adults alike in smaller nations are just as interested in "outer space" as citizens in the major space faring countries. That there are a number of Google Lunar X-Prize contenders in some smaller nations is ample testimony to that. Bulgaria, one of these, contributed an instrument to India's Chandrayaan-1 probe. So clearly, there are avenues where smaller nations who must budget carefully, can still play a role. Generally, information is shared with nations covered in the various data sweeps by remote sensing satellites flown by the bigger space agencies.

But "Mission to Planet Earth" - studying our own home planet from the vantage of space, whether by individual satellites or from the International Space Station is vital, as well as a powerful economic tool for nations around the world to plane management of their own resources. Just one of many many examples below.



Left: This ALOS satellite image shows an area with extensive agricultural use in western Russia, with roads and rivers cutting through the cropland, part of Russia's Black Earth Region, is about 400 km directly south of Moscow.
http://www.space.com/17531-earth-from-space-chernozem-cropland.html

Right: Diagram of elements involved

Links:

http://en.wikipedia.org/wiki/Remote_sensing - http://en.wikipedia.org/wiki/Remote_sensing_application
http://en.wikipedia.org/wiki/Remote_sensing_(archaeology)#Location_of_ancient_Iram
http://scioly.org/wiki/Remote_Sensing - http://www.sciencedirect.com/science/article/pii/S0924271609000884
http://www.isro.org/isrocentres/rrssc.aspx - http://landsat.gsfc.nasa.gov/education/tutorials.html
http://www.jaxa.jp/about/centers/eoc/index_e.html - http://www.crisp.nus.edu.sg/
https://earth.esa.int/web/guest/home;jsessionid=58DB1E58598AC7A01227EE850A1D38FC.eodisp-prod5040

Search Google Images - **http://www.google.com/imghp?hl=en&tab=wi**

For "**remote sensing images**" - "**remote sensing satellites**" - "**remote sensing systems**" etc. ◘

Remote Sensing over India

http://en.wikipedia.org/wiki/Indian_Remote_Sensing

India launched its first Remote Earth-Sensing Satellites Bhaskara-1 and Bhaskara-2 satellites in 1979 and 1981. The country has since developed the **Indian Remote Sensing (IRS)** satellite program to support rational economic growth in **agriculture, water resources, forestry and ecology, geology, water sheds, marine fisheries and coastal management**.

The following applications show the broad scope of the IRS program

- Preharvest crop area and production estimation of major crops.
- Drought monitoring and assessment based on vegetation condition.
- Flood risk zone mapping and flood damage assessment.
- Hydro-geomorphological maps for locating underground water resources for drilling well.
- Irrigation command area status monitoring
- Snow-melt run-off estimates for planning water use in down stream projects
- Land use and land cover mapping • Urban planning • Forest survey • Coastal Studies
- Wetland mapping • Environmental impact analysis • Mineral Prospecting
- Integrated Mission for Sustainable Development (initiated in 1992) for generating locale-specific prescriptions for integrated land and water resources development in 174 districts. To date, there has been 19 IRS launches, 16 on ISRO vehicles. At this time, 4 additional IRS launches are in some phase of development
- **RESEOURCESAT-3**: A follow on to Resourcesat-2, it will carry more advanced LISS-III-WS (Wide Swath) Sensor having similar swath and revisit capability as Advanced Wide Field Sensor (AWiFS), thus overcoming any spatial resolution limitation of AWiFS. It would also carry theAtmospheric Correction Sensor (ACS) for quantitative interpretation and geophysical parameter retrieval. It slated to be launched during 2015.
- **CARTOSAT-3:** A continuation of Cartosat series with a resolution 30 cm over a 6 km wide swath suitable for cadastre [a comprehensive register of the metes-and-bounds real property of a country] and infrastructure mapping and analysis. It would also enhance disaster monitoring and damage assessment. It is slated to be launched during on board a PSLV during 2014.
- **OCEANSAT-3**: Oceasat-3 would carry Thermal IR Sensor, 12 channel Ocean Color Monitor, Scatterometer and Passive Microwave Radiometer. IR Sensor and Ocean Color Monitor would be used in the analysis for operational Potential Fishing Zones. Satellite is mainly for Ocean biology and sea state applications. It is slated to the launched aboard PSLV in 2014.

The **National Remote Sensing Center** NRSC) is located in **Hyderabad** and is the nodal agency for reception, archival, processing and dissemination of remote sensing data in India. India's remote sensing satellites gather data for contiguous nations such as Nepal, Bhutan, and Sri Lankha. ###

Dr. Abdul Kalam's relevant speech "**Geospatial technologies for Sustainable Development" -**

http://www.abdulkalam.com/kalam/jsp/display_content_front.jsp?menuid=28&menuname=Speeches%20/%20Lectures&linkid=68&linkname=Recent&content=2064&columnno=0&starts=0&menu_image=-

Outreach Suggestion for Chandrayaan-2 Lander/Rover & ISRO Mars Orbiter

The names of SEDS-India members and M3IQ subscribers as well as of Indian space enthusiasts at large **could be micro-engraved on Candrayaan-2** Lander &/or rover as well as on the ISRO Mars orbiter.

For both missions, there is sufficient lead time for this outreach and public support building project. Micro-engraving can be done on a small chip or CD that adds an insignificant weight to the probe in question.

This project could be sponsored by M3IQ and indigenous Indian space support groups or organizations, including Indian Amateur Astronomy clubs and organizations. This campaign would gain public support and increase public interest in both missions. Similar projects have put names aboard a good number of NASA missions. Aboard the **New Horizons** craft now bound for Pluto is a CD containing 435,000 names of individuals who signed up to "send your names to Pluto" and beyond. Such a project is easy to organize. And gaining publicity for it is also easy - a natural for newspapers and magazines and Internet sites**.** Note that photos can also be microengraved.

Such an effort can have its own Facebook and/or Orkut and Twitter sites.

The Project Team could keep the names of the publications and reporters and writers who helped spread the news about the Project, providing a valuable list for further publicity and outreach needs. Lets do this! **M3IQ**

COMMUNITY: "MOON AND MARS" - A CONFESSION

By Peter Kokh

I have been known for more than two and a half decades as a "Moon Man." But I have a confession to make. I started out way back in the mid-to-late 1950s, (my late teens and early twenties) as "a passionate Mars person." I was fascinated (infected?) with the Red Planet from my youth, thanks to the science fiction novels by Ray Bradbury ("Martian Chronicles"), Arthur C. Clarke ("The Sands of Mars") and Edgar Rice Burroughs ("John Carter on Mars" series). Then there was Sputnik in 1957 and the Space Age burst upon us faster than anyone expected, thanks almost entirely to the Cold War rivalry between the Unites States and the Soviet Union (Russia and 15 lesser Republics, now each independent).

I watched, read, listened avidly to reports of the Apollo Moon Landings, and was devastated that the last three planned missions (18, 19, 20) were cancelled. Apollo was a J. F. Kennedy thing, and when this Democratic leadership (carried on after his assassination by Lyndon N. Johnson) passed into the Republican hands of Richard Nixon, key programs accredited to Kennedy were cancelled. By the late 1970s, I was already a member of the L5 Society and of the National Space Institute (Life member #2 after its founder Wernher von Braun who was life member #1) which eventually became the National Space Society after the merger with L5. I wanted to express how I felt and I started taking notes for an alternate history novel detailing where we would be (I had hoped to publish the book in the early 1980s) had we not turned our back on the Moon. I would never finish that novel, but let's get back to the story.

We would have been on Mars "by now," of course, or so I reasoned, but we would have had to "do the Moon" first, establishing both science outposts and a settler frontier, and I wanted to sketch how this would unfold. I quickly learned that the Moon was severely handicapped by a lack of key volatiles: hydrogen, nitrogen, and carbon, as well as some key metals, copper, zinc, gold silver, platinum, etc. Anything but discouraged, I would attempt to show how "we would do the Moon anyway" and in doing research along those lines, became thoroughly enchanted with the Moon.

In short, I saw the Moon to be the Japan of Space: lacking many key resources needed to build a technological civilization, but with a population of energetic, bright, enterprising individuals, and a key location on the Pacific rim. Japan would go on to develop the whole Pacific rim: Korea, Manchuria, all of coastal China, SE Asia, and the Philippines. The Moon is like that, at the hub of key low energy "cis-lunar" trajectories. The Moon might not have key resources, but it had something else, like Japan: "Location, location, location." And if its pioneers were resourceful and enterprising, the Moon could quickly become the Japan of the inner solar system "rim."

But I never lost my fascination with Mars. Every year, the March ("is for Mars") issue of Moon Miners' Manifesto has been a Mars-Theme issue. And, in my seven years as President of the Moon Society, 2004-2011, I shaped Moon Society policy to include Mars. A Moon-Mars economy would be essential to the economic viability of both worlds. And there were so many technological issues that faced the pioneers of both that there is enormous room for collaboration on many fronts.

I wrote many Moon Society web pages and documents related to Mars, including many, many articles in Moon Miners' Manifesto. And you can find links to all of these on this one page: **http://www.moonsociety.org/mars/**

I began "Moon Miners' Manifesto" in the fall of 1986 as the newsletter of the "Milwaukee Lunar Reclamation Society" at first a chapter of the L5 Society, but within three months, the first fully merged chapter of the L5 Society and the National Space Society. In the fall of 1995, the newly formed Moon Society contracted with us to have MMM become its newsletter as well.

Don't be mislead by the name! A cornerstone of "The Manifesto" is that pioneering either the Moon or Mars, one without the other, is a foregone doomed effort. Neither the Lunar or Martian Frontiers can be viable long term except as trading partners. If you want one of the two, you owe it to yourself to support settlement of the other.

So while the name has not changed, you would not be amiss to call it the Moon/Mars Miners' Manifesto!

I understand that many newly enthused space enthusiasts in India are interested in both Moon and Mars, and in the rest of the solar system to boot. Well so am I, and as long as I am editor of MMM (and M3IQ) so are these publications. MMM has had many articles on the Asteroids, particular Ceres, Pallas, and Vesta, and on Venus and Mercury, Jupiter and its moons, particularly Europa, Saturn and its moons, particularly Titan, and the rest of the Solar System and beyond. Yes we have written many articles about other star systems too. **PK**

"The Moon is not the end. It is the Beginning!"

And to that extent, whatever destination is your passion, MMM and M3IQ are a good place to start.

On the Death of Neil Armstrong, First Man to Step Foot on the Moon

Neil Armstrong: Personal Recollections by a Penny Pincher of an Apollo Hero

By **Dave Dunlop** August 29, 2012

Paul Harvey's Den, July 1969

Like so many people around the world, I watched **Neil Armstrong** set foot on the Moon live on television. I was in my early twenties and in the home of Paul Harvey, a prominent American radio news commentator, whose son was my best friend from high school. We were sitting on the floor of their den "glued" to the TV. After a while we watched Buzz Aldrin also descend from the Lunar Excursion Module and watched pictures of both men on the surface of the Moon. Those ghostly black and white TV images transfixed us and everyone who saw them at that moment.

Neil Armstrong, who became an instant world hero however retreated from the pressure of global fame to an "ordinary life" as a professor of engineering in Cincinnati, Ohio. He also became "famous" for his reluctance to do public presentations or to celebrate his celebrity. When he did, it was on rare occasions over the years, often in some official celebration connected with the US Government.

Oshkosh AirVenture Air Show, Oshkosh, Wisconsin, July 1989

I live in Green Bay, Wisconsin some 60 miles from Oshkosh, Wisconsin which is the home of the Experimental Aircraft Association. The EAA holds a huge world class aircraft show, AirVenture, during late July every year. About twenty years ago I learned that Neil Armstrong was making a rare appearance at this (then called) EAA fly-in, perhaps because before he was "the astronaut," he was one of the elite pilots of experimental aircraft. He was speaking to a large crowd in an open air auditorium. The crowd that came to see him could not fit under the roof but spilled out onto the grass surrounding the building that July evening.

He spoke about the Apollo program without pretension and gave a straightforward account of his experiences. After his speech he generously remained up on the platform and answered questions from those coming to the front. I was among them and was delighted to be able to approach him and ask him, "If you had the opportunity to go back to the Moon would you? He smiled at me and said, " I'd do it in a heartbeat if you buy the ticket."

Moon Geologist, Dr. Harrison (Jack) Schmidt

About four years ago I also had the privilege of listening to astronaut Dr. Harrison (Jack) Schmidt, of Apollo 17 fame, speak in Houston, Texas. (1) He was the only physics scientist (A PhD in geology) among the Apollo astronauts, and subsequently he went on to become a US Senator from the State of New Mexico. He said that at one time he had calculated that if one took the entire Apollo program budget (about $110 Billion) and divided it by the number of minutes the 12 astronauts who landed on the Moon collectively spent there, that the cost per minute would roughly be a million dollars a minute.

I then more fully appreciated why Neil Armstrong had that smile when he said to me "I'd do it in a heartbeat if you buy the ticket." That price point (a million dollars a minute) also perhaps best explains in a practical sense why no one has returned to the Moon in over 40 years. Any national leader must ask those advocates of space exploration and operations, "What are you going to do for the country that is worth a million dollars a minute?"

The National Treasure of Space

In the fever of "the cold war" it was worth the treasure to engage in a peaceful combat with the Soviet Union (Russia and 15 other captive republics) in a race to demonstrate national superiority as well as face the risks of engineering failure in the vacuum and cold of space and with the additional risk of radiation events from solar flares or potential coronal mass ejections. Why was it worth it? Let us not forget that those in charge in both the US and the Soviet Union at that time had fought the desperate battles of WWII. They had seen friends die and witnessed the terrible willful destruction of war. Both Kennedy and Nikita Khrushchev were hardened veterans of that conflict. Neil Armstrong had also flown in combat in the Korean war. Today, we look at Apollo, not as just an incredible engineering stunt, which it was, but also as a mission which began to unlock the secrets of our companion planet the Moon. Because of the understanding gained since the Apollo Program not only of the Moon, but of the Earth and its limitations, and of material science, and our economic models we have a much better grasp of "the stakes" financially of our space program.

If we are emotionally honest about the Apollo Program, "we" the US, mostly went to the Moon to demonstrate that we could "beat" the Soviets with our teamwork and our technology. If it were not for that almost no one would, in the political system at that time, have been taken seriously if they had proposed to spend 110 Billion dollars to get "a few boxes of rocks" from the Moon. The justifications that this was about science were made of the thinnest tissue to "dress up" the fact that so much money and effort was being spent. This was a type of social psychological mobilization of American society for the cold war.

In retrospect it shows how tragically shallow and immature that humanity is that "the sport of war" psychologically would lead to such an enormous effort by both the US and the Soviet Union. In the aftermath of WWII when so much had been destroyed and so many killed, and when there was also so much to be done to alleviate

suffering and misery, and disease, was this really the best that we could do? But as “shallow” as that was it was infinitely better to have spent that fortune in a “cold war” race to the Moon than in a hot one with the Soviet Union. That was the real choice for President Kennedy as the US political leader in the aftermath of the Cuban missile crisis and the American fiasco of the failed Bay of Pigs military invasion attempt. I can surely understand that Neil Armstrong as a veteran of 78 combat missions also felt it was worth it to risk his life in a peaceful competition and journey to the Moon and back.

But risking one's life is one thing! For most penny pinching cheapskates wasting a fortune in other peoples money is another! On the face of it many even today would say: “There is nothing practically useful that can be done at a price of a million dollars of minute that can really justify sending astronauts back to the Moon.” The citizens of Neil's home town of Wapakoneta, Ohio did not apparently feel that way when they built a wonderful museum to their native son. NASA apparently did not feel that way when they provided Neil's personal T-38 jet trainer which now graces the entry boulevard entrance to Neil's museum there.

For example, The Planetary Society, founded by Carl Sagan and Louis Friedman, and run by the later for many years, has opposed the focus on manned systems in space when robots can do the job at much less expense. Well, they have a point, which the Soviets also made during the competition of the Apollo era. After a couple of terrible explosions of their monster N-1 rocket, (with a large associated loss of life in one instance which was kept a secret from the world public), they refocused their efforts on a robotic exploration of the Moon. Three times they sent Lunokhod rovers to the lunar surface and then returned with samples of that surface. The last time was in 1976. That is something the United States did not do during that competition and has not done yet. That was also a triumph of robotic engineering in its own right. We have just seen the recent celebration of the landing of **Curiosity**, the largest robotic lander to date on Mars. I attended a wonderful party that night at the Museum of Fight in Seattle that celebrated a feat that also resulted in well deserved cheers and tears of triumph and that I also celebrate as an extension of the spirit of Neil Armstrong.

To their credit, both the Soviet Union and the US followed up their stupendous competition of a human adventure to the Moon with continued robotic exploration initiatives to Mars and elsewhere. Indeed those “boxes of rocks” have opened up the understanding of our co-planet Moon. We have pushed out to gain the understanding of Mars, the next challenging planet, and a much more detailed understanding of the asteroids and the solar system at large. The Science Mission Directorate of NASA can be vastly proud of its robotic achievements as can the other national space faring agencies that have joined this exploration. They are also an extension of Neil Armstrong’s sprit.

Curiosity Knows No Bounds

To those who say manned space activities are “a waste” (of financial resources) I say they reflect a taste for adventure, a taste of the exotic and the risky, a basic yearning to go beyond existing limits, and an exercise of man's unique capabilities for observations and problem solving. It is arguable that 'Linnaeus' (The Swedish doctor/ taxonomist Carl Nilsson Linnaeus) naming of our species “homo sapiens,” which could be loosely translated from the Latin as “the smart monkeys” or worse “the wise monkeys,” is a self-pretentious fraud as an act of naming. He would however had been“dead on accurate” if he had named us “the curious monkeys.” Our latest Martian robot Curiosity is aptly named, at least as a psychological mirror of humanity but I doubt anyone would claim that it had Neil Armstrong's courage in those last terrifying before his successful landing. The cool courage of the engineering team remained behind at JPL mission control consoles for Curiosity's “seven minutes of terror.”

To skeptics of the value of manned space flight I would contend if that is true then our International Space Station reflects the “the wastefulness” of a collection of fools”, (the 16 countries that were mortal enemies in WWII and that cooperated and planned and built that station over some twenty years of effort). That too is about curiosity and the ability to learn how to sustain human presence in space but also about the wisdom of human cooperation. Those like the Planetary Society who denigrate manned space flight and prefer only robotics are to me at least mere penny pinchers. We, the curious monkeys, do not want to be just bystanders to robots. We wish to directly exert our own powers of observation, acquisition, and intuition. Personal engagement is worth a lot to our species. One study on the International Space Station has placed the cost of an astronaut per day on ISS at about $7.5 million dollars a day in 2010 dollars. (2) This compares favorably with the estimated cost of $19.6 Million dollars per day on Skylab, the direct descendant space station of the Apollo Architecture. If I can work my calculator competently (often questionable) I come up with a cost of $ 5,208 dollars a minute for the ISS and $13,611 per minute for Skylab.

The reason I am a member of the National Space Society (NSS) and the Moon Society (an affiliated organization of NSS) is because I believe in the future of the presence of humanity in space on both the Moon and Mars and elsewhere. I believe in the application and use of space resources to both protect and preserve the Earth and its environment and its many species.

I believe that the use of space resources will enable the Curious Monkeys and their co-dependent species to both explore and settle in other destinations in our solar system and beyond. I also believe that this can be done cost efficiently. The benefits of these efforts can transform our vulnerable planet Earth into a better place where humanity can live in a more benign balance with other species than at present with our limited resources. I am sure that our

space engineer hero Neil Armstrong also shared those beliefs in his dedication of Purdue University's new space engineering building..

I have to count myself among those who are skeptical of the cost-benefit ratios of a million dollars a minute for human presence in space. But in the NSS and the Moon Society, we believe in a commercial model and much improved cost efficiency in both explorations and space operations. We support collective government efforts where pioneering exploration demands collective government expenditures that could never be justified by proprietary enterprise. Expenditures of those magnitudes cannot be justified by a private business model that demands timely returns on investments for the investors. In forty-some years we have gone from a million dollars a minute in Apollo on the Moon to $5,208 dollars a minute on the ISS. That would still yet be "One small minute for Dave, One Giant Withdrawal from my bank account."

Opening The Frontier of Falling Price Points

Of course Neil Armstrong knew what he was doing when he asked me to buy his ticket back to the Moon. The cost frontier of space is one of the next barriers to overcome. The price points are dropping and a number of companies are gambling that enough tourists can really afford trips to space. Virgin Galactic has advertised that the cost of a suborbital flight over 100 kilometers into space on SpaceShip Two is $200,000 for about a 30 minute flight. That is $ 6,666 per minute. Other competitors in that market for suborbital tourists hope to charge perhaps half that figure or $ 3,333 per minute. In "a mature" well competed suborbital market some have speculated perhaps the costs can be driven down to $50,000 per trip or $1,666 per minute if the flight is 30 minutes. With progress like that perhaps in another twenty years I might have afforded Neil's ticket!

Robotic Missions of exploration are being planned that use the new low-cost, low-mass paradigm of cube-satellite scale construction and instrumentation to reduce the cost of new missions of exploration beyond LEO from hundreds of millions to a price point perhaps now approaching single digit millions.

Neil would have liked that.

I believe that we will see a continuing drop in the price of manned operations as the development of reusable launching technology advances. Companies such as Space-X hope to succeed in demonstrating this possibility. And companies like Bigelow and Excalibur Almaz hope to reduce the cost of building and manning space stations twice the pressurized space of the ISS for perhaps an order of magnitude lower cost. Neil would **really** have liked that!

Opening The Frontier of Space Resource Utilization

The greatest economic opportunity facing humanity at present is the potential of changing the dominant energy supply of humanity from fossil fuels to "clean energy resources". We can do that on a global scale by direct dependence on the sun via solar power satellites. That is an achievable goal within 20 to 30 years with the current technology in hand. (3) Alternatively we might derive clean power from the mastering of a sustainable fusion reaction which is beyond the state of the art at present, but the Moon could be a source of fusion fuel when sustainable fusion is achieved. Armstrong knew that.

We can also produce rocket fuel from frozen lunar volatiles, lunar minerals, and asteroidal materials. That is the potential return on that "obscene investment" in those boxes of rocks. The investment of hundreds of billions that we have made in the space program during Apollo and afterwards to the present can yield within the lifetimes of children now in school trillions of dollars of value annually as a power source for global civilization. It will avoid trillions more in costs by saving environmental destruction and species extinctions. It will be worth more trillions in the desalinization of ocean water and pumping it to where it is needed. It can perhaps eliminate trillions wasted in competition for earthly resources via wars, and much more. In that light the investments of Apollo and since are rather trivial in comparison to the benefits within our grasp. That is what was opened for humanity when Armstrong, Aldrin, and the other Apollo heroes walked on the Moon. Armstrong also knew that and wanted to go back.

Neil Armstrong Knew It

Eighty-two-year-old Neil Armstrong, our now departed hero, the canny space engineering professor and hot-shot pilot, knew what he was saying when he framed his answer to the question of an average citizen challenging him to go back to the Moon. He was keenly aware of the cost barriers of going back to the lunar frontier. He was a pioneer explorer and a test pilot who was far more than a daredevil just doing unthinkable exploration and taking unthinkable risks. He was the consummate engineering professional who knew the stakes and the path forward. He was the real deal, a man whose cool courage, confidence, and intellect will shine for the ages.

References:

(1) Personal experience attending a lecture of Harrison at the Space Museum in Clear Lake Texas, near the entrance to Johnson Space Center on NASA Road One.

(2) Lafleur, Claude (8 March 2012) "Costs of US piloted programs" The Space Review cited in Wikipedia, the free Encyclopedia in their article on the International Space Station.

(3) International Academy of Astronautics Study of Space Solar Power, John Mankins editor, 2011. **DD**

Neil Armstrong: Ultimately, his Legacy is up to us!

By Peter Kokh

In the news recently, someone noted that no human being born since 1935 has set foot on another world. We have frozen out generations of young people from following the Apollo Overture. There are many reasons, but the first and most foremost reason is rooted in the very announcement of the Apollo Program way back in 1961. First, as we noted in our In Focus editorial in MMM #238, September 2010: "**In This Decade,**" - three little words that won us the Moon Race but that have hamstrung us ever since" - **in order to win, we built an unsustainable space architecture, good for a few short sorties, nothing else.** We overawed even ourselves. The result is that we have six sites on the Moon at which Apollo mission equipment was left behind, including the LEM landing platforms, flags, foot prints and rover tracks, and assorted equipment that was left behind to reduce weight for takeoff back to Earth.

http://history.nasa.gov/moondec.html - http://er.jsc.nasa.gov/seh/ricetalk.htm

We agree with the ideas expressed in the following recent web article:

http://www.space.com/17330-**neil-armstrong-death-moon-landing-site-preservation**.html

> "The passing of famed astronaut Neil Armstrong, the first man to walk on the moon and commander of Apollo 11, may strengthen the movement to designate the Tranquility Base lunar landing site as a National Historic Landmark. The field of space heritage preservation is gaining momentum, and a recently authored bill aims protect the Apollo 11's Eagle lunar lander touchdown site and all the artifacts that astronauts Neil Armstrong and Buzz Aldrin left behind on the lunar surface."

Related Articles:

http://www.csmonitor.com/Science/2012/0829/Should-the-Apollo-moon-landing-site-be-a-National-Historic-Landmark

http://lunarscience.nasa.gov/articles/nasa-sets-guidelines-apollo-moon-landing-sites/

http://news.discovery.com/space/nasa-will-preserve-apollo-landing-sites-120528.html

http://www.washingtonpost.com/opinions/stepping-lightly-on-the-moon-anticipating-tourists-researchers-want-to-preserve-apollo-11-sites/2012/07/17/gJQA4Jn2rW_story.html

http://cosmiclog.nbcnews.com/_news/2012/05/29/11943652-rocketeers-obey-nasa-moon-rules?lite (short video)

> **It is important that we go beyond NASA rules and regulations, and draft an internationally applicable document that both preserves historic artifacts and allows tourists to view them in a way that minimally disturbs these sites as well as sites where artifacts of other nations lay exposed.**

Why would we need to do this? Obviously, because many of us believe that humans will someday go back to the Moon, this time to dig in and stay, as the first "Lunans." And there will be tourists, not only from the ranks of the first pioneers and those to follow, but also from Earth on short "bucket list" trips of a lifetime.

The present movement seems to focus on the Apollo 11 site, the very first, but some order of protection should be given to the other five sites. Apollo 15 at scenic Hadley Rille with the very first moon buggy rover still on location, and Apollo 17 in the scenic Taurus-Littrow Valley and the site of the very last mission getting equal billing.

This might involve installation of elevated walkways lest the historic bootprints get ground into the dust, and railing off the various artifacts left behind in a "see but can't touch" state of preservation. A small museum - tourist center could be within sight, but safely separate. I have seen a small number of proposals for such "National Historic Monument" preservation, but we do not need to go into details here.

Nearby, there may be a place where tourists could make their own bootprints to be preserved by an electronic 3D scan. Back on Earth a personal bootprint likeness could be "3-D printed" of various materials for a special memento. Add photos of tourists on the walkway with Apollo paraphernalia in the background, Earth overhead.he p

An international design contest to design tourist facilities that allowed people to visit and tour these sites without disturbing them, might help illustrate the possibilities as well as better define the treaty restraints. It would involve the international public in the process.

Why we should enact such a "treaty" as soon as possible - after such a design competition has been held

Once it becomes apparent that humans are going back to the Moon, not just for further exploration, but to lean how to use lunar materials to help build structures in Geosynchronous Earth Orbit (solar power satellites and large platforms that can each host hundreds or more telecommunications and other satellites) at far less cost than shipping all the needed materials up from Earth's surface, then we are going to hear from well-intentioned environmentalists (among whom I count myself) that we should leave the Moon to itself, "hands off!," in its pristine state.

If we enact such a historic site preservation and monument measure, that will help those of us who want to see the Moon developed in a way that preserves its beauty, not only from Earth, but from lunar orbit, and indeed on the surface itself. To this end, we have published a proposal for a Lunar National Parks & Monuments Treaty.

Our proposal appeared as an article "National Parks on the Moon" in MMM **# 176 June, 2004 p 5**. reprinted on **pp. 34-35, MMM Classics #18. You can freely download this issue and article at** http://www.moonsociety.org/publications/mmm_classics/**mmmc18_Jan2008.pdf**

While eulogies of Neal Armstrong are fitting, I can think of nothing better that we can do to honor his memory than to campaign for such an Apollo Historic Sites preservation treaty, as an overture to a broader, more comprehensive treaty on lunar preservation that respects the lunar environment while allowing settlement and scenery-preserving industrialization. As I have remarked before, the precedents set by the current Antarctic Treaty are extreme, and not a model to follow. **PK**

How extensive is the Apollo 11 landing site?

http://www.theatlantic.com/technology/archive/2012/08/the-apollo-11-landing-site-superimposed-on-a-baseball-diamond/261802/

While the Apollo 11 astronauts spent only a few hours on the Moon and did not stray far, the astronauts on the five successive missions ranged further, and much further once they had the services of the moon buggy, on Apollo Missions 15, 16, and 17. So the standards for protection that might apply to the Apollo 11, 12, and 14 sites, will need to be revisited when considering how best to preserve the later locations, which might draw even greater numbers of tourists and organized excursions.

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In our last issue, M3IQ#15 pages 53-54, we published a student proposal about this very topic.

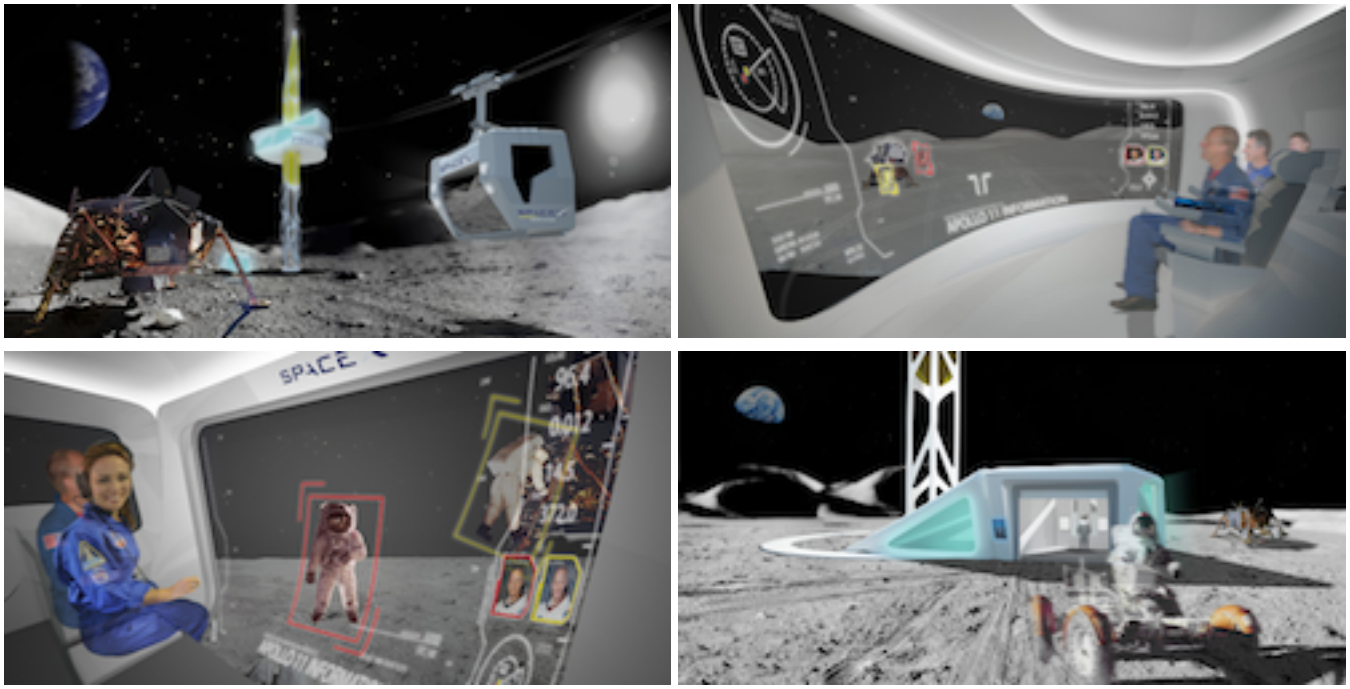
Touring an Apollo Moon Landing Site - A Design Proposal

By Frankie Sharpe, student of M3IQ Co-editor Madhu Thangavelu

If you did not receive download instructions of this issue, simply go to:

http://www.moonsociety.org/india/mmm-india/m3iq15_July2012.pdf

Below are some of the accompanying illustrations



See the full proposal and the above and additional illustrations in original larger size at **http://www.frankiesharpe.com/**

The Many Growth Options in an Evolving & Growing Cislunar Economy

By Dave Dunlop

The "bestiary" of the emerging cislunar economy is a melting pot of business ideas and companies, as well as government initiatives, and other advocacy organizations:

Space Advocacy

They reflect the impact of the space advocacy movement which has long preached of a future in which the economic development of space and its human settlement would be transforming to the conditions on Earth as well as the in the spread of humanity beyond the Earth. I list these organizations because they have been a catalyst for both educational and economic thinking and also an element for the evolution of government space initiatives. We encourage our readers to also become advocates and to join those organizations that promote this development, educate the public, and influence both governments and investors. The lunar track that was presented at the International Space Development Conference in Washington D.C. by the NSS and Moon Society focused on the cislunar economy but merely scratched the surface of what is developing.

Listing Space Companies, Project Developments, and Missions

The list I have provided is significant and evidence of the scale of the "movement". I have not attempted to provide an economic total associated with this list but it is conservative to guesstimate that this list represents a multi-billion dollar level of investment annually. Some of these ideas have been around for decades and some seem to have just arrived by stork! The reality of these diverse initiatives reflects the increasing momentum of this economic trend. They reflect different ambitions ranging from transportation related initiatives such as manned capsules, lunar, space stations, additional orbiters, and solar power satellites, and space infrastructure.

They reflect a new vigorous international competition and collaboration in space and especially in cislunar space but increasingly the attempt of private capital to both master the technologies and the market potential of impending commerce. They also reflect the complexity of this newly developing economy which will require both sophisticated robots, telepresence, and direct human presence.

The M3IQ has covered many of these projects in the past and looks forward to their progress in the future. The extensive nature of this list would show skeptics of the future that even in times of economic difficulty there is a vibrant faith in the future of the cislunar space economy that is not limited to just one country or one market development. This is also an area where new jobs will be generated and students planning for careers can look at the skill sets that will be needed when they make their curriculum choices.

Picking Up the Pace

The first decade of this century saw a new blitz of lunar orbiter missions not seen since the 1960's. The second decade will see more than double the cislunar missions of the first including the first private lunar missions. Another notable development is a diversity of transportation initiatives including the new Lunar Cube models at the low mass end, to a range of small landers, to larger supply vehicles like a European cargo lander. This nuanced development is evidence of investor confidence in a variety of market "niches". The foundations are now being laid for a " commercial space economy breakout" in the 2020's and 2030's. The momentum of the 2010's will increase with a rapid increase in the number of launches in the 2020's reflecting both new lower cost launchers and a wider range of missions.

International Momentum

International collaboration will likely result in lunar robotic village initiatives on the lunar surface during the third decade and a developing infrastructure of fuel depots and transportation nodes in both LEO, Lagrange, and even GEO locations as precursors to the likely human return to the lunar surface in the 2020's. It is however the economic roles of using cislunar space as an economic resource for the production of fuels, of transportation infrastructure, of human space tourism, of expanded GEO satellites and ultimately solar power satellites that will be the drivers of growth. The Footprints and Flags strategy of Apollo was an unsustainable model now being superseded by both an international space "race" that reflected a Global Exploration Roadmap approach.(www.globalspaceexploration.org/)

Links: Commercial Enterprises

Asteroid Discovery, Assay, and Mining: Planetary Resources Company

(Small low cost spacecraft launched as secondary payloads)

http://www.planetaryresources.com/ - http://en.wikipedia.org/wiki/Planetary_Resources

Lunar Ice Mining & a Supporting Platform of Diversified Support Services: Shackleton Energy
http://www.shackletonenergy.com/ - http://en.wikipedia.org/wiki/Shackleton_Energy_Company

In-space fuel depot storage and transfer: NASA Tech Funding: Boeing, Lockheed-Martin
http://en.wikipedia.org/wiki/Propellant_depot
http://www.nasa.gov/mission_pages/station/research/experiments/RRM.html
http://arstechnica.com/science/2012/03/astronauts-at-iss-begin-learning-to-refuel-spacecraft-in-orbit/
http://www.space.com/3644-prototype-satellites-demonstrate-orbit-refueling.html
http://www.spacenews.com/civil/110623-nasa-defends-satellite-refueling-demo.html

Solar Power Satellites:

- **Space Energy** - http://spaceenergy.com/
- **Artemis Innovative Management Solutions** - http://www.space.com/15189-solar-power-beaming-satellite.html
- **Soleren** - http://phys.org/news159020477.html
  http://www.msnbc.msn.com/id/30198977/ns/technology_and_science-space/t/pge-makes-deal-space-solar-power/#.UFCiO1F5nzI
- **SunSat Energy -** http://spacejournal.ohio.edu/issue16/preble.html
- **JAXA Tech Program** -
  http://www.popsci.com/scitech/article/2009-09/japan-wants-power-300000-homes-wireless-power-space
  http://www.telegraph.co.uk/science/space/8277780/Japanese-scientists-seek-to-harness-solar-power-in-space.html
- **CNSA Tech Program** - http://spacejournal.ohio.edu/issue16/ji.html
  http://www.spaceenergy.com/announcements/chinese-academy-of-sciences-continues-r-d-into-commercialisation-of-solar-satellites

GEO Satellite servicing & Refueling

INTEL - http://www.milsatmagazine.com/cgi-bin/display_article.cgi?number=152118614
MDA - http://www.spacesafetymagazine.com/2012/01/20/mda-intelsat-cancel-on-orbit-servicing-deal/

Space Tourism

Space Adventures - http://www.spaceadventures.com/
Zero-G - http://www.spaceadventures.com/index.cfm?fuseaction=Zero_Gravity_Flights.welcome
SubOrbital - http://www.spaceadventures.com/index.cfm?fuseaction=suborbital.welcome
Orbital - http://www.spaceadventures.com/index.cfm?fuseaction=orbital.welcome
Lunar - http://www.spaceadventures.com/index.cfm?fuseaction=Lunar.welcome
Virgin Galactic - http://www.virgingalactic.com/
X-COR Lynx - http://www.xcor.com/products/vehicles/lynx_suborbital.html
Blue Origins - http://www.blueorigin.com/ **-** http://en.wikipedia.org/wiki/Blue_Origin
http://www.space.com/2587-tourism-update-jeff-bezos-spaceship-plans-revealed.html
Excalibur Almaz - http://www.space.com/16367-private-moon-missions-excalibur-almaz.html
http://www.dailymail.co.uk/sciencetech/article-2161646/Excalibur-Almaz-prepares-tourist-trips-moon-500k-mile-round-trip-cost-100m.html

New Manned Capsules

Orion - NASA (2022) - http://www.nasa.gov/mission_pages/constellation/orion/index.html
http://en.wikipedia.org/wiki/Orion_(spacecraft)
Dragon (Space-X) in development) - http://www.space.com/15615-spacex-dragon-capsule-crew-mockup.html
http://en.wikipedia.org/wiki/Dragon_(spacecraft)
http://www.space.com/15429-spacex-dragon-space-capsule-manned-infographic.html
CST-100 Boeing (2015?) - http://en.wikipedia.org/wiki/CST-100
http://www.space.com/15363-boeing-space-capsule-cst-100-infographic.html
ATK Liberty Capsule - http://www.spaceflightnow.com/news/n1205/09liberty/
http://www.flightglobal.com/news/articles/atk-announces-capsule-for-liberty-launch-vehicle-371644/
http://www.space.com/15626-iberty-rocket-private-space-taxi-photos-atk.html
"**Soyuz Next Gen**" - 6 person, Roscosmos (in development 2020?)
http://en.wikipedia.org/wiki/Prospective_Piloted_Transport_System - http://en.wikipedia.org/wiki/CSTS
ISRO manned capsule (India) in development (2016?) - http://en.wikipedia.org/wiki/ISRO_Orbital_Vehicle
http://en.wikipedia.org/wiki/Indian_human_spaceflight_programme
http://www.space.com/5967-designs-india-manned-spaceship-revealed.html

New Man-rated Vehicles:

Dream Chaser - Sierra Nevada (test flight stage) - http://sncspace.com/space_exploration.php
http://www.nasa.gov/offices/c3po/partners/sierranevada/index.html

Falcon 9 - Space-X (flown prototype(e) 2015?) - http://www.spacex.com/falcon9.php
http://en.wikipedia.org/wiki/Falcon_9

Liberty - ATK- http://en.wikipedia.org/wiki/Liberty_(rocket)

Manned HTV - JAXA in development 2025 - http://www.spaceflightnow.com/news/n1202/09jaxa/

Lunar Landers

Google Lunar X-Prize Teams (Overall Scoring, and in 9 categories: Funding, Innovation, Social, Connections, Progress, Feeling, Rover/Hopper, Inspiration, Participation) **http://evadot.com/glxpscorecard/**

(The following are the writer's selection of likely top contenders)

Astrobotics (& commercial) (2015?) - http://www.googlelunarxprize.org/teams/astrobotic

Moon-Express (& commercial) (2015?) - http://www.googlelunarxprize.org/teams/moon-express

Space IL (Team Israel) (Lunar Cube Model) (2015?) - http://www.googlelunarxprize.org/teams/team-spaceil

Other GLXP Teams (20 active, 8 withdrawn) **-** http://www.googlelunarxprize.org/teams

Lunar Cube - Vermont Tech College with NASA Vermont Space Grant Consortium/ EPSCOR with NASA Goddard/ JPL support (2017?) - http://www.vtspacegrant.org/cubesat_vtproject.php

Open Luna (250kg Lunar lander) (commercial) - http://openluna.org/missions
http://openluna.org/wiki/index.php?title=Lunar_Lander

ISRO Chandrayaan II - Lunar lander/rover (2014-2015) use of Russian Lunar Resurs rover uncertain - http://www.chandrayaan-i.com/index.php/chandrayaan-2.html - http://en.wikipedia.org/wiki/Chandrayaan-2

CNSA Change'e 3 (2013) - http://news.xinhuanet.com/english/video/2012-07/31/c_131750533.htm
http://en.wikipedia.org/wiki/Chang'e_3

Change'e 4 (backup?) - http://en.wikipedia.org/wiki/Chang'e_4 -

Change'e 5 Sample Return (2017) - http://news.xinhuanet.com/english2010/china/2011-03/02/c_13758065.htm

ESA Moon Lander (2018) - http://www.esa.int/esaCP/SEMUV2KOXDG_index_0.html
http://en.wikipedia.org/wiki/Lunar_Lander_(space_mission) -

JAXA Selene II (2017) - http://www.jspec.jaxa.jp/e/activity/selene2.html -
http://en.wikipedia.org/wiki/SELENE-2

Roscosmos Lunar Resurs (likely to be cancelled) -http://www.russianspaceweb.com/luna_resurs.html

Roscosmos Luna Glob (2014) - http://www.russianspaceweb.com/luna_glob.html
http://en.wikipedia.org/wiki/Luna-Glob

Lunar & Cislunar Orbiters/Impactors: Present & Proposed (US only?)

Lunar Reconnaissance Orbiter NASA 2010- ongoing http://lro.gsfc.nasa.gov
http://www.nasa.gov/mission_pages/LRO/main/index.html
http://en.wikipedia.org/wiki/Lunar_Reconnaissance_Orbiter

GRAIL (orbiter) NASA 2012- extended - http://lro.gsfc.nasa.gov
http://en.wikipedia.org/wiki/Gravity_Recovery_and_Interior_Laboratory
http://www.sciencedaily.com/releases/2012/08/120831135012.htm

Artemis IV & V (L1 and L2 Lagrange points orbit respectively) NASA 2011- ongoing
http://www.nasa.gov/mission_pages/artemis/index.html

LADEE NASA 2013 - www.nasa.gov/mission_pages/LADEE/main/ - http://science.nasa.gov/missions/ladee/

Armadillo CubeSat Low Orbit Mission Baylor/UT-Austin 2012 - http://www.uk.amsat.org/7042

Kordylewski Mission Baylor - http://www.baylor.edu/content/services/document.php/124326.pdf
http://en.wikipedia.org/wiki/Kordylewski_cloud
http://www.daviddarling.info/encyclopedia/K/Kordylewski_Clouds.html

Lunar Swirls impactor UC Santa Cruz (2015?) - http://en.wikipedia.org/wiki/Lunar_Swirls
http://science.nasa.gov/science-news/science-at-nasa/2006/26jun_lunarswirls/
http://www.lpi.usra.edu/meetings/leag2011/pdf/2038.pdf ◘

Abstract: **An Affordable Paradigm of Hitchhiker Lunar Cube Spacecraft and Lunar Cube Labs for Exploration and Commerce**

Dave Dunlop, National Space Society, and Dr. Rene Laufer, Baylor University

”Hitchhikers Paradigm”

A number of teams of are defining a new paradigm of low cost spacecraft missions which “hitchhike” to their cislunar objectives on larger rockets heading to GEO or a translunar injection trajectory and which use a variety of approaches for affordable exploration. (1). These save considerably on the launch costs of such secondary payload missions. Significantly lower prices can in turn make more frequent cislunar exploration and commercial missions possible. Strictly speaking the hitchhiker paradigm is defined by the secondary payload requirements and technology for large launch vehicles. Their mass range includes Mini-satellite (100kg to 500kg), MicroSatellites 10kg to 100kg), Nanosatellites (1kg to 10kg), PicoSatellites (.1kg to 1 kg).

Small Sat History

In the United Kingdom, the University of Surrey pioneered this Microsat. approach in 1981, subsequently spinning off Surrey Satellite Limited, now a part of EADS. Many universities followed with microsatellite projects during the next twenty years. These spacecraft are also termed “University Class projects” connected to University Engineering and Science programs and small agile teams which include students in the design and construction effort and most often faculty as Project Principal Investigators.(2)

About 12-13 years ago the low cost cube sat architecture and PPOD launch system developed initially at Stanford University and the University of California State University, Santa Luis Obispo and the development of the Small Satellite Workshop Conference at Utah State University influenced many new projects. This Hitchhiker paradigm applied to lunar missions has also been recognized in recent Conference such as the International Astronautical Conference in CapeTown South Africa, 2011. The First Interplanetary CubeSat Conference was held at MIT in May to address the extension of the Cubes Sat architecture to destinations such as the Moon and Mars. Several workshops have also been held on “Lunar Cube” which focus on the application of this architecture to Lunar Missions by Flexure Engine/˘Æ

Low Cost, Mass, Power and Volume Architecture

This Hitchhiker-Cube Paradigm involves technical challenges of reducing the volume, mass, cost, and range of microdevices instrumentation, as well as short development time line for such satellites. Many cube sat initiatives are not only educational but scientific, military, and commercial. As such it also draws in many additional elements that are part of this design paradigm. Not all projects will include all of the elements listed below and some elements listed are at the edge of technological feasibility. Together these Hitchhikers define a pattern that will reduce the cost of cislunar and Mars operations with a low cost, low mass, low power, low volume architecture and an array of adjunct technology approaches:

1 Utilization of the design standards developed for cube satellites and associated launch systems as secondary “low cost spacecraft mission paradigm < $10M.

2 The development of reusable large booster systems, such the Falcon 9, may drop the cost of launch costs for both primary and secondary missions.

Navigation

3 Utilization of of weak stability boundary navigation and low energy trajectories to define low mass ion propulsion system requirements for mission object

4 Advanced autonomous intelligent navigation, hazard avoidance and landing technologies.

Propulsion

5 Development of micro thruster systems for active spacecraft orientation. (Many cube sat now have a passive gravity gradient orientation)

6 Small ion drive spacecraft propulsion systems that are solar powered. (Thrusters with expensive xenon may be replaced with less expensive propellant)

7 Development of solar sailing technologies

Communications

8 An in-space communication and navigation infrastructure for communication relay in cislunar space. (Small spacecraft with low power and low bandwidth rely on large dishes for Direct communication with Earth or on a relay of weak signals to other spacecraft with more power which may be in Lunar or Mars orbit

9 In space multi-spacecraft neural net communication system.

10 Low cost global web connected small dish low bandwidth tracking networks.

11 Development of an integrated solar array and refractory antenna system (4)

12 Integrated optical communications and proximity sensors (4)

Electronics

13 Ultra low power electronics utilization.

14 Ultra low temperature electronics utilization.

15 Long duration radiation hardened electronics.

16 On board data storage and compression capability.

17 On board data analysis.

18 Micro devices sensors systems constrained by 1 U scale mass,power and volume design standards.* (5)

LEO Testing

19 Spacecraft testing including utilization of LEO test missions and flight qualification in the LEO space environment providing space flight heritage for subsequent selection in deep space missions.

Smart Autonomous Systems

21 Advances in artificial intelligence will enable small labs and space craft to be situationally aware of their environment, to monitor their own performance, to make certain levels of autonomous decisions, and to also process data and analyses result in situ. "Systems on a chip" or "lab on a chip" technologies will make the capabilities of these small craft quite formidable and also provide a capability to obtain analysis of phenomenon that are far distant from Earth observers. Surface navigation across challenging terrains is another pioneering aspects of this paradigm that can results in both more affordable and capable missions.

20 Multi-strand funding development in the United States from NASA OCT, OEMD, AFRL, DARPA, Commercial NASA Space Grant, NASA's Small spacecraft Technology Program. Similar cube sat scale missions are being funded by non-US funded universities around in Europe, Korea, Japan, China, and elsewhere around the world.

Hitchhiker/Lunar Cube Evolutionary Development

Generation 1.0

This generation builds on the design experience and use of commercial off the shelf hardware. NASA or other navigation software is used to define propulsion requirement and to utilize existing chemical propulsion systems to reach cislunar space. The use of LEO cube sats as a means of testing instruments, electronic, and power systems for second generation is a cost effective means of developing space qualified hardware. Convention communications systems are used. and passive gravity gradient orientation is used.

Generation 2.0

Cube satellites designs provide newly developed micro thruster thruster for space craft orientation. Low cost global web-connected communications systems reduce costs of tracking, communications, and missions operations. Low energy trajectories are selected which match mission requirements with the abilities of ion propulsion systems which use xenon gas or alternative less expensive fuels. Integrated solar and reflectory antenna systems are used to increase available power and communications capabilities. Rad hardened electronics are used to meet requirement for long duration mission.

Generation 3.0

Cube sat scale space craft are developed for the cyro-environments in deep space, lunar cold traps, and other cryo-destinations. Ultra low temperature electronic and ultra low power electronic and cryopower systems mature so that these environments are opened to exploration. Optical communications and sensor proximity systems enable coordinated space craft operations. More reliance on on-board processing and data analysis and make these space craft more adaptive. The maturity of these advances in autonomous intelligent navigation, hazard avoidance and landing technologies will allow these small spacecraft to investigate the surfaces of the Moon, Mars, and the asteroids. These later missions may also utilize solar sail propulsion systems for very low mass advanced spacecraft.

Cost Evolution

Hitchhiker "Cube lab" and modular cube scale spacecraft in the microsatellite mass range (2) may grow a significant customer base and a larger volume of lunar missions which can deploy to a variety of cislunar destinations or ultimately to the lunar surface. The Cube Sat architecture has provided mission costs of tens of thousands of dollar to several hundred thousand so dollars to exceptional projects which have cost in the low millions. Nanosatellite Class cube sats will remain a significant training ground for student engagement. Picosatellite scale design may offer a low risk approach to the exploration of challenging surface environments where the deployment of numbers of nanobots may be a cost effective strategy. Mission components may benefit from common design standards but space qualified components increase the costs. A larger market for such mission may also mean some economy of scale in production and purchase of components. Even small scale micro landers with a price point in the low tens of millions of dollars are likely to be demonstrated well before the end of this decade. A these technologies mature, with additional experience and lower mission costs may result in a much wider number of countries and companies that can support these missions. Micro Sat and Lunar Cube lander missions in the $ single digit millions range may become a common place.

Summary: Mission price points in the low tens of millions dollars or even single digit millions are now projected to be within reach for cislunar missions due to the creative use of a variety of approaches enumerated and described above. While not replacing larger scale missions that have been developed in the past this new paradigm will define a new era of affordable exploration missions to many destinations including cryo-destinations in the solar system and of the potential of a commercial market mechanism driving affordable commercial missions in cislunar space and to the surface of the Moon itself.

Notes:

Appendix I

https://sites.google.com/a/slu.edu/swartwout/home/university-class-spacecraft

http://prod.nais.nasa.gov/cgi

http://www.nasa.gov/home/hqnews/2012/aug/HQ_12274_Small_Tech_Demo_Missions.html

http://www.nasa.gof/home/hq

Appendix II

Current Mission Development

As mentioned above the Lunar Cube Model did not arise from an intentional funding program focus but rather from the convergent utilization of diverse technology development drive but cost imperatives. It's reality is based on current mission initiatives as well as research and development technology trends.

Some current projects include:

1 The Lunar Swirls Mission proposed by Principal Investigator Dr. Ian Garrick Bethel would provide two cube scale impactors with magnetometers launched from a mother ship/relay orbiter the size of a washing machine for about $30M. Participating organizations include US Santa Cruz, UC Berkeley, a S Korean University, NASA AMES and the KARI, South Korean Space Agency. Launch might be anticipated in the 2016-17 time frame.

2 The Google Lunar X-Prize SpaceIS (Team Israel), lead by Yariv Bash, is developing a 3 U" lunar lander mission as its approach to winning the GLXP by landing on the lunar surface, taking pictures, moving 500 meters and transmitting live imagery of its activities. Its estimated cost range for this project is in the range of $25M to $45M by the December 31, 2015 GLXP prize time line. Participating organizations include the Weizmann Science Institute, Ben Gurion University, The Technion, and the Israeli Defense Industries Association.

3 A Lunar Cube lunar lander project is also in development at Vermont Technical College lead by Principal Investigator Dr. Carl Brandon. Project partners include Vermont Space Grant consortium partners U of Vermont, Norwich University, St. Michel's College and assistance from Goddard SFC and JPL. A spacecraft fabrication cost of approximately $1M is projected but no transportation or launch cost are included in this figure. Space Grant and EPSCOR funds have been used thus far. A launch time frame of 2017 is anticipated with continued funding support.

4 A Kordylewski Dust Cloud Lunar Cube mission is being planned by Dr. Rene Laufer of the CASPAR Program at Baylor University in Waco, Texas. A precursor CubeSat flight test of the dust/particle detector is scheduled in late 2012 on the Armadillo CubeSat developed by the University of Texas at Austin. The primary mission would be launched as a secondary payload on a commercial satellite launch to GEO. **DD**

Strategic Issues in LEO: Beyond the International Space Station

By David Dunlop

The successful completion of the International Space Station represents the end of one era and the beginning of another. Defining an era is always easiest in retrospect and defining the next era is always more difficult. But looking back may be a useful exercise in prediction not because in some statistical sense the future will be like the past but because the impact of the ISS past is in any ways the foundation of the future.

Political Collaboration

The ISS represented a unique set of circumstances which reflected the end of the cold war between the Soviet Block and Alliances between the Democracies of Canada, Europe, the US and Japan. The collapse of the Soviet Union economically meant that there was an unparalleled opportunity to coordinate the efforts of Russia and its principal political opponents in one large and expensive but affordable project. The aerospace industrial complexes in each of these countries had a significant role to play in an overall undertaking that has immense political and social value in the aftermath of WWII in which some these same countries had been largely destroyed or largely been brought to economic ruin. This program provided a means for this capacity to be maintained as a critical element of the supply chain of the ISS project and strategic relations with Russia after the collapse of the Soviet Union.

Economic Collaboration

The large costs of this endeavor were spread among the member countries although the principal burden was born by the United States which had the largest and most dominant economy. There were also other quid pro quo considerations such as the purchase, decommissioning and reprocessing of nuclear materials from the Soviet Union to limit the strategic spread of these weapons. The economic collapse of the Soviet Union also posed a grave threat to both the strategic capacity of Russia and its skilled aerospace workforce.

Parallel Strategic Development; Launcher Development

The ISS also provided a political and economic rational for the parallel development of sophisticated launcher systems in both Europe with the Ariane V launcher and in Japan with the H-II B. Both of these programs now means that there is a more redundant supply chain to the ISS. The Russians have been developing the Angara launcher program with some collaboration with the Koreans as it next generation launch system. While the Shuttle system was retired the US has also improved it strategic foundation for manned flight with the man rating of the Atlas V Heavy EELV with the United Launch Alliance. It has also provided investment incentives for the development of the Falcon 9 system with Space X and the Antares (formerly named Taurus II) launcher from Orbital Sciences.

Launch Facilities

During the ISS program the ESA matured it launch facilities in Kourou. The Russians have also just completed launch facilities in Kourou in collaboration with ESA, maintained their operations in Baikonur in Kazakhstan, and are developing a launch complex in Eastern Siberia. NASA is also investing in refurbished facilities at KSC in partnership with Space Florida State launch agency. (1) Similarly NASA has in partnership with the Virginia Commercial Space Flight Authority developed upgrading its Mid-Atlantic Regional Spaceport (MARS) at Wallops Island to support the Antares-Cygnus program. (2)

Manned Systems Development

The ISS also represents significant advances in manned systems development demonstrated by the contributions of not only the US and Russia in but also the Europeans with the Columbus Lab built by Thales Alenia, and the Japanese with the Kibo lab. The European AVT cargo supply program will provide the foundation for an ESA manned access program and its expertise is incorporated in the pressurized Cygnus capsule also being developed by Thales Alenia under NASA's Commercial Cargo program contract with Orbital Sciences. The Japanese HTV cargo supply program will have the same potential. NASA's Commercial Crew Program is also pushing toward manned vehicle development by Space-X with it Dragon capsule, Boeing with it CST-100, and Sierra Nevada with its Dream Chaser. the latter two launched atop a Falcon 9.

Strategic Cooperation: Insiders, and Outsiders,

The ISS represents a strategic collaboration of four the great space faring powers powers of Canada, Europe, Japan, Russia, and the US. India and China are not represented in the ISS program.

Foundations for the Future: Newcomers

Korea, Brazil, and Ukraine are also developing space powers with both launch facilities and launcher development, and their impact is not likely to be significant for another decade. However their development will predictably provide more avenues of innovation in the evolution toward an international space commercial market.

China is also making significant investments and efforts to build its own manned space program with demonstrations of manned flight, and the beginning of their own space station, and the development of a new launch complex on Hainan Island. The ISS has been a highly constructive demonstration of the value of coordinated international efforts and the Chinese also seem to be opening the door for international cooperation with their new Taingong space Lab.(3)

The rise of commercial space capabilities has been stimulated by the ISS project with commercial crew and cargo programs, the Google Lunar X-Prize Program, and interest in space tourism. These will become an increasingly significant consideration in what lies beyond the ISS. This internationalized commercial approach to space development promises to shuffle the deck and the players. Bigelow and Excalibur Almaz are companies that are planning commercial space station initiatives.

Roadmaps for Cooperation and Development

During the ISS era the partner space agencies had opportunities to consider their future options with the development of an International Space Exploration Coordination Group which was a key recommendation of "Global Exploration Strategy: The Framework for Coordination signed by 14 nations and released in May 2007.(4) One result was the ISEWG Reference Architecture for Human Lunar Exploration (5). Most recently The Global Exploration roadmap was released in 2011 (6) More recently NASA Deputy Administrator Lori Garver highlighted the NASA Voyages Report which discusses NASA's focus on integrated ISS capabilities to multiple destinations beginning with the role of the ISS "for technology demonstrations, tests, and experiments to develop the essential capabilities for compelling and benefit rich multi-destination space exploration." (7)

These destinations include:

- The goal of establishing a human presence in Cislunar space including the LaGrange points.
- The Moon • The Near Earth Asteroids • Mars

The ISS is envisioned as the cornerstone of human space exploration "at least through 2020. Its role in pushing out beyond LEO includes a variety of activities including:

- Robonaut 2 and advances in human robotic integrated activities
- Flight tests for Crew and Cargo capabilities
- Development of common standards for docking interfaces, rendezvous, and communication protocols
- Environmental Control and Life Support Modular Systems for long term habitation
- Inflatable Modules for long term habitation
- EVA activity to model human operations on near earth asteroids or the Moon of Mars
- Supporting exploration missions going beyond LEO in Cis-lunar Space , NEAs, the Moon, and Mars.
- In space propulsion testing solar electric propulsion systems
- Demonstrating operations capabilities that are needed to push beyond LEO

It is clear that the ISS has a strong and vibrant role as the foundation for further advances outward in in a collaboration with both international and commercial partners.

Another critical piece of this vision is the use of propellant storage and transfer capabilities in LEO and beyond and the establishment of such facilities further along the path to the suite of destinations. Getting gas stations developed is another central strategic capability that will leverage past investments and enable a economic breakout in space activities and participants.

Summary: The ISS is in the mainstream to international space cooperation and development. It has shifted from being "The Destination" to a Gateway Destination. Perhaps the ISS will grow to include a stronger role in space construction of facilities needed beyond LEO. It may also play a growing role in the servicing and checkout of "stacks" automatically docked and assembled in orbit that are headed out to ambitious missions to the Moon, Mar, and the asteroids. Perhaps its size will be increased with inflatables and additional solar arrays as commercial organizations present opportunities for manufacturing, space tourism, or gravitational biology research, and radiation protection technologies. Perhaps some ISS elements will be detached and become nodes for new more specialized facilities.

The expense of building the ISS as an set of international learning labs has been questioned but it is only just beginning to demonstrate its value and these multi-strategic development roles that are the next step. As new international and commercial launchers and manned transportation systems are developed it seem very clear that the ISS will be an increasingly busy hub fostering a critical, progressive, and diversified research and development agenda.

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Lunar Supercomputer Complex: 21st Century DSN Evolution Prospects

(DSN: NASA's Deep Space Network) - AIAASpace2012_Chang_Thangavelu_paper.pdf

http://www.newscientist.com/blogs/onepercent/2012/09/**supercomputer-moon.**html

http://www.wired.com/wiredenterprise/2012/10/**supercomputer-moon/**

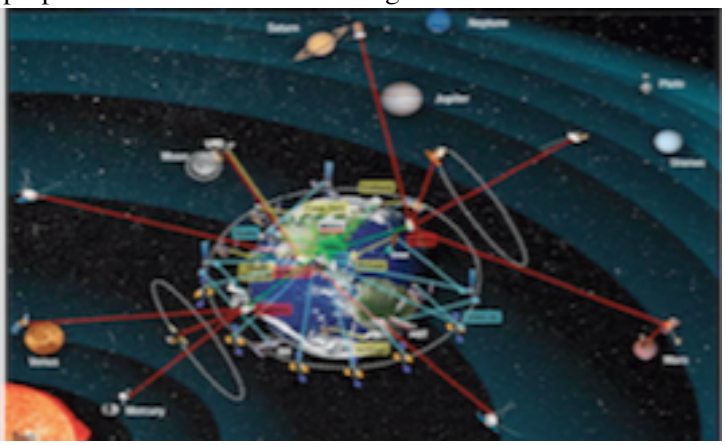
By Ouliang Chang (graduate student) and Madhu Thangavelu (adjunct professor)
both at Department of Astronautical Engineering, University of Southern California, Los Angeles, CA, USA
(Synopsis by Editor, based on their paper and online report about it, link above)

NASA currently controls its deep space missions through the Deep Space Network of huge satellite dishes in California, Spain and Australia. But with the increasing number of missions and data, the system could soon be overwhelmed. Australia is adding more dishes, but this can only serve as a temporary stopgap.

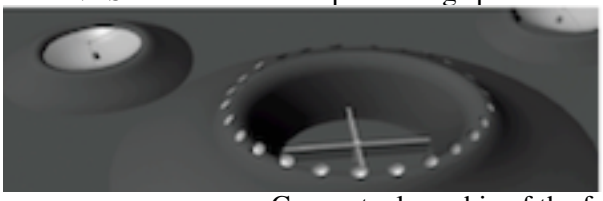
NASA is looking into building a laser-based system, as opposed to radio, capable of handling vastly more traffic - http://www.nasa.gov/centers/goddard/news/releases/2012/12-074.html

More continuous and extended missions and high-fidelity broadband telerobotic operations

But there may be another solution, say Ouliang Chann and Madhu Thangavelu, namely building a Super Computer Complex on the Moon itself as a new off-Earth Deep Space Network to handle "the more and more continuous missions and current duration-extended missions as well." "it is also expected that the first phase of lunar industrial and settlement development will commence, focusing on projects and missions employing **high-fidelity,** broadband tele-robotic operations." The Earth-based Deep Space Network will be challenged to handle all this traffic.



NASA's Earth-centric-processing space communications and processing space communications architecture



Conceptual graphic of the future lunar supercomputer complex as part of
an Earth-Moon Dual-Nexus 21st Century Deep Space Network

Earth-Moon Dual-Nexus Network Features and Benefits

- much needed system **redundancy**
- much faster signal processing employing **antennae placed on the lunar far-side**
- fast computing and **data processing ability for lunar developments and settlements**, such as imaging and **data transport for observatories**, real-time **teleoperations** and **complex guidance, navigation and control maneuvers for lunar service vehicle**s.
- Lunar environment monitoring activities (**solar storm early warning** and l**unar surface charging forecasting**

Objectives of this Exercise

- Foster the creation of **innovative architecture concepts for future space exploration missions** using aerospace system engineering/architecting tools, evaluated by academic/industry experts at mid-term and final presentations.
- Creation of concepts to reinvigorate human space exploration following the retirement of the Space Shuttle

This concept was developed by Ouliang Chang under the supervision of M. Thangavelu during the Fall 2011 session of a graduate course offered by the Astronautical Engineering Department of the Viterbi School of **Engineering** at the University of Southern California.

ASTE 527: Space Exploration Architectures Concepts Synthesis Studio. **>>>**

A Civilization Risk Assessment and Risk Mitigation Plan cannot be further delayed

By Adriano V. Autino - aa@tdf.it
President of **Space Renaissance International**
[Edited by Walt Putnam and Peter Kokh]

The risks of unsustainable growth

Four years after the beginning of the first global crisis, I believe it could lead directly to an implosion of our civilization. We still have time to revert the process, if the general public underestimation of such global risk could be reversed as soon as possible.

We are seven billion humans on this planet, now 60-70% industrialized. We have both intellectual and material means to put in place a global risk mitigation plan and work it out in sufficient time to prevent the looming implosion of our civilization, and to launch an era of unprecedented economic and cultural growth. So, why we are not moving on that road? What is missing is the perception of the risk, and the persisting fully pre-Copernican metaphysics (perception of the world) bound to the limits of our mother planet.

We at **Space Renaissance International** identified such a general underestimation of the risk, and obsolescence of the world, as the greatest threat to civilization. As Stephen Hawking wisely said, humanity is condemned if it will not expand outside our mother planet, since within the end of this century planet Earth will not be able to sustain more than one billion people.

Recently I was listening on an Italian radio channel (Rai3, a channel devoted to culture and intellectual issues), to an interview with the philosopher Zygmunt Bauman, at a convention on philosophy in Modena, Italy. He was talking about the global problems, the crisis etc... He said that we (civilization) have only two alternatives: (i) to kill some billion people, or (ii) to come to an agreement to deal some sort of “de-growth” path. This concept – de-growth - is currently the most dangerous threat to civilization. None of these self-called philosophers spent ten minutes to analyze what it would mean for a seven billion person civilization to begin forming a degrowth roadmap. It would mean de-science, de-technology, de-culture, and an awful jump back in history.

An Alternative to an unstoppable collapse of civilization

A backwards jump too the Middle Ages? Maybe more, to the Stone Age, since there will be no limits to depression, rising superstition, starvation and barbarianism, once that Pandora’s box is opened. However, these people have a great influence, since they claim to be motivated by a moral rationale. Why they don't even consider the expansion of civilization into the Solar System, to take advantage of the great abundance of energy and resources in our solar system, enough for thousand billion people at least, for millennia to come?

There are several answers to this question. Many of these people are simply subject to a kind of bureaucrat in their mind (remember the Robert Pirsig's "mind Joe"?), preventing them from seeing the evidence, since they are not educated to see it. Many simply fear any adventure, and they prefer to die in a known condition than to risk exploring the unknown. Many think that this is a great opportunity to make capitalism finally pay for its sins. But I believe the bigger part of them (both the philosophers and the people who follow them), think that the need to manage scarce resources is an opportunity for the advent of a "new morality," after an age of consumerism and waste. Combine this aim with ecologist beliefs and the result is a powerful antidevelopment (and ultimately anti-human) social vector.

I believe that, down deep, this is the true cause of the current crisis: it is a crisis of philosophy, and we will not come out of it without a complete post-Copernican re-foundation of the general philosophy of our civilization. If that -- the de-growth philosophy -- is the ideological adversary of those who care for the continuation of civilization (and not only of the human species somehow, but of civilization itself) the true humanists don’t fight with the sub-cultural means of slander and insults, sadly so common in the current political scene. We will move ahead on the road of scientific rigor. It is time to put in place a serious project, involving all universities and research centers that will manifest their interest. This project was selected by the Space Renaissance International’s first Congress, in 2011, but it took until now to put it in the form of a statement of work suitable to be communicated and to be used to call for partnerships and manifestation of interest. We seek partnership by all of the logical stakeholders in this project.

The first basic requirements of the project involve a social analysis. Seven billion humans on one planet have likely already passed the threshold of sustainability of that planet. If we keep growing within a closed system, civilization will implode (as Stephen Hawking so clearly pointed out), and the break-event is expected to occur somewhere in the first half of this century.

The main problem is not technological (suitable technologies exist, or will exist soon) but political, the absence of public awareness of the risk, and of the need for political decisions on a mitigation road-map. Furthermore, the global crisis will reduce the work capacity, the general scientific and technological knowhow, and accelerate the process of social implosion. People intuitively know that a big risk is looming, but don't have a realistic vision of it.

The development of a space economy is a mitigation plan that will oppose and reverse the above social processes and create millions of jobs, in turn restoring hope in the future and stimulating young minds in a positive direction. To win the game, the new risk-reversing industries (such as new space industry) need popular support. Governmental support in the forms of grants, tax discounts, incentives to the new space industry, etc., would accelerate the process and adoption. In order for the above processes to take place, public awareness of the risks and of the urgent tasks to be undertaken should be raised quickly and systematically.The main stakeholder of this project is the whole human community – in a word, the civilization. Since the civilization risk is tied to all of the species living on planet Earth, the stakeholders includes them as well.

From an evolutionary point of view, being the human species the maximum expression of intelligent life on Earth and possibly in the Solar System, since life in the Solar System can be spread and developed only by an intelligent technological species, the continuation of the civilization is essential to the development of any form of life in the Solar System and beyond. Moving our attention from evolution to society, the young generations hold the major interest in civilization risk mitigation. Therefore all of the institutions dealing with education, student associations, social organizations dedicated to youth, cultural entities, artistic entities, and charity organizations are included within stakeholders as well. Humanitarian international and local associations, such as UNO, UNICEF, Amnesty International and similar organizations, churches, having the help to the Earthling people, enhancement of human rights, safeguard of freedom and democracy in their scope of existence, are part of the stakeholders as well. All of the trade unions, devoted to the defense of the interests of workers and/or entrepreneurs. All of the Earthling governments, devoted to the defense and enhancement of the citizens living conditions. All of the artists and cultural dealers, sensitive to the human living conditions, and all people endowed with a sharp and visionary perception of social changes. All of the enterprises, interested to a growing economy and growing markets. What do we mean with 'civilization risk'? A global risk threatening the existence of civilization as we know it (not necessarily the extinction of human species), or a global risk that could cause that extinction?

A non-exhaustive list of Civilization Risks for analysis and mitigation: progressive dwindling of earthly energy and raw materials sources; the prospect of wars erupting over scarce resources, escalating, perhaps, to nuclear exchanges; asteroid or comet impacting the planet; natural disasters, tsunamis, hurricanes, earthquakes, floods, drought, extreme climate change; environmental decay, either natural or anthropogenic; biological warfare, whether caused by a terrorist strike, a "rogue nation", or a simple accident; evolution of "Superbugs"; cultural decay, resulting in a second "Dark Ages" characterized by superstition, criminalization of science and technology. Each one of these risks can end in global economic decay, leading to a global crash of civilization, ruin of all industrial activities, then implosion of civilization. Some of them lead to a quick extinction of human life and all living species on Earth.

The goals of the CRAM Project, coherent with mission of the SRI, are to transcend the space community, making accessible to the general public the extreme risks civilization is facing.

- Identify actual or credible risks with a probability of occurring within the next 50 years.
- Provide scientific proofs of the probability of the main risks related to our civilization continuation.
- Provide an awareness of one or more mitigation plans being necessary and require the urgent attention of political leaders; the need for implementing global projects, targeted to assure the continuation of the civilization and enhance industrial and cultural development; the relationship between global crises and human population growth on our native planet and peoples' empowerment to resist societal decay through cooperative work toward sustainable solutions.

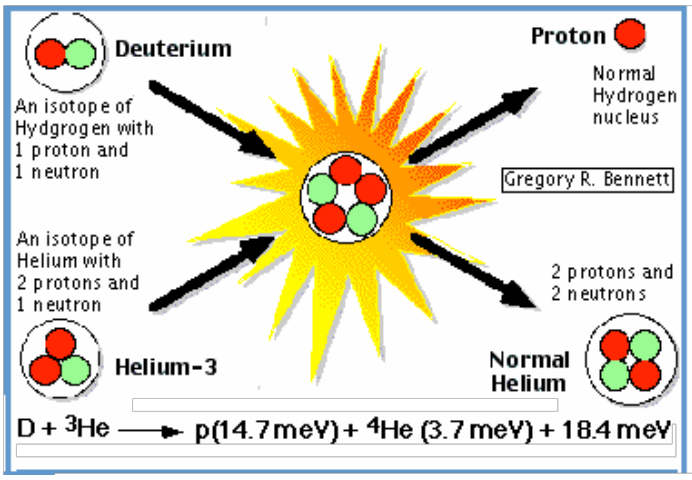
The project also aims to solicit the involvement of universities and research communities, administer a social questionnaire positing the key questions about the future of our civilization, reach interdisciplinary communities, stakeholders of the mitigation plan, which could be directly involved in the realization of the plan itself. The project will seek partnerships with universities and research centers, including those with the following expertise: technical and scientific faculties, sociological and social sciences, philosophy, communication sciences, computer sciences, psychology, political sciences, environmental sciences, architecture and urban planning. A wide parallel development among several working teams will be admitted and encouraged, in order to get forecast and simulation results as much realistic as possible, a strong base for a general mitigation plan.

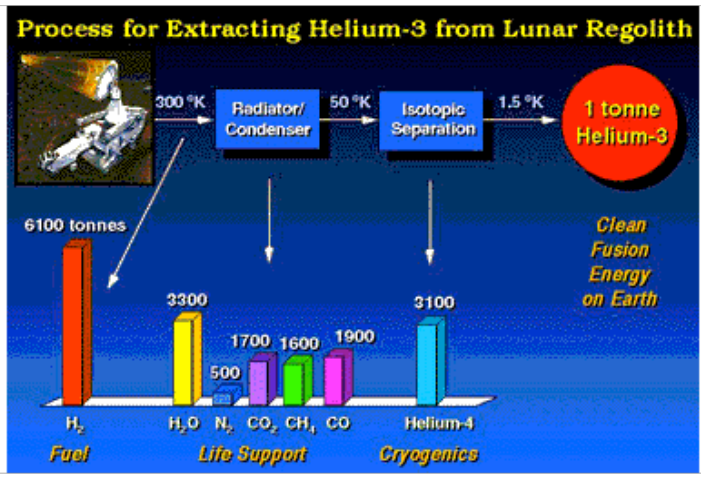
All people interested to team up please send their manifestation of interest and CVs directly to the author:

China proposes Mining Helium-3 on the Moon for Clean Fusion Power

By Peter Kokh

http://inventorspot.com/articles/chinas_upcoming_moon_mission_seek_out_helium3_fusion_fuel





Left: the Helium-4 fusion reaction **Right:** by-products of mining He-3 from solar wind volatiles in moondust

Information Resources:

http://www.explainingthefuture.com/helium3.html

http://en.wikipedia.org/wiki/Helium-3

http://ares.jsc.nasa.gov/HumanExplore/Exploration/EXLibrary/docs/ISRU/06Energy.htm

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http://www.ibtimes.com/articles/171239/20110629/lunar-reconnaissance-orbiter-nasa-moon-apollo-mission-surface.htm

Video on He-3 Fusion - He-3 expert Dr. Gerald Kulcinski - http://www.youtube.com/watch?v=2HeMAXO9OA

A fascinating hour with Gerald Kulcinski - http://www.thespacereview.com/article/536/1

Three Scenarios to use the Moon to solve Earth's long range energy problems

1. **Building solar power satellites with the help of materials produced on the Moon**, is only one of 3 scenarios by which the Moon could play a critical role in providing Earth's burgeoning population with abundant and clean power, reducing our reliance on fossil fuels which are currently pumping CO2 into our atmosphere.
2. **Using lunar materials to build extensive solar panel farms on the Moon itself** and then beaming the power to relay stations in Geosynchronous Earth Orbit is a scenario proposed by David Criswell. Extensive areas at both E and W limbs of the Moon would host these panels, one or the other being in sunlight.
3. **Harvesting the solar wind particles affixed to moondust fines** for Helium-3 is the other. As only 1 out of 4,000 Helium atoms is Helium-3 (instead of the standard He-4) there would be extensive useful byproducts produced in this harvesting project. See graphic above. The He-3 fusion reaction is unique in that it produces no radioactive particles. You could live inside a helium-3 fusion reactor and receive less radiation than most of us receive all the time from radon in Earth's crust.

As exciting and promising as this process seems to be, progress towards achieving nuclear fusion, of any kind, seems to be slow. A common response is "Nuclear Fusion has been 30 years in the future, for the past 30 years." But Gerald Kulcinski begs to differ: We are a thousand times closer to achieving a stable fusion reaction than we were thirty years ago.

Despite a NASA report confirming the potential of He-3 mining, United States government support has been close to nil. The second Bush administration, cancelled all funding for continued fusion research. President George W. Bush and his father President George H. Bush have been heavily involved in the Texas oil industry. There seems to be no support in the US Congress.

Helium-3's future role in allowing all humankind to reach and sustain a prosperous life while helping keep our beautiful planet healthy and green, could be critical. Meanwhile, Japan, a power company in the US State of California, and nor China are backing demonstration projects.

Twenty-some years ago, when total United States power consumption was lower, it would have been true to say that if NASA were to land just one Space Shuttle External Tank on the Moon and fill it with liquid Helium-3, that one shipload could produce all the power the Unites States needs in one year. While we might now need 2 or 3 "ET" tanks full a year, this claim shows the tremendous potential.

In comparison with the other two scenarios above, the He-3 fusion process would not create a ring of bright solar power satellites and/or power relay satellites in Geosynchronous Earth Orbit, forever transforming the night sky. Most SPS power advocates do not realize how much opposition may arise from astronomers, professional and amateur alike. Such opposition could lead to a healthy round of SPS design research to come up with designs that could minimize this problem to some degree.

It would be wise for space enthusiast organizations to sponsor SPS design contests that minimize how bright an SPS unit would appear from Earth's surface, now, while we wait for government support.

Impact on the growth of the Lunar Frontier

Meanwhile, the byproducts of He-3 mining could sustain many thousands of lunar pioneers. The mining process itself is benign and harmless. A harvester would pick up the top layer of moondust, probably less than a meter deep, and after extracting the volatiles with heat, lay that moondust layer back down behind it. This gentile racking of the moondust would not change the appearance of a harvested site except from very close up. The harvester would avoid any crater of size (more than a meter or two wide).

In short, easy top layer sifting in place would do the trick:

√ no landscape scaring, √ no strip mining, √ no landscape alteration, and, as frosting on the cake,

√ the bulk of non-He3 volatiles harvested, when separated out, will be an enormous aid towards creating and maintaining settlement mini-biospheres.

Read "**Moon Mining and Common Eco-Sense**" page 60, MMM Classics Vol. 4

http://www.moonsociety.org/publications/mmm_classics/mmmc4_Jan2005.pdf

Two Helium-3 harvestor concepts. One at left uses a static mirror to direct sunlight to the miner

Taking the lead

If China does conduct a Helium-3 moon-mining demonstration, that could change prospects significantly. The impact on the future of all of us on Earth could hang in the balance. The attention of short-sighted American politicians seems to be fixed on more mundane and near-term issues, further complicated and misdirected by the flow of money from vested interest fossil energy corporations to the pockets of lawmakers.

So we should all wish the Chinese good fortune in this endeavor. Whether this proposal becomes real or not is up to the Chinese government which may be immune to such bribery. Perhaps this could become an International effort, spearheaded by the Chinese. That would be even more promising, no matter which additional nations become involved.

At the same time, we strongly encourage continued study, research, and demonstrations of solar satellite beaming technologies and other "space energy" alternatives. The more we know, the better the choices we will make.

Now demonstrating the harvesting of Helium-3 from moondust, does not in itself advance fusion research, but it would definitely build more financial and political support for that research. This is a long term effort and will take two or three decades at the least. The prospect of getting started soon should excite all of us. **PK**

Moon and Mars Outposts: Building Shelter Structures First

By Peter Kokh

Apollo left no occupyable structure on the Moon. There is no 'friendly' place to return to, no place where we can go and pick up where we left off. We must start over, from scratch, this time with a plan!

We can't "do the Moon" so long as we fear the Night(span)

All six Apollo Moon landing missions were confined to the early/mid-morning "hours" of lunar dayspans. NASA has never attempted to keep astronauts on the Moon for a full dayspan-nightspan cycle, much less for several of them. Given that deliberate "toe-in-the-water self-limitation, the new rounds of astronauts only being on the Moon for less than two weeks before coming home, there is no urgent need to provide shielding.

However, for longer missions, as essential as shielding is for radiation protection, it will also be essential for thermal management in the month ("sunth") long temperature cycle from 200° plus above zero to 200° plus below zero. Now, choosing polar sites or sites at high latitudes, north or south, would mitigate the problem. But consider an alien species visiting Earth and choosing a Pacific Island where the temperature varied very little over the year, radioing home, "we have mastered living on Earth." Yes the polar sites offer access to water ice, yes they are more thermally benign, yes there is less difference between nightspan and dayspan, but the poles are anything but characteristic of the Moon at large, and do not offer critical access to mineral resources found only in the Maria, or along Highland/Mare "coasts" which means limiting ourselves to parts of the Moon we can explore, but more importantly, limiting ourselves to what lunar resources we can develop to fuel the Earth-Moon Cis-Lunar Economy.

The Two Faces of Shelter

The key is providing shelter, not only from cosmic and solar radiation over extended stays, but also to provide thermal moderation at comfortable temperatures. We would want to "shelter" our living spaces to provide moderate temperatures without energy-intensive heating and cooling even if there were no such thing as solar flares, coronal mass ejections, and cosmic radiation!

How to Shield

Considering the source of the author's original "eureka" moment in May of 1985 (read: http://www.moonsociety.org/chapters/milwaukee/mmm/mmm_1.html) it is natural that I have long visualized an ever growing complex of interconnected habitat and activity modules and pressurized hallways, and as whole "neighborhoods" emerged, pressurized streets - all individually covered with shielding as they were added.

Exercising due foresight

But, whether we are talking about a one-nation effort or about an International Lunar Research Park for the first "permanent" outpost, **it is likely that we will want to rearrange modules and hallways etc. as the complex slowly grows** and as experience suggests more favorable layouts. **Watch this time lapse animation video of the construction of the International Space Station, during which several modules were disconnected and repositioned elsewhere. - http://www.youtube.com/watch?v=h8kOAroNNAo**

This is the flexibility that we will need in building a full-function lunar outpost as well. The original plan for expansion may end up being scrapped, and probably more than once. The way McMurdo Station in Antarctica grew to its present size is a case in point. Early expansion plans proved quite inadequate to provide needed expansion not only in the physical complex but in the variety of activities supported.

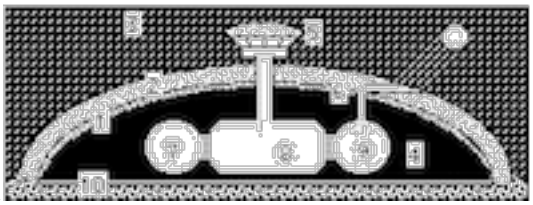
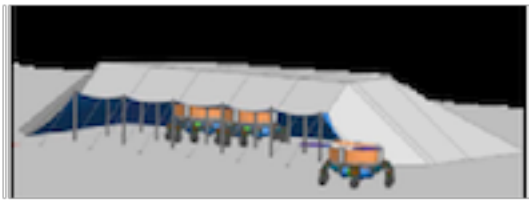
In this light, **it would be best not to start with a few modules**, shielding them as added. For when we wanted to rearrange the complex layout, we would have to remove some of that shielding. Even if we had used sandbags, this would be a chore. There is another way: **Build an expandable shielded canopy first, before delivering modules** to park and interconnect in a temporary arrangement underneath.

Canopies, Hangers, "Ramadas"

A word frequently found in MMM is "ramada." I first learned the word driving through the American southwest in 1980, long before the first MMM. At roadsides where tired drivers can pull in and rest, eat a lunch they brought along, and perhaps use the restrooms, there is often a roof supported by four poles at each corner, its main function being to provide shade from the hot unrelenting sun, rather than shelter from infrequent rains. This shelter is called a "ramada" - Spanish for sun shelter.


Above left: a traditional "ramada" sun-shelter in the SW United States - **Right:** a quonset type shelter

On the Moon, we will probably want unpressurized shelters of various types that are shielded from all directions. That does not mean "closed." Openings through which to bring in modules and other things to be deployed or stored inside can be baffled so that there is no direct path for solar or cosmic radiation to enter.

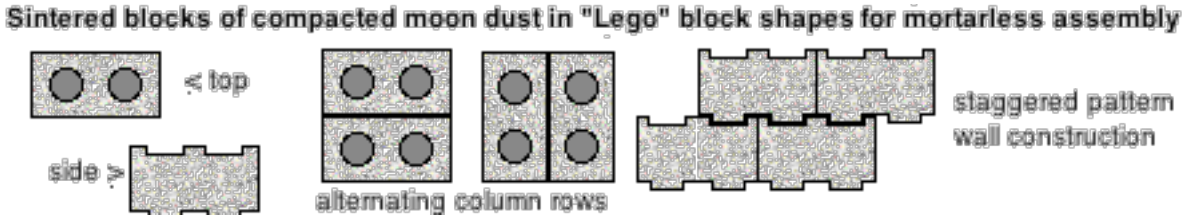
A 


Above left: an illustration from MMM; **Above right:** a similar NASA concept

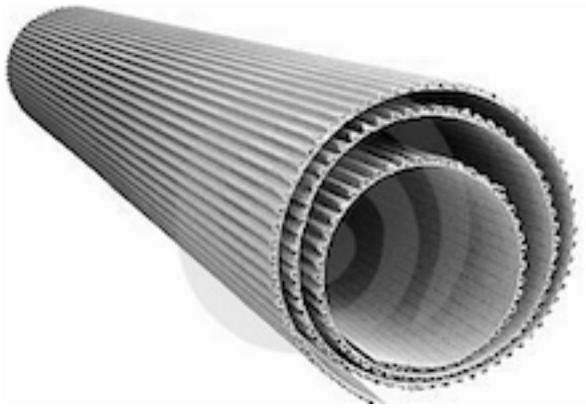
Above left: KEY: (1) Space Frame Arch, Fabric Cover; (2) 20 cm or more regolith dust shielding; (3) exposed vacuum, radiation, micro-meteorites, UV, solar flares; (4) protected lee vacuum service area; (5) observation cupola with ladder shaft to habitat space below (7, 8, 9)

Two ways to deploy such a shelter "first"

1. We can send small crews to the Moon, living inside their lander, and working outside to assemble a suitable shelter. That would take several very expensive missions.
2. Or we can deliver the following package:
   - **teleoperable equipment** to fabricate useful building elements from moondust, and do some pre-assembly chores including producing sintered **building blocks in the "Lego" design** for self stacking without mortar, producing sand bags (basalt fiber fabrics if the site is in a mare area) and filling them



   - **"intelligent" "avatar" robots** operated by "telepresence" from Earth, to handle some of the harder routine tasks, including leveling the area, assembling support walls from sintered blocks, piling up and bags
   - **cargo container structures designed to be reusable**, for example with an unrollable wall for "roofing." **Keep in mind that there are at least two ways to reuse a rocket stage:** a) **refuel it** for another trip or b) **reuse the materials** of which it is made to help construct things needed at the landing location.



A roll of corrugated cardboard

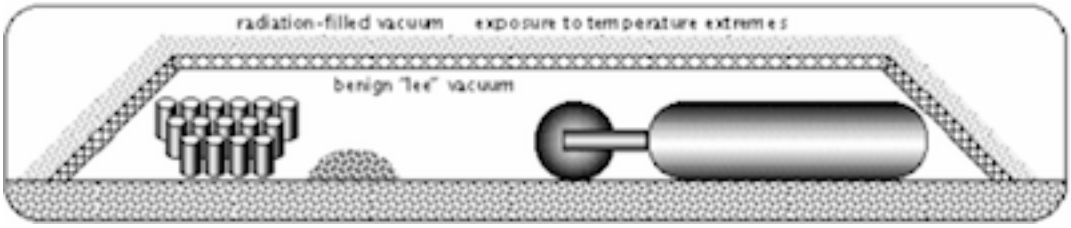
Above: a roll of corrugated cardboard suggests how the **corrugated aluminum skin of a landing cargo stage** (or empty fuel tank) could be reused as a roof to hold blown or bagged moondust, with sintered lego block columns spaced to support the load in1/6 G. If it proved too difficult to manufacture basalt fiber fabrics for bagging moondust to cover a space frame to create roofing, such fabric could be part of the cargo in this shipment.

The corrugation will strengthen this structure in at least one direction. A 2-layer cross-corrugated sheet could not be rolled. But it could be designed to unroll in an arc, short of flat, to provide strong support, the low ends resting on block walls and/or pillars, providing extra internal height.

An option would be two layers of material, placed so that the corrugation of one is at 90° to the other, making a very strong flat roof. (It is cross-grain plies that give plywood its strength and dimensional stability.)

Question: Could Cargo Hold wall unroll into a stable quonset structure? The arched hold wall roof supported in the middle would be stronger than a flat one.supported at the sides. If the corrugated cargo hold wall was designed so that it could not unroll completely but retained a shallow curve, it might be strong enough to hold considerable shielding mass in light lunar gravity.

This type of pre-made reusable roofing, would seem superior, if practical, to constructing a space frame that would then have to be covered with some sort of sheeting (aluminum? basalt-fiber fabric made on the Moon). Both avenues should be pursued to expose and rank all the options.



An earlier MMM Illustration: A hangar with "space frame" wall/roof construction requires some type of sheeting to support moondust, Note warehousing area to the right.

The Advantages of pre-constructing a shielded hangar or ramada before first human crews arrive are clear: Each crew could simply park the modules brought along on its mission and connect them. The assembly area would be shielded, and the construction crew could wear lighter "pressure suits." If a following crew brought more modules that required rearrangement of what was already in place, this would be easy, with no contact shielding materials to be removed and then repositioned.

Of course, sintered moondust lego blocks, basalt-fiber sandbags, sandbag filling equipment, and the ramada/hangar itself are not the only job that can be done beforehand. Teleoperable equipment can grade a landing site "spaceport" and compact and sinter the soil, and build berms around the site to contain rocket exhaust-blown moondust, which can be quite abrasive. And of course, the could level the area in which the hangar/ramada is to be built, and build some peripheral roads.

Open warehousing areas can also be pre-constructed, the ground leveled and sintered, the perimeter baffled by berms, sand bag walls, or lego-block walls, for items that can be stored unsheltered. The hangar/ramada should offer a limited amount of sheltered space for storing items best not exposed to extremes of heat and cold, as well as those that needed to be accessed frequently.

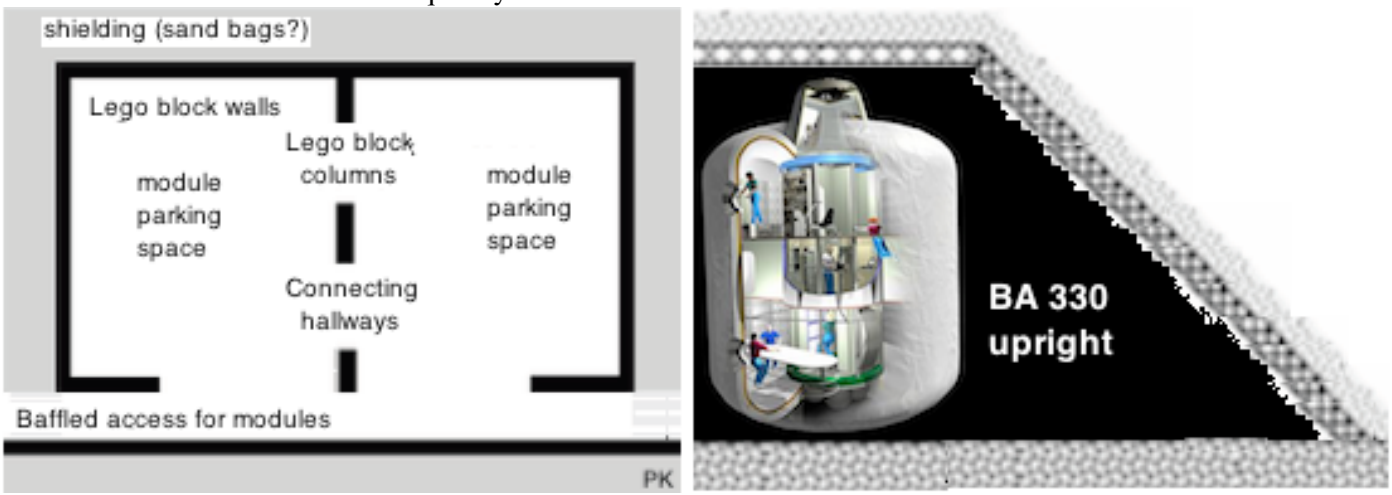


Illustration of the shielded ramada/hangar concept: Note that a shielded hanger could shelter upright BA 330 modules, difficult to shield otherwise. The vertical orientation offers maximum floor space. Constructive criticism of these concepts is welcome!

ISRU (on location resource use) items that need research now:

- basalt-fiber technology is advancing quickly: can we make sand bags from such a material? What about sheeting strong enough to hold several feet (minimum 2 meters) of blown moondust?
- automated sandbag manufacturing
- automated production of sintered regolith lego blocks of standard size
- automated or teleoperated lego block wall stacking/construction
- compacting roller wheels (think steam roller size) shipped hollow, filled with compacted regolith

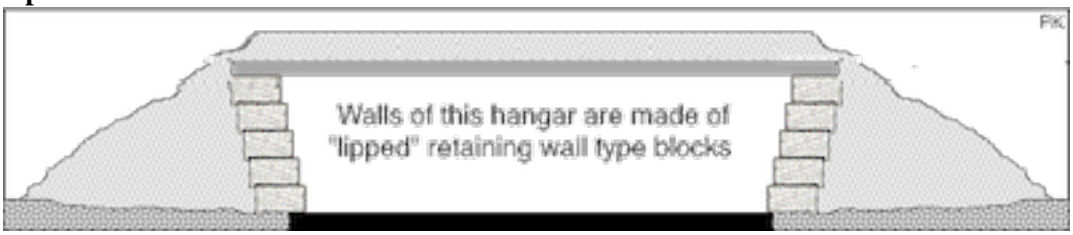
You can help!

Perhaps you can help fill in what we have missed or not thought of! Why not conduct local, regional, national, international engineering design contests to develop the ideas above.

The Good and the Bad of the above scenario for outpost establishment

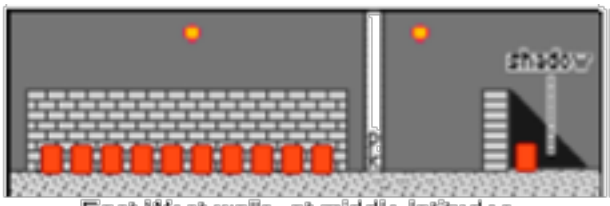
On the one hand, **very expensive on-location manpower** is reserved only for those things that cannot be done by teleoperated equipment or by telepresence-operated avatar robots. This also decreases the chances of serious injuries. Further, when the first crew arrives, and parks the modules they brought along or which have been pre-landed within the hangar/ramada structures, they will be ready to stay several lunar cycles, i.e. in ISS type length crew stints, for which 2 meters of pre-provided shielding will be ample.

Another conceptual illustration:

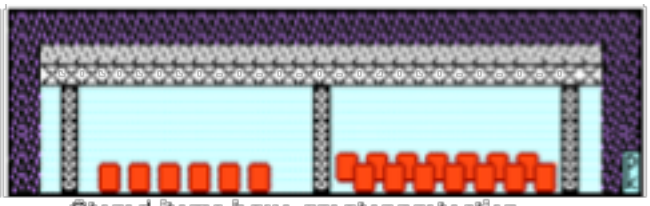


Beyond bricks: pavers and panels

Closely related to bricks are “pavers” which can be brick like in size and thickness up to much bigger slabs. These would have a use as well, for example serving as pavement for rocket landing/launch pads to cut down on the spray of sandblasting moondust driven by rocket exhaust. Such pads would be bermed as well to present a horizontal barrier; and these berms could well be confined between retaining walls.



East-West walls, at middle latitudes provide shade for stored drums etc.



Stored items have greater protection under a shielded ramada-hangar canopy

Panels, whether of concrete or made in the same moondust sintering fashion as bricks and blocks, could be held in place by Lego type blocks with forked ends. Panels, whether of concrete or made in the same moondust sintering fashion as bricks and blocks, could be held in place by Lego type blocks with forked ends.

The hangar interior can be **naturally lit**, during dayspan, by providing intermittent broken-path sun-wells or direct path “sundows” made of bundled optic fibers that double as shielding. Electric lighting for nightspan can be separately suspended from the ceiling or placed above the exterior surface, to use the in-place sun-well or sun-dow light delivery system. A light pipe network suspended from the ceiling could be fed by sulfur lamps.

Visual access can be accommodated by broken-path (radiation-proofed) mirrored shafts from the habitat modules underneath through the hangar roof. With proper planning, such ready-access observation ports can be provided ahead of time as the hangar is expanded section by section. Alternately, a pressurized vertical ladder-shaft can lead from habitat below to pressurized observation dome on the hangar roof.

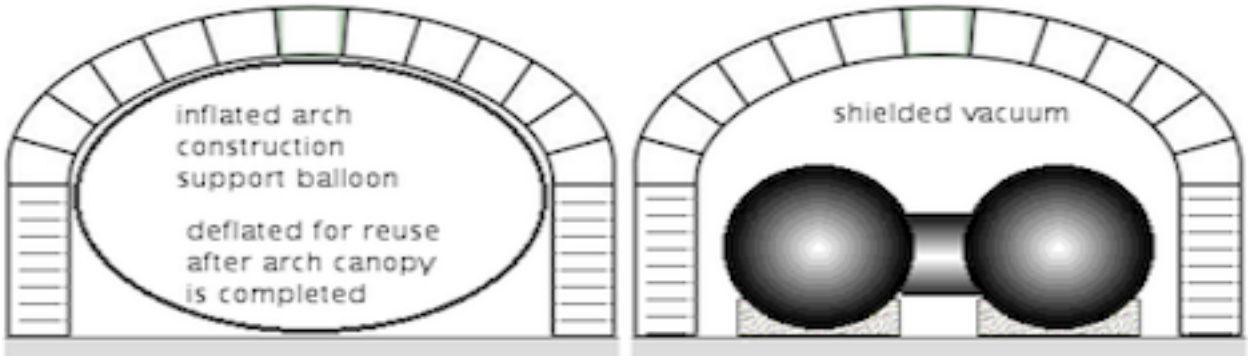
Who gets to teleoperate the brick making and deployment controls?

Such a project, coordinated with NASA or any other contracting tenant, would be an early indication that a base was about to become real. Indeed, we think that we can make this proposal even more interesting by expanding on the teleoperation angle. Finding ways to select individuals from the public at large by lottery of other means and give them a turn behind the brick/block manufacture and deployment teleoperation controls, would give this project significant public attention. The use of supervised students selected by lottery would be even better.

We'd have to train the lottery winners, and they would only get a chance to do actual work on the Moon remotely, if they demonstrated a required level of expertise. But to win and then be approved for this privilege and then actually get to do some of the work on the Moon would be a lifetime feat, something to tell the grandchildren.

Afterthoughts: Blocks designed for arches:

There is another way to create a brick/block shelter before any pressurized modules arrive from Earth. That would be to use blocks designed for arches. You could build interlocking rows of arches over a temporary supporting inflatable structure.



This slip-form sintered arch-block approach is well-developed in the paper "Lunar Base Design" by Peter Land of the Illinois Institute of Technology, pages 363-73, in "Lunar Bases and Space Activities of the 21st Century", Ed. W.W. Mendel, Lunar and Planetary Institute, Houston, 1984.

The '**ground**' under the arch (the floor of the hangar) can be graded smooth, compacted and sintered to provide a relatively dust-free apron for the sheltered outpost. As we will see in a later article, "site management", dust control, and good housekeeping habits must be in place from the gitgo if our attempt to establish an interface beachhead is not to fall flat on its face. (Inner and Outer "Yard" Managers or yardmasters will be critical job slots.) The hangar approach favors the early adoption and rigorous pursuit of good home*steading* habits.

Conclusion: There would seem to be many options to providing ready to use shelter for the first crews before they arrive. We need to further brainstorm and pre-engineer each line to see which is the most problem free not only architecturally but with a view to teleoperated pre-construction, and to utility and versatility of use.

Which options could be further shielded to provide adequate protection for crews staying up to a year or more? If several sites are to be developed, and that is likely, then the most promising technologies should all be tested and tried, first on Earth if possible, then on the Moon. In time, a truly indigenous lunar-appropriate architecture will be developed and continue to be elaborated and refined.

The bottom line is the need to reserve expensively-supported crew hours on the Moon to those things that only crew on location can do. In time, the total pioneer population will grow more quickly, not less so, **because we have taken the time to do it right.**

We admit that the above ideas may not be appropriate for polar areas because basalt which we expect to play a crucial role in lunar industrialization is nowhere to be found. But it is time to get off "the Poles Only bandwagon." We do need polar ice for water and fuel. But one of the most fundamental enabling technologies, cast basalt and basalt-fiber products require mare or highland/mare coastal siting that provides access to both major suites of moondust materials. Those who are only interested in accessing the Moon for ice-derived fuels should keep developing their plans and scenarios. That said, the rest of us need to realize that water alone cannot help us transform the Moon into a new human pioneer world. The author's recommendation? A site on the "northern shore" of Mare Frigoris, the Sea of Cold. Why?

- This places the outpost only about 200 mi (320 km) from the nearest ice-bearing craters to the North. The pole itself is some 600 mi (960 km) north. The nearest "shore" to the south pole is double that distance.
- This site has easy connections to the rest of the near side "mare-plex."
- The Sinus Roris - Mare Frigoris plain stretches 150 degrees E-W. A power grid with solar stations along the route, would provide power for some 83% of the local nightspan, equalling the power coverage at the poles.
- Thorium-rich (nuclear power) and KREEP-rich (potassium, rare Earth elements, phosphorus) are to be found just to the South in Mare Imbrium.
- The Mare Frigoris area, at 60°+/- North, experiences substantially moderated dayspan temperatures.

Indirect Shielding Methods: Summing up

Building a dust-shielded "hangar" that provides large unstructured "lee vacuum" space in which pressurized modules can be "parked" in various forms of interconnection, offers a much faster, and easier way to set up an open-ended expanding modular outpost. There is no shielding to remove when adding additional modules, nor any directly applied shielding to interfere with servicing and repair of system components on modules a.

As a bonus, there is extra radiation-free, UV-free, micrometeorite-free, and flare-proof unpressurized "lee" *service* space for storing tankage and other routinely needed, frequently tended equipment that does not need to be exposed to the sky. This allows wearing light-weight pressure suits for some exterior housekeeping chores.

The hangar shed makes sense if there is firm, review-proof **commitment to phased expansion** of the base beyond the original bare minimum habitat structure. For while its construction adds an original base-deployment "delaying" mission or two, the time-saving and effort-saving dividends down the road are considerable. If our commitment is scaled back to putting a toe in the water, rather than to "getting thoroughly wet" with a wholesale plunge, then, of course, the hangar will be seen as unnecessary. But then we have an Apollo "Flags & Footprints" "Kilroy was here" repeat, and for what? Anything that is worth doing is worth doing well, and doing right, so that it becomes the foundation of something greater and not a just a stunt that leads nowhere.

Providing ready to use shelter will be even more essential for Mars explorers

Staying a year in orbit "within the van Allen Belts" is not the same risk-wise as staying a year on the Moon, where radiation shielding is strongly recommended. It will be even more so for Mars outposts which include travel time to and fro at risk. Crews arriving on Mars will already have been exposed to maximum acceptable limits of radiation. They need to have usable shelter immediately upon landing., not months later! This will minimize the chances of serious construction accidents in a place where getting to a hospital can be months, even years away.

Teleoperation and telepresence operation of equipment and robot avatars on distant Mars will be exceedingly tedious because of the 6-40 minute time delays strictly enforced by the speed of light. It would be helpful first to create shelter under the surface of Phobos or Deimos for teleoperators and telepresence operators who could then direct construction of surface shelters almost anywhere on Mars other than at the poles, in near real time. Those whose impatience demands that they bypass the "PhD" accelerator, will hopefully give way to those of us, who like the tortoise, realize that the fastest way in the end, is the most deliberate, carefully thought out, and patient way to do anything.

Below is a well-intended concept from **MarsOne.org**, with no attention to shielding. Otherwise, the modular concept using many (interior outfitting) versions of a few basic structures, is good.

Watch the Video: http://www.space.com/16300-mars-one-reality-show-colony.html

PK

GREAT BROWSING LINKS

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http://www.space.com/16507-**private-spacesuits-final-frontier-design-photos**.html
http://www.space.com/16512-**fly-dna-moon**.html
http://www.space.com/16631-**private-liberty-rocket-space-capsule-milestone**.html
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http://www.space.com/17720-**private-spaceflight-liability-california-law.**html
http://www.telegraph.co.uk/news/worldnews/asia/southkorea/9428047/**South-Korean-artist-set-to-launch-homemade-satellite.html**
Troubles with Russia's Space Program - http://www.jamesoberg.com/oberg_aerospace_america_2012.pdf
36 photos of Baikonur Spaceport in Kazakhstan - http://www.yuga.ru/photo/polosa/1503-96568.html
Photo of the never used Soviet Shuttle "Buran" - http://www.yuga.ru/media/baikonur_b(25).jpg

ANALOGS + SPACE TECHNOLOGY

http://www.space.com/17219-**nasa-rats-mock-asteroid-mission.**html
http://www.space.com/17537-antimatter-fusion-engines-future-spaceships.html

MOON: NEWS, PANORAMAS

http://www.space.com/17138-**helium-moon-atmosphere-lunar-discovery.h**tml
http://www.space.com/17290-**space-elevator-moon-project**.html
Magnetic Fields Explain Lunar Surface Features - http://physics.aps.org/articles/v5/92
Astrobotic to Explore Martian and Lunar Caves - http://astrobotic.net/2011/11/29/**astro**
http://www.panoramas.dk/moon/apollo-15.html - http://www.panoramas.dk/moon/apollo-17.html

MARS

http://www.space.com/16503-photos-mars-science-laboratory-curiosity-landing-guide.html
http://www.usnews.com/opinion/articles/2012/07/09/**put-humans-on-mars-by-2030**
http://www.mercurynews.com/opinion/ci_20976582/chris-carberry-**economics-mars-its-time-be-bold**
http://www.space.com/13681-**mars-biggest-mysteries-water-life**.html
http://www.space.com/16630-**mars-odyssey-orbiter-glitch-recovery**.html
http://www.space.com/17087-**mars-surface-marsquakes-plate-tectonics.**html
http://www.marsdaily.com/reports/**Mars_rover_takes_cool_detour**_NASA_999.html
http://www.marsdaily.com/reports/**How_a_Mars_Sample_Return_Mission_Can_Go_Electric**_999.html
http://www.space.com/17220-**mars-rover-curiosity-martian-driving**.html
http://www.space.com/17360-**private-mars-one-mission-sponsors.**html
http://www.space.com/17306-**mars-rover-curiosity-red-planet-life-search**.html
http://www.space.com/17321-**mars-rover-curiosity-human-voice-photos**.html
http://www.space.com/16385-**curiosity-rover-mars-science-laboratory.**html
http://www.**panoramas**.dk/**mars/greeley-haven**.html
http://www.space.com/17743-**earth-mars-like-places-life**.html

ASTEROIDS

http://www.space.com/16515-**space-mining-asteroid-legal-issues**.html
http://www.space.com/16501-**private-space-telescope-asteroid-mining**.html
Dawn leaves Vesta, on it way to Ceres - http://www.jpl.nasa.gov/news/news.cfm?release=2012-277
http://www.space.com/17497-**nasa-asteroid-naming-contest**-1999-rq36.html

OTHER PLANETS + MOONS

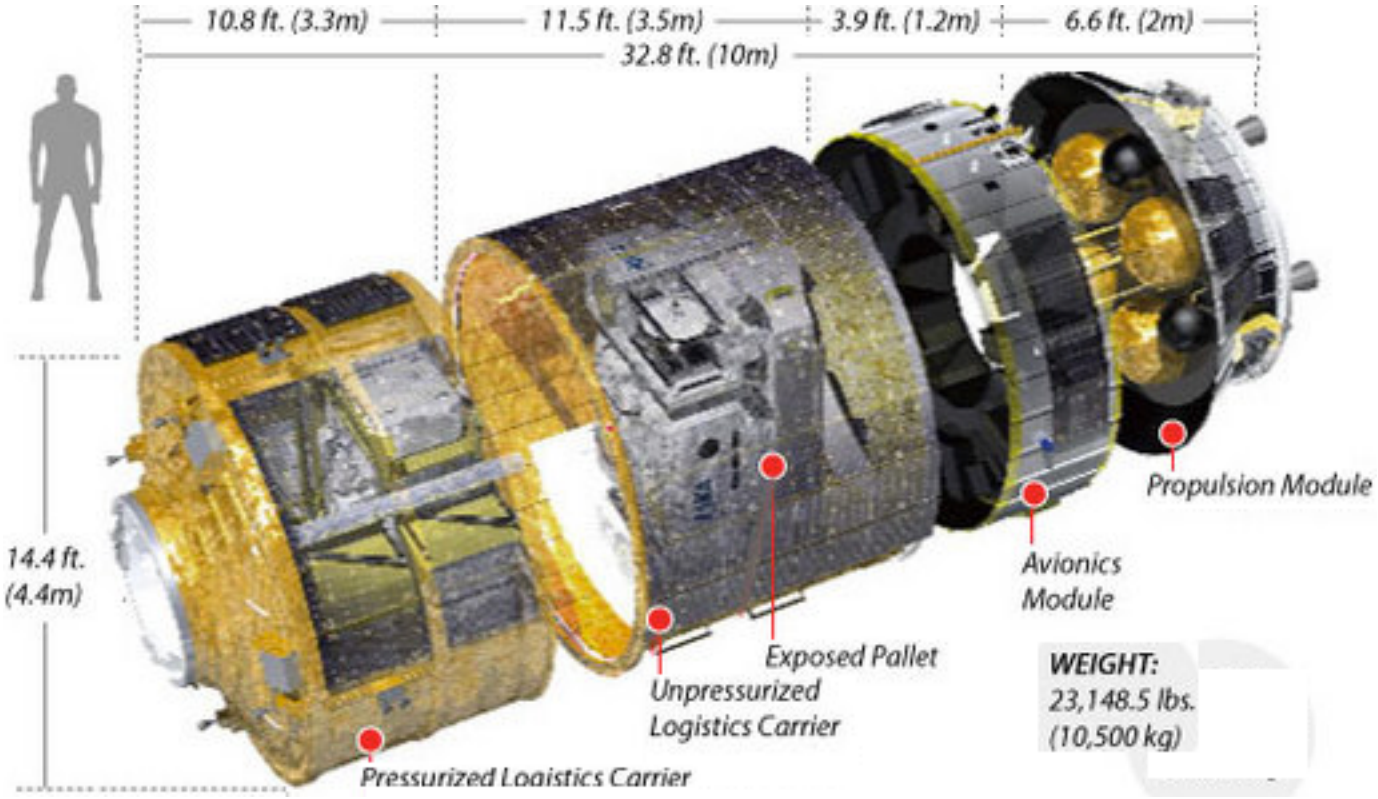
http://www.space.com/16547-**pluto-fifth-moon-planet-status.**html
http://www.space.com/16533-**pluto-new-horizons-spacecraft-pictures**.html
http://www.space.com/16539-**pluto-fifth-moon-five-fact**s.html
http://www.space.com/16538-**pluto-moons-explained-infographic.**html
http://phys.org/news/2011-12-**nasa-europa**.html - www.space.com/17741-**europa-ocean-jupiter-moon-water.**html
http://www.space.com/17657-**alien-planets-methane-meteorites-atmosphere**.html

GREAT VIDEO LINKS

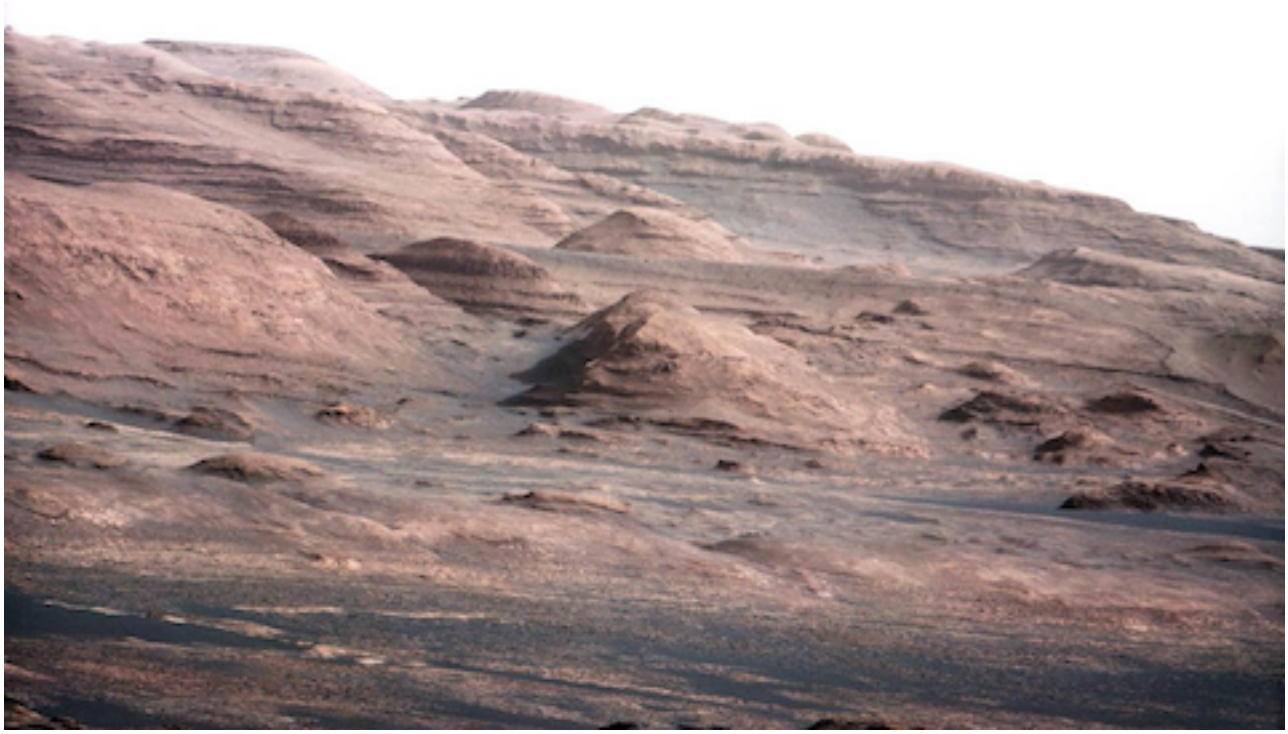
http://www.space.com/16570-**new-water-searching-moon-rover-begins-testing-video**.html
http://www.space.com/16757-**supersonic-skydive-from-edge-of-space-animated**.html
http://www.space.com/17208-**what-s-inside-mars-nasa-s-insight-mission-will-probe-deep-video**.html
http://www.space.com/17212-**curiosity-wiggles-wheels-and-stretches-arm-video**.html
http://www.space.com/17277-**curiosity-s-descent-in-high-resolution-with-commentary-video**.html
http://www.space.com/17259-**curiosity-team-celebrates-first-drive-victory-video**.html
http://www.space.com/17540-**how-did-mars-lose-its-atmosphere-maven-aims-to-find-out-video**.html
http://www.space.com/17904-**a-ground-based-telescope-better-than-hubble-video**.html
Evolution of Moon (from Goddard) http://www.youtube.com/watch?v=UIKmSQqp8wY&feature=related
NASA GRAIL Mission: 2 videos http://orbiter-forum.com/showthread.php?t=24042
Dawn's accomplishments at Vesta http://www.nasa.gov/multimedia/videogallery/index.html?media_id=151669301
Mars Society Convention Talks on YouTube
http://www.youtube.com/playlist?list=PL57B8D5FFF5B55A62&feature=view_all

SPACE STAMPS INDIA

M3TQ PHOTO GALLERY

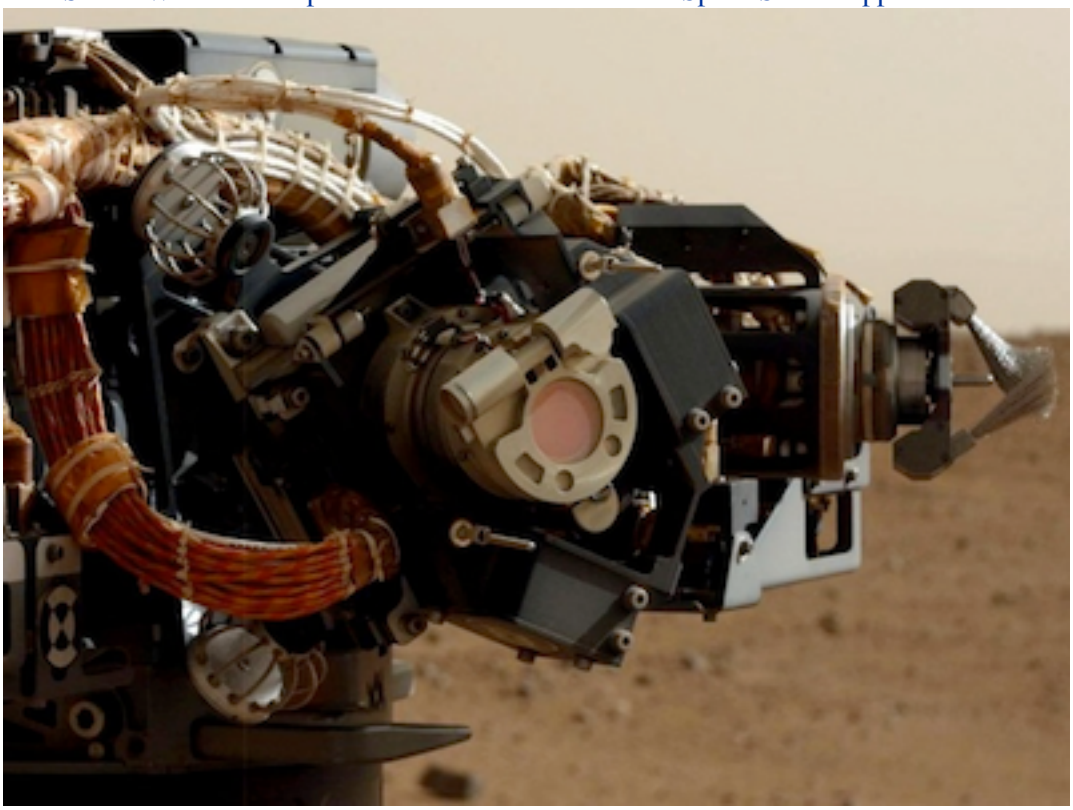


Space.com "infographic" on large Japanese H-II Cargo Carrier that supplies the International Space Station
http://en.wikipedia.org/wiki/H-II_Transfer_Vehicle



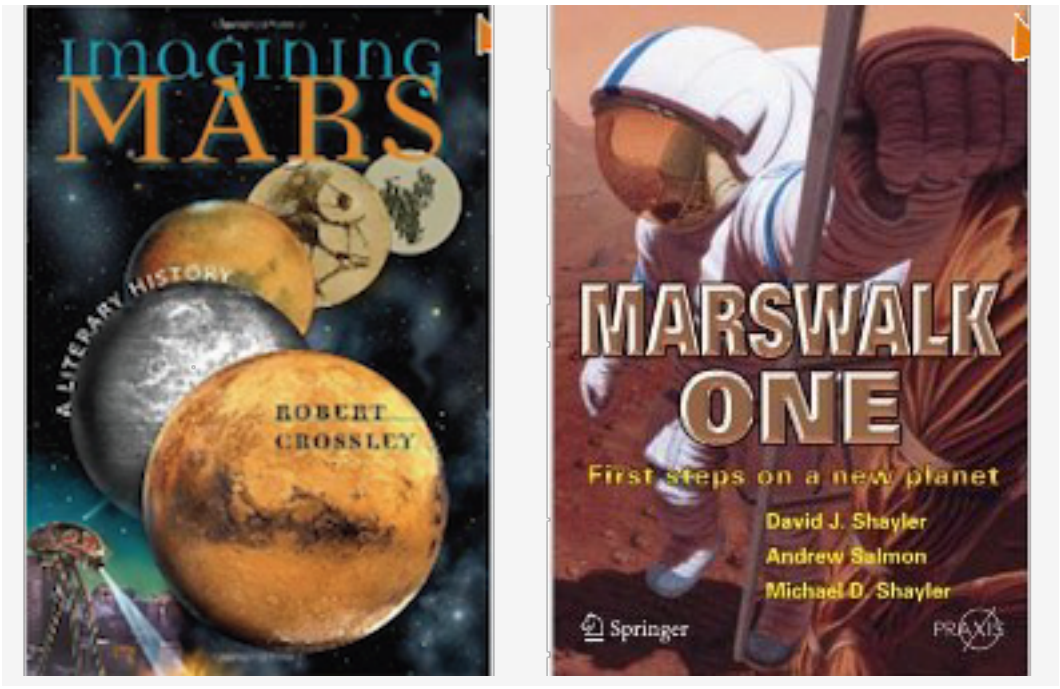
This photo from NASA's Mars rover Curiosity shows the layered geologic history of the base of **Mount Sharp**, the 5-km-high mountain rising from the center of Gale Crater. Image taken August 23, 2012. (NASA/JPL-Caltech/MSSS)
http://www.foxnews.com/scitech/2012/08/28/mars-rover-sends-human-voice-from-red-planet/#ixzz261GlpOWy

Astronaut Sunita Williams on space walk outside International Space Station appears to touch the Sun



Curiosity self-portrait: One of Curiosity's cameras photographed by another - **Below:** 360° Mars panorama

Some Books THE book WORM on Mars



Left: Imagining Mars: A Literary History (Early Classics of Science Fiction) (Hardcover) by Robert Crossley (Author) (January 2011)

"For centuries, the planet Mars has captivated astronomers and inspired writers of all genres. Whether imagined as the symbol of the bloody god of war, the cradle of an alien species or a possible new home for human civilization, our closest planetary neighbor has played a central role in how we think about ourselves in the universe. From Galileo to Kim Stanley Robinson, Robert Crossley traces the history of our fascination with the red planet as it has evolved in literature both fictional and scientific.

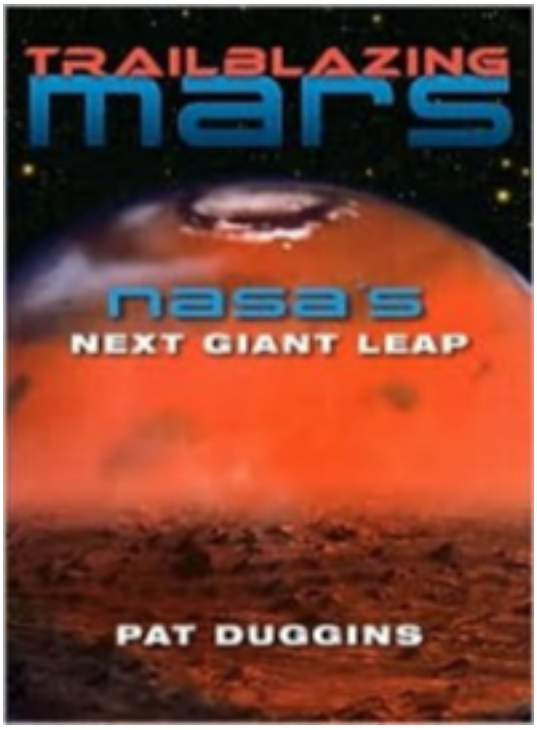
"Crossley focuses specifically on the interplay between scientific discovery and literary invention, exploring how writers throughout the ages have tried to assimilate or resist new planetary knowledge. Covering texts from the 1600s to the present, from the obscure to the classic, Crossley shows how writing about Mars has reflected the desires and social controversies of each era. This elegant study is perfect for science fiction fans and readers of popular science." Above review is quoted from http://www.aerospaceguide.net/spacebook/mars.html

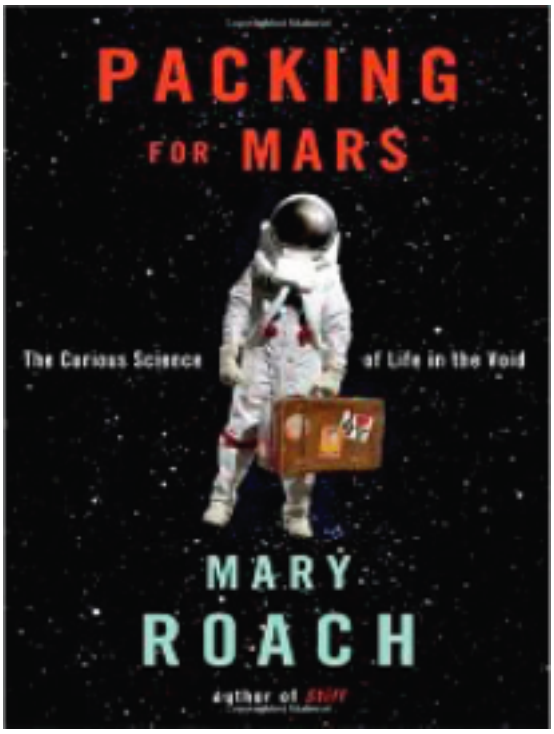
Right: Marswalk One : First Steps on a New Planet (Paperback)

By David J. Shayler (Editor), Andrew Salmon (Editor), Michael D. Shayler (Editor) (August 2005)

"**Marswalk One** addresses the question of why we should embark on a journey to Mars, documenting what the first human crew will do when they place their feet in the red dust of the planet. The book also addresses why we need to carry out these tasks and, more importantly, what a human crew could achieve that an automated mission could not." (Springer Praxis Books / Space Exploration) http://www.aerospaceguide.net/spacebook/mars.html

On this site, **http://www.aerospaceguide.net/spacebook/mars.html** there are brief reviews of the above books and also of: **Mars 3-D: A Rover's-Eye View of the Red Planet** by Jim Bell**; Planet Mars: Story of Another World** by François Forget, **On to Mars 2: Exploring and Settling a New World** by Dr. Frank Crossman,**Roving Mars: Spirit, Opportunity, and the Exploration of the Red Planet** by Steve Squyres, **Magnificent Mars** by Ken Crosswell, **A Traveller's Guide to Mars: The Mysterious Landscapes of the Red Planet** by William K. Hartman (highly recommended by M3IQ Editor Peter Kokh), **The Case for Mars: The Plan to Settle the Red Planet and Why We Must** by Robert Zubrin, **Expedition Mars: How Are We Going to Get to Mars** by Martin J. L. Turner, **Mars on Earth: The Adventures of Space Pioneers in the High Arctic** by Robert Zubrin





Trailblazing Mars: NASA's Net Giant Leap By Pat Duggins

University Press of Florida, 2010 - hardcover, 224 pp., illus. - ISBN 978-0-8130-3518-5
http://www.amazon.com/Trailblazing-Mars-NASAs-Next-Giant/dp/081303518X/ref=sr_1_1?ie=UTF8&s=books&qid=1288717687&sr=1-1

Book Review: By Jeff Foust, Nov. 11, 2010. http://www.thespacereview.com/article/1717/1

Excerpt: "What technology, planning, and other preparation needed to be able to successfully mount human expeditions to the Red Planet is at the heart of Trailblazing Mars.

"Pat Duggins, a longtime National Public Radio reporter who covered the space program from Florida, digs through the history of space exploration as well as the various issues associated with the exploration of Mars. He takes on a broad range of issues in a relatively slender book, from the experience of building and working on the ISS to the biological and psychological lessons learned from the Biosphere 2 project in the early 1990s.

"He also examines some of the criticism for human Mars exploration from those who think such exploration is better done by robots and/or think NASA's priorities should be focused elsewhere, such as (in the opinion of Gregg Easterbrook) protecting the Earth from asteroid impacts."

"Given the book's subtitle and its timing, one might think that the book covers the shift in direction in space policy towards human Mars exploration that came earlier this year. Unfortunately, that's not the case:"

Excerpt from Amazon.com review: "The reader will be enlightened to find out that going to the moon and visiting Mars are not the same and why."

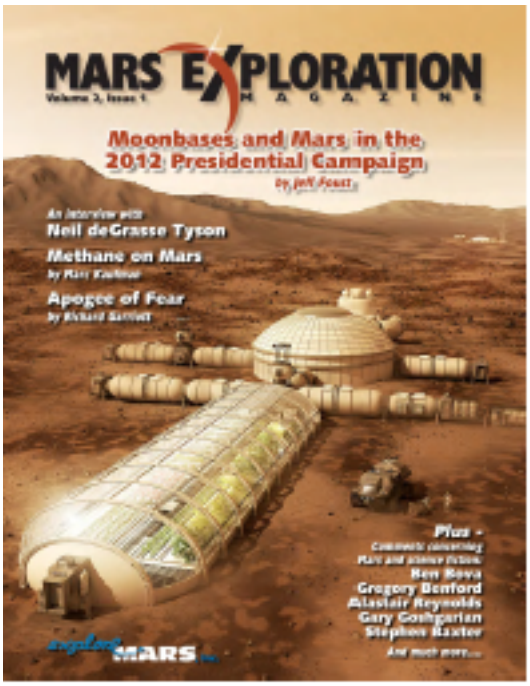
Packing for Mars: The Curious Science of Life in the Void By Mary Roach

W. Norton and Company, New York, London - ISBN 978-0-393-06847-4 (hardcover)

Reviews on this website http://www.amazon.com/Packing-Mars-Curious-Science-Life/dp/0393068471/ref=sr_1_2?ie=UTF8&s=books&qid=1288717750&sr=1-2

The author explores the irresistibly strange universe of space travel and life without gravity.

Space is a world devoid of the things we need to live and thrive: air, gravity, hot showers, fresh produce, privacy, beer. Space exploration is in some ways an exploration of what it means to be human. How much can a person give up? How much weirdness can they take? What happens to you when you can't walk for a year? have sex? smell flowers? What happens if you vomit in your helmet during a space walk? Is it possible for the human body to survive a bailout at 17,000 miles per hour? To answer these questions, space agencies set up all manner of quizzical and startlingly bizarre space simulations. As Mary Roach discovers, it's possible to preview space without ever leaving Earth. From the space shuttle training toilet to a crash test of NASA's new space capsule (cadaver filling in for astronaut), Roach takes us on a surreally entertaining trip into the science of life in space and space on Earth.



Mars-focused Online Publications

Mars Exploration Magazine is published by **ExploreMars.org** - you can read Volume 2, issue 1 online (software lets you flip the pages forward or backward) at http://www.exploremars.org/MEM_V2i1/index.html

More information including how to contribute an article: http://www.exploremars.org/mem - on this page you can access all 5 issues published to date by clicking on the cover image of each.

Additional ExploreMars.org links:

http://www.exploremars.org/page/mars-education-challenge
http://www.exploremars.org/page/isru-challenge
http://www.exploremars.org/page/mars-agriculture
http://www.exploremars.org/page/iss-mars - 2 ISS and Mars conferences to date
http://www.exploremars.org/page/women-and-mars
http://www.youtube.com/user/ExploreMarsinc/featured

The Mars Quarterly is published by **The Mars Society** - Volume 4, Issue 1(pictured above) can be read online at:
http://content.newmars.com/TMQ/TMQ-V4-I1.pdf - all issues at: http://content.newmars.com/TMQ/index.html
http://education.marssociety.org/home/recommended-reading
http://education.marssociety.org/home/links

Other Online Mars-focused sites and Resources

http://www.marsdrive.com - http://www.youtube.com/user/marsdrive
http://www.astrodigital.org/mars/
http://marsed.asu.edu/
http://www.nasa.gov/audience/foreducators/index.html
http://mars.jpl.nasa.gov/participate/marsforeducators/
http://www.google.com/mars/
http://www.moonsociety.org/mars/
http://www.moonsociety.org/publications/mmm_themes/mmmc_Mars1.pdf
http://www.moonsociety.org/publications/mmm_themes/mmmc_Mars2.pdf

More Mars-related Book Reviews

http://www.nss.org/resources/books/non_fiction/NF_097_marsresources.html
http://www.nss.org/resources/books/non_fiction/NF_067_passionformars.html
http://www.nss.org/resources/books/fiction/SF_026_howtoliveonmars.html

Moon Miners' Manifesto Resources

http://www.moonsociety.org/chapters/milwaukee/mmm/

MMM is published 10 times a year (exc. Jan. & July. The Dec 2011 issue #251, began its 26th year of continuous publication. Most issues deal with the **opening of the Lunar frontier**, suggesting how pioneers can make best use of **local resources** and learn to **make themselves at home.** This will involve psychological, social, and physiological adjustment**.**

Some of the points made will relate specifically to **pioneer life** in the lunar environment. But much of what will hold for the Moon, will also hold true for **Mars and for space in general.** We have one Mars theme issue each year, and occasionally **other space destinations** are discussed: the asteroids, Europa (Jupiter), Titan (Saturn), even the cloud tops of Venus.

Issues #145 (May 2001) forward through current are as pdf file downloads with a Moon Society username and password. Moon Society International memberships are $35 US; $20 students, seniors – join online at:

http://www.moonsociety.org/register/

MMM Classics: All the "non-time-sensitive editorials and articles from past issues of MMM have been re-edited and republished in pdf files, one per publication year. A 3-year plus lag is kept between the MMM Classic volumes and the current issue. **As of December 2012, the first twenty-two years of MMM, 220 issues, will be preserved in this directory,** These issues are freely accessible to all, no username or password needed, at:

www.moonsocietyorg/publications/mmm_classics/

MMM Classic Theme Issues: introduced a new series to collect the same material as in the Classics, but this time organized by theme. The first MMM Classic Theme issue gathers all the **Mars** theme articles from years 1-10 in one pdf file. A second pdf file collects all the **Mars** Theme issues from year 11-20. The 2nd Classic Theme is "**Eden on Luna**," addressing environmental issues underlying lunar settlement. **Asteroids**, **Tourism, Research**, **Select Editorials, Analog Programs, Arts & Crafts, the Cislunar Economy, and Architecture & Construction** have been added. New Theme Issues will be coming.

www.moonsociety.org/publications/mmm_themes/

MMM Glossary: The publishers of MMM, the Milwaukee Lunar Reclamation Society, has published a new Glossary of "MMM-Speak: new words and old words with new meaning" as used in Moon Miners' Manifesto.

www.moonsociety.org/publications/m3glossary.html

The initial addition includes over 300 entries, many with illustrations. Additional entries are under construction. It is hoped that new members will consider this to be a "Read Me First" guide, not just to Moon Miners' Manifesto, but to our vision and goals.

All of these resources are available online or as free access downloads to readers.
But M3IQ does need your help!

MMM-India Quarterly Advisors, Liaisons, Contributors, Correspondents, Illustrators

If this publication is to help spread the word about Space in India, among the public at large, especially among the students and younger people, it must become a truly Indian publication. We need people from many fields in India to join our team

If you think that you can add to the usefulness and vitality of this publication, in any of the ways listed above, or in fields we had not thought of, write us at: **mmm-india@moonsociety.org** [This email address goes to the whole editorial team]

Tell us about yourself; your interest in space, and how you think you can make this publication of real service in the education of the public in India, and in the education of young people on whom the future of India and the world will rest.

Guidelines for Submissions: M3IQ is intended for wide public distribution to encourage support for space research and exploration and development. M3IQ is not a scholarly review or a technical journal for professional distribution. Submissions should be short, no more than a few thousand words. Longer pieces may be serialized editorials and commentary, reports on actual developments and proposals, glimpses of life on the future space frontier, etc. Articles about launch vehicles, launch facilities, space destinations such as Earth Orbit, The Moon, Mars, the asteroids, and beyond, challenges such as dealing with moondust, radiation, reduced gravity, and more.

Help Circulate *MMM-India Quarterly*

If you know someone who might enjoy reading this publication, send us their email address(Esc) so that they receive notice when a new issue if published. Readers are encouraged to share and to distribute these issues widely, either as email attachments, or via the direct download address (for all issues): **http://www.moonsociety.org/india/mmm-india/**

MMM-India Quarterly will remain a free publication.

Upcoming International Conferences & Events
http://www.spacecalendar.com/downrange/

INDIA **------2012 -----**

October — ISRO, Launch PSLV / SARAL, *Sriharikota, India*: An ISRO Polar Satellite Launch Vehicle set to launch the SARAL ocean altimetry satellite which will measure sea surface height from Space. The rocket will also carry a Canada Sapphire space surveillance payload and NEOSSat space telescope to search for near-Earth asteroids.

Nov 30 – Dec 1 — Aryavarta Space, Nirma University, et al, *Ahmedabad, Gujarat, India:* International Space Conference 2012.

December — ISRO, Launch GSLV / GSAT 14, *Sriharikota, India*: An ISRO Geosynchronous Satellite Launch Vehicle with an Indian-built cryogenic 3rd stage set to launch the GSAT 14 communications satellite.

ELSEWHERE – a selection by the editor **--- 2012 ----**

Oct 25-27 — ESA, International Association of Sedimentologists, et al, *Marrakech, Morocco:* '3rd Conference on Terrestrial Mars Analogues.'

Nov 4-11 — Association of Space Explorers, *Riyadh, Saudi Arabia:* 'The 25th ASE Planetary Congress.'

Nov 8-11 — Students for the Exploration & Development of Space (SEDS), *Buffalo NY:* 'SEDS SpaceVision 2012 Conference: Crossroads – How Our Generation Will Take Us To The Space Frontier.'

Nov 11-15 — Pacific International Space Center for Exploration Systems (PISCES), *Waikoloa HI:* '2012 PISCES Symposium: Pioneering Sustainable Settlements Beyond Low-Earth Orbit.'

Dec 1 — Space Tourism Society, *Los Angeles CA:* 'Seminar: Space Experience Economy (SEE).'

Dec 11-14 — Asia-Pacific Regional Space Agency Forum (APRSAF), *Kuala Lumpur, Malaysia:* '19th Annual Meeting of the APRSAF.'

Dec 31 — X Prize Foundation, *Santa Monica CA:* Google Lunar X Prize deadline for full $20M first prize; if prize not yet claimed first prize now drops to $15M.

-----2013 -----

Mar 5-7 — International Space University, *Strasbourg, France:* 17th ISU Annual International Symposium: 'Space Technology and Tele-Reach: Benefiting Humanity on Earth and Beyond.'

Mid-2013 — NASA, ESA, Launch Lunar Atmosphere and Dust Environment Explorer (LADEE) / Minotaur V, *Wallops Island VA*: 160 day mission to Moon to transmit laser signals to NASA stations in California and New Mexico as well as ESA's Optical Ground Station in Tenerife, Spain.

Apr 15-19 — IAA, NASA, ESA, *Flagstaff AZ:* '2013 IAA Planetary Defense Conference.'

May 23-27 — The National Space Society, *San Diego CA:* '32nd Annual International Space Development Conference.' Moon Society to host Track on Lunar Lava Tubes

Nov — ISRO, Launch PSLV / Mars Orbiter, *India*: Augmented version of 4-stage Polar Satellite Launch Vehicle set to launch Orbiter carrying 25 kg of scientific payloads to Mars.

Note: ***If you know of a scheduled space event in India that is not listed at the address above, please inform us of this in advance –*** email mmm-india@moonsociety.org

Trivia hint for non-Indian Readers

In the US, "**NASA"** is not pronounced letter by letter "N-A-S-A" (4 syllables) but **Na**-Sa (2 syllables), likewise in India, **ISRO** is not pronounced letter by letter "I-S-R-O" (4 syllables) but **iS**-Ro (2 syllables)

Earth Trivia: Mount Everest is the **highest place on Earth above sea level,** at 8,848 meters (29,028 feet), but it is not the **point on Earth most distant from the center of the Earth**. That distinction belongs to Mount **Chimaborazo** in the Andes Mountains in Ecuador. Although Chimaborazo is about 3,000 meters shorter (relative to sea level) than Everest, this mountain is about 2.4 km (1.5 miles) farther into space because of the equatorial bulge.

Student Space Organizations in India

Students for Exploration and Development of Space - India

http://india.seds.org/

http://en.wikipedia.org/wiki/Students_for_the_Exploration_and_Development_of_Space#SEDS-India

National Headquarter - SEDS VIT - C/O , Dr. Geetha Manivasagam, - Room No. 401 , CDMM Building , VIT University, VELLORE-632014, Tamil Nadu - Phone No. +919952749426 -Anmol Sharma (Director, Chapter Affairs)

EXECUTIVE COMMITTEE Pranay Puchakayala, President pranayp53@gmail.com
Lakshmanaperumal K, Vice-President 0lakshmanaperumal@hotmail.com
Soumya Batra, Secretary - batra_soumya@hotmail.com
Deepak Namdev, Joint Secretary (Events and Projects - tia747@gmail.com

SEDS-India Chapters (currently 6):
http://india.seds.org/CHAPTERS.HTML

SEDS VIT (Vellore) (756 members)
SEDS VEL TECH (Chennai) (419 members)
SEDS GGITM (Bhopal) (136 members)
SEDS NITW (Warangal) (100 members)
SEDS KCT (Coimbatore) (100 members)
SEDS NITT (Thiruchirapalli.) (17 members)

SEDS-India Projects - http://india.seds.org/projects.html

VITSAT - 1 - series of small satellites to demonstrate miniaturization of technology and implementation of a variety of payloads

SEDS VIT UAV - automatically controlled aircraft, different sensors, servos, communication equipment, GPS, Microcontroler

CanSat - a satellite in a Tin Can - to conduct basic atmospheric studies at cloud base, provide a test for amateur communication protocols, provide basic knowledge of a Satellite to the students

Help Wanted!

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Editorials and Commentary, reports on actual developments and proposals, glimpses of life on the future space frontier, etc.

Articles about launch vehicles, launch facilities, space destinations such as Earth Orbit, The Moon, Mars, the asteroids, and beyond, challenges such as dealing with moondust, radiation, reduced gravity, and more.

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MMM-India Quarterly will remain a free publication. We will set up an online subscription service so that each issue is emailed to your email box directly, if you wish.

Printing this publication in the US would not be costly, but mailing it overseas to addresses in India would be.

If anyone in India wishes to become a Moon Society agent and publish and mail hardcopies of MMM-India Quarterly to addresses on a paid-subscription basis, please contact us at **mmm-india@moonsociety.org**

If this publication has been forwarded to you by someone else,

And you wish to add your email address to our new-issue-ready announcement list,
Write **mmm-india@moonsociety.org** Put "Subscribe" in the subject line of your email.
Feel free to send us email addresses of others - Individuals and/or organizations and/or lists.

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Moon Miners' Manifesto - India Quarterly #13

Engage! And Enjoy!