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

Moon Miners' Manifesto

India Quarterly Edition

www.moonsociety.org/india/mmm-india/

Sriharikota Launch Center, India - a Polar Satellite Vehicle Launcher about to launch 7 satellites into orbit

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 every-where, and from all walks of life, in the effort to create an expanded Earth-Moon economy that will contribute solutions to the major problems that continue to challenge 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 space 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 available 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 accessibleat: www.moonsocietyorg/publications/mmm_classics/

MMM Theme Issues: The same material has been reorganized in **14 Theme Issues**, also freely downloadable at: http://www.moonsociety.org/publications/mmm_themes/

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

This publication was launched with the August 2008 issue. This issue begins our 5th year. The Moon Society was founded as an International organization, but has few members outside the US, mostly solitary and unorganized.

Background – The Moon Society and The Planetary Society of Youth (TPSY) in India, www.youthplanetary.org/ in December 2003, put together a "Design a Mission to the Moon" category in TPSY's student design contest -- "A Mission to the Moon and Beyond." The contest was designed to help students learn about various objects in the solar system as they compete in the design of a mission. www.youthplanetary.org/moon_mission_contest.html

Why an MMM – India Quarterly? – India is a very populous country, and one in which, through the heritage of the British Raj, English is the almost universal medium of higher education. English-fluent Indians now outnumber English speakers in the United States. More books are published in English in India than in any other country. And – I**ndia has now gone to the Moon and will soon be headed to Mars.**

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.

This issue is online at: http://www.moonsociety.org/india/mmm-india/

A Letter to our M3IQ Readers from the Editor

April 8, 2010

"M3IQ" was launched over four years ago with the intention of encouraging readers in India (and elsewhere) to support space research and space missions. Speaking for the rest of the editorial team, we have enjoyed putting together each issue. It is our intention to continue this no-cost service.

Last August, 2012, The National Space Society's International Committee, led by M3IQ co-editor and major contributor David Dunlop, looked at the possibility of producing a similar/parallel quarterly for students and others outside the United States on NSS' email list. The result was "To The Stars International Quarterly" to be published on the same January-April-July-October schedule as M3IQ, beginning with the October 2012 issue.

"**To The Stars**" is the English translation of "**Ad Astra**!" - a Latin (ancient Roman) exhortation - the name of the National Space Society's gloss print quarterly which is mailed to members of that Society.

This name was my choice. The first suggestion was that I just change the "I" in M3IQ from India to International. India has always had a special interest and fascination for me since my early youth when I followed the news about Mahatma Gandhi in the late 1940s. So I vetoed this suggestion.

The result was two distinct publications, 90% the same in content, but with different formats.

The India Quarterly had been begun with the Space News organized by source:

• India-ISRO; Elsewhere in Asia (China, Japan, Russia); • Elsewhere in the Commonwealth (United Kingdom, Canada, South Africa, Australia, Malaysia, etc.); and finally, • Elsewhere in the World.

In contrast, in **TTSIQ**, the International Space News is arranged in a totally different way:

• Earth Orbit / Mission to Planet Earth • Cis-lunar Space & the Moon • Mars & the Asteroids
• Other Planets and their Moons • Starbound (astronomy, astrobiology, exoplanets etc.)

Now I like this new arrangement much better. It makes more sense to me to arrange the worldwide news according to "what it is about" than according to National Space Agencies. But the more important point for me as editor, was that having two distinct arrangements of the same material means extra work for me. Make no mistake, I love putting both issues together and the many hours of work that go into this. But at 75, I think it is important to me to make the editing part (not the fun of finding all these stories and material) easier, by using the same system of arranging the news in both quarterlies.

So this issue of the India Quarterly will be substantially identical to the International Quarterly with two key exceptions. (1) The name and list of sponsor organizations will be different for both. (2) While the "news" and "articles/essays" will be the same, those things that are distinctively and specifically for the sake of the National Space Society's international members and friends will not appear in the India issue, and vice versa. And there are two separate email lists, one for Moon Society use, one for National Space Society use. The two organizations are mutually affiliated (collaborating) since 2005 but independent.

Now for those of you to whom "**who is doing what**" is important, I am introducing an up front National Source Index, below. Here, under India, you will find a list of relevant articles and their page numbers, Under China, the same thing. In fact I have found that by searching for topic areas rather than by nations, I am uncovering many more articles of interest. So I hope you enjoy the new format for this issue.

Personally, I am amazed and gratified by how many of my friends on Facebook, 80% or more, are from outside the United States, on all continents other than Antarctica, the largest number from India. Your comments on the new layout and format, as on space issues and concepts, are always welcome. You can reach me at kokhmmm@aol.com or at mmm-india@moonsociety.org (both go to same inbox.)

NATION/SPACE AGENCY NEWS

Note: on some of this pages, the nation/agency is mentioned as involved but not necessarily the lead.

TO THE EDGE OF SPACE

Hypersonic 'SpaceLiner' Aims to Fly Passengers in 2050

The SpaceLiner being developed by the Institute of Space Systems at the German Aerospace Center, could allow 50 passengers to board in Europe, sit back, and disembark 90 minutes later half way around the world, in Australia, at a top speed of 24 times the speed of sound.

Beyond up/down tourist flights to "the edge of space" – It may take a while

http://www.space.com/19416-**hypersonic-spaceliner-fly-passengers**.html

With a rocket booster stage for launch and a separate orbiter stage, the Spaceliner would cost "several hundred thousand dollars" to board. How far off? The "just right" shape of the craft has yet to be determined, and the motors designed. The hope is that in ten years, the design effort will be advanced far enough to attract corporate investors. Don't start saving for a trip just yet! And don't count on the ticket price being that "low!" The editor remembers similar plans for "ram jet" airliners in the late 1950s!

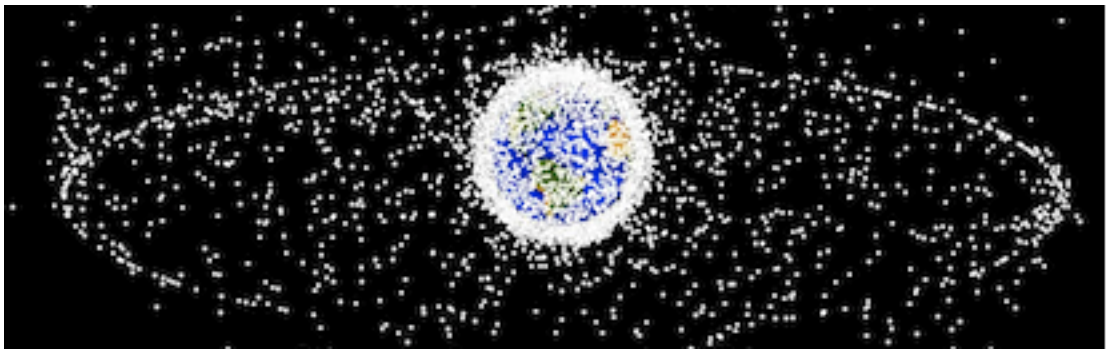
Canadian Tour Companies Launch Private Spaceflight Deals aboard Lynx

http://www.space.com/19953-**space-tourism-canada-xcor-lynx**.html

Xcor **Video** = http://www.space.com/10223-**xcor-flight-lynx**.html

Adventure Travel Company (ATC), in Toronto, and Montreal-based Uniktour will offer amateur astronauts rides on the suborbital **Lynx** spacecraft under development by Mojave, Calif-based **XCOR Aerospace**. Canadians have much interest in space projects, partly a result of the media attention paid to the nation's off-Earth robotics program, which contributed the huge Canadarm2 robotic arm to ISS.

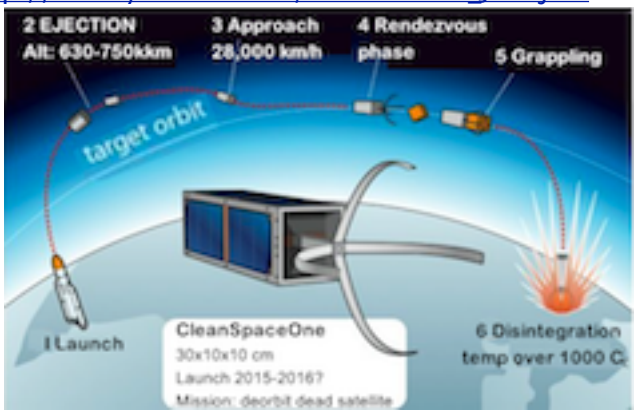
ORBITAL SPACE DEBRIS PROBLEM

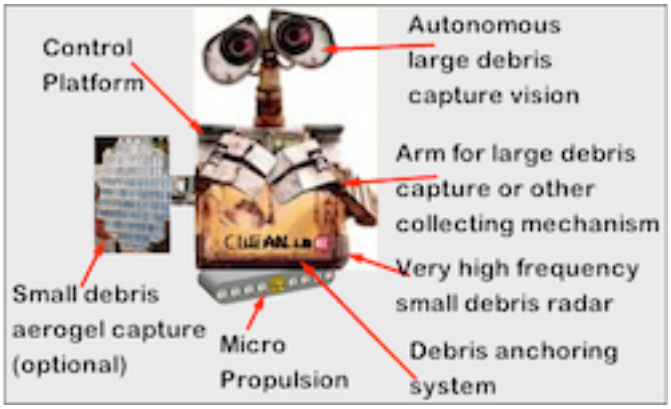


Debris congestion is far worse in **L**ow **E**arth **O**rbits but reaches out to **G**eosynchronous **E**arth **O**rbit as well

VIDEOS: The Space Debris Problem
http://www.youtube.com/watch?v=L915JJMcu4s (Start here)

VIDEOS: Space Debris Removal
http://www.space.com/19430-**darpa-s-satellite-repurposing-program-shows-progress-video.**html
http://www.youtube.com/watch?v=BxG0f2Z5eTc Removal of obsolete/hazardous rocket stages
http://www.youtube.com/watch?v=4CJfEKoZKWc Space Debris Removal
http://www.youtube.com/watch?v=ArxVySJuv68 Space Debris Removal around the world
http://www.youtube.com/watch?v=ZtdRG7gAL_4 Time to remove
http://www.youtube.com/watch?v=Aoow-t7qu7k TAMU Sweeper with Sling-Sat
http://www.youtube.com/watch?v=oM_J7nRjxi0 Active Space Debris Removal 1 ACT Workshop





Swiss CleanSpace One spacecraft (above)

Good Reading: Essays on the Problem of Space Debris

Addressing the challenges of space debris, part 1: defining space debris

Technical approaches to removing **space debris** first require legal solutions to key issues, such as a definition of **space debris**. http://www.thespacereview.com/article/2187/1 – Feb. 27/13

Addressing the challenges of space debris, part 2: liability

Also required is **addressing** concerns about the liability such ventures may incur by trying to clean up **debris**. http://www.thespacereview.com/article/2204/1 – Feb. 27/13, 18442 bytes

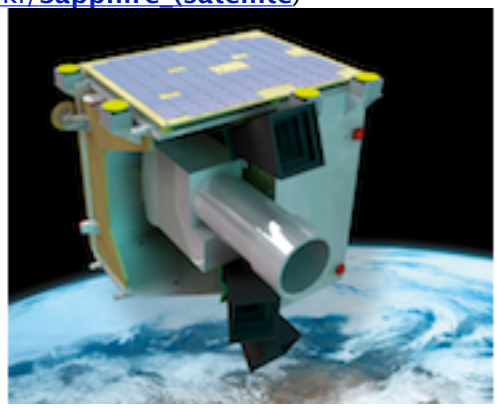
Addressing the challenges of space debris, part 3: policy

While dealing with space debris requires overcoming a number of technical obstacles, the political ones may be even greater. Michael Listner completes his assessment of the challenges of cleaning up space debris by offering a potential solution to some of the policy challenges associated with this effort.

- http://www.thespacereview.com/article/2255/1 – Mar 11/13

India launches Canadian Sapphire Satellite to monitor Space Debris

http://www.reuters.com/article/2013/02/25/idUSnCCNq7tKwa+1c4+MKW20130225
http://en.wikipedia.org/wiki/**Sapphire_(satellite**)



25 February, 2013 ISRO (Indian Space Research Organisation) successfully launched a PSLV rocket with 6 satellites aboard. One of them was Sapphire, Canada's first dedicated operational military satellite, with **a space-based electro-optical sensor to track man-made space objects in high Earth orbit to avoid the collision of critical space platforms with other orbital objects.** Canada's contribution also ensures access to orbital data on space objects.

LOW EARTH ORBIT

Nasa to turn ISS into coldest spot in the universe

http://articles.timesofindia.indiatimes.com/2013-02-22/science/37241491_1_iss-universe-mars-science-laboratory By Srinivas Laxman (condensed by editor)

Nasa's Jet Propulsion Laboratory (JPL) at Pasadena in California is developing an experiment that will make the International Space Station (ISS) the coldest spot in the universe, quite literally.

Interestingly, this hitherto unknown project, known as the Cold Atom Laboratory (CAL), is being led by an Indian woman, **Anita Sengupta**, who hails from West Bengal. Prior to this she led the supersonic parachute development for the highly successful Mars Science Laboratory (MSL) mission which landed the Curiosity rover on the Red Planet on August 6, 2012.

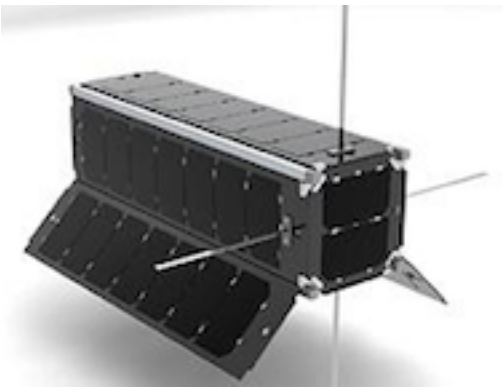
The main role of the new laboratory, to become a part of the ISS in 2016, will be to explore new quantum physics in an extremely cold temperature regime that cannot be explored in earth-based laboratories. "It is a regime where matter ceases to behave like particles, but instead like a wave," she said, while pointing out that it may be representative of the way matter was at the formation of the universe. "This is a very exciting fundamental physics experiment that will make the ISS the coldest spot in the universe, quite literally.

"We started the development in October 2012 and will launch roughly in April 2016. We are in the design phase now. It will be installed by astronauts into the ISS and operated remotely by us at JPL," she stated. CAL is likely to be launched by the Dragon cargo vehicle. ###

Scotland makes its mark in space with its own nanosats

http://www.spacedaily.com/reports/**Scotlands_first_satellite_set_to_boldly_go_into_orbit**_999.html

Feb 08, 2013 - **Clyde Space**, which designed and built the **UKube-1** nanosatellite, is running final tests at the company's headquarters in the West of Scotland Science Park ahead of its deployment in March to Kazakhstan, where it will be launched in a Russian Soyuz-2 rocket later this year.



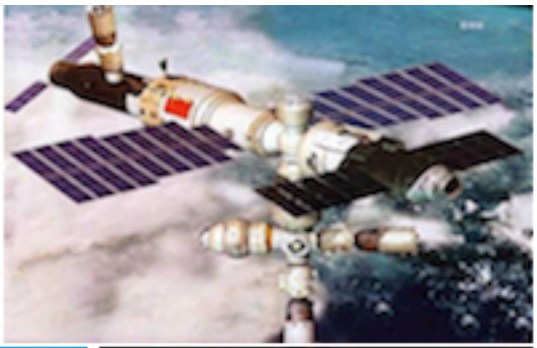
http://www.space.com/19783-**scotland-s-first-satellite-whats-inside-animation**.html

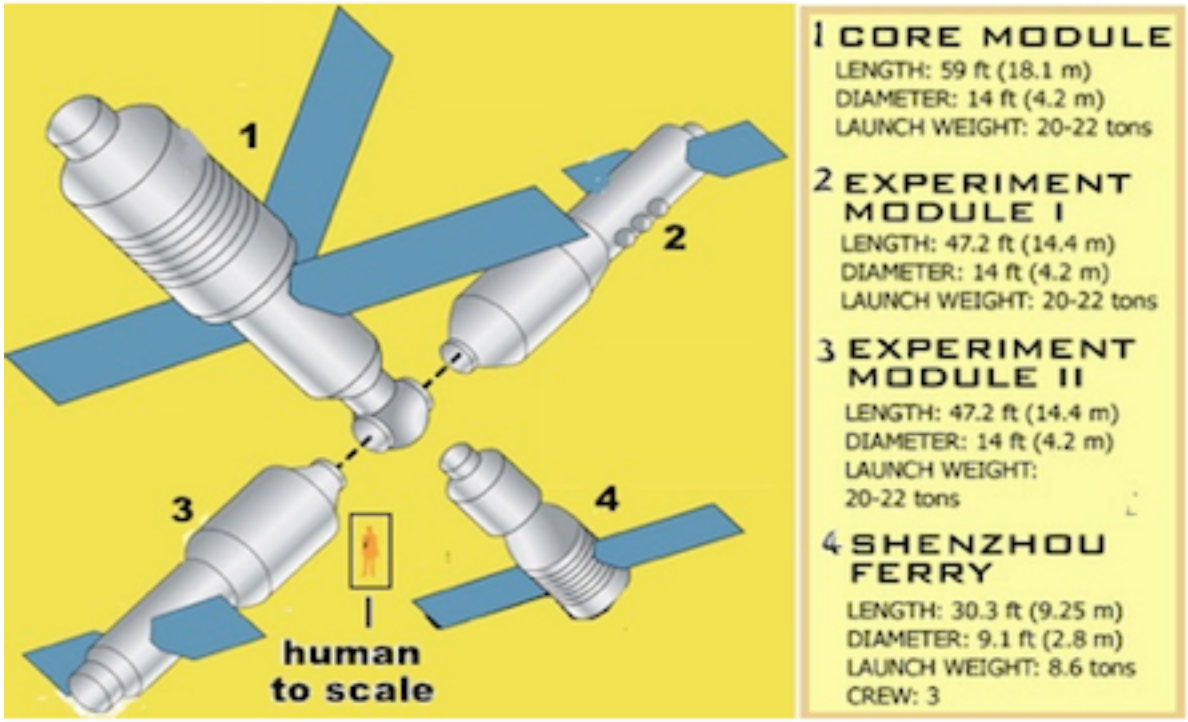
China, European Space Agency to Collaborate on Tiangong 1 Space Station

http://www.space.com/19960-**china-space-station-europe-cooperation**.html

China's planned large manned space station to be built over the next seven years, may host European astronauts as well as Chinese "taikonauts." ESA can contribute its space building technologies, experience and rendezvous-docking system, in exchange for visits bt its astronauts to the facility.

China plans to have the space station running by 2020. Both the station and China's Shenzhou capsule could use ESA's International Berthing and Docking Mechanism (IBDM), because of a problem with the Russian system the Chinese have been using until now. China's Shenzhou and Tiangong-1 space laboratory already in orbit, use a modified version of Russia's Androgynous Peripheral Attach System (APAS). APAS was developed for the 1975 Apollo Soyuz Test Project and is used on the International Space Station (ISS). An unmanned Shenzhou spacecraft docked with Tiangong-1 for the first time in November 2011, and the docking mechanism didn't work exactly as planned. Shenzhou is not heavy enough to activate the APAS docking system correctly. It had to be rammed forcefully to make a connection. ###





http://i.space.com/images/i/000/009/465/i02/china-space-station-infographic-110505d-02.jpg

China's Space Station will be Energy-Efficient

http://www.spacedaily.com/reports/**Chinas_space_station_will_be_energyefficient**_999.html

China's space station, to be completed around 2020, will be an example of green technology. It will use cutting-edge technologies in flight control, power supply and waste recycling. The green technologies to be incorporated will raise its recycling rate and reduce its reliance on input from the ground.

Waste water and urine will be used to extract oxygen, and carbon dioxide and other human waste will also be recycled. Power generation from solar cell will be made more efficient and the life-span, reliability and safety of energy storage batteries will also be improved. The intent is to apply technologies developed for space to address environmental problems on Earth.

MISSION TO PLANET EARTH

Powerful New Earth-Observation Satellite Landsat-8 Snaps 1st Photos

http://www.space.com/20335-**landsat-satellite-first-photos**.html

NASA's **Landsat Data Continuity Mission** [video] (LDCM) continues a four-decade effort by numerous spacecraft to track environmental change and resource use across the planet. It is the eighth satellite in the history of the Landsat program, a joint NASA/United States Geological Survey (USGS) effort that has been monitoring Earth from above since Landsat 1 lifted off in 1972, 41 years ago.

LDCM peers down at our planet with two instruments — the **Operational Land Imager** (OLI), which collects data in visible, near infrared and shortwave infrared wavelengths, and the **Thermal Infrared Sensor** (TIRS), which measures heat emitted from Earth's surface. Its first photo is of the Boulder, Colorado area NNW of Denver, where the Rocky Mountains (left) meet the Plains (right)

http://i.space.com/images/i/000/027/322/original/ldcm-landsat-first-photos.jpg?1363893690

The linked image below, of the Fort Collins, Colorado to the East of Boulder, Colorado, US includes a key to understanding the information and knowledge gathered from this photo.

http://i.space.com/images/i/000/027/323/original/landsat8-first-photos-diagram.jpg?1363894596

Amplified Greenhouse Effect Shifts North America's Growing Seasons

http://www.nasa.gov/home/hqnews/2013/mar/HQ_13-069_**Northern_Growing_Seasons**.html

Satellites observe large Northward Shift of Growing Seasons since 1982

This study was published 10 March, 2013 in the journal Nature Climate Change.

Data used in this study came from NOAA's Advanced Very High Resolution Radiometers (AVHRR) onboard a series of **polar-orbiting satellites** and NASA's Moderate Resolution Imaging Spectroradiometer (MODIS) instruments on the **Terra and Aqua satellites**.

Left: area under study - **M & R:** Changing vegetation patterns in southern Saskatchewan province, Canada

Editor: this is an extensive report and deserves attention. **Below are a selection of quotes:**

- "Vegetation growth at Earth's northern latitudes increasingly resembles more lush latitudes to the south"
- "Changes in surface temperature and vegetation growth from 45° north latitude to the Arctic Ocean. Results show temperature and vegetation growth at northern latitudes now resemble those found 4° to 6° latitude farther south as recently as 1982.
- "Higher northern latitudes are getting warmer, Arctic sea ice and the duration of snow cover are diminishing, the growing season is getting longer and plants are growing more,"around 4° to 6° latitude farther south as recently as 1982. "
- "Large patches of vigorously productive vegetation now span a third of the northern landscape, or more than 9 million square kilometers, an area about equal to the contiguous United States. This landscape resembles what was found 400 to 700 kilometers (250 to 430 miles) to the south in 1982."
- "It's like Winnipeg, Manitoba, moving to Minneapolis-Saint Paul in only 30 years,"
- "A cycle of positive reinforcement between warming and loss of sea ice and snow cover"
- "These models show that increased temperatures in Arctic and boreal regions would be the equivalent of a 20° latitude shift by the end of this century relative to a period of comparison from 1951-1980."
- For more information and images associated with this release, visit: http://go.nasa.gov/12Amv2s

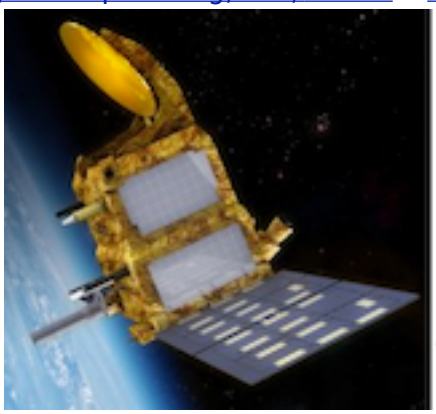
Editor: While this study focused only on northern latitudes, major changes, hard to reverse, are happening **in tropical areas** as well: **deforestation** and **spreading of deserts**, changing precipitation patterns, etc. Deforestation is less the result of climate change, and more due to direct indiscrete logging in an effort to extend farmland, but the changes this causes in the way sunlight is reflected rather than absorbed, probably also leads to climate change. Forest shrinkage diminishes nature's ability to remove excess CO2 from the atmosphere. This is accelerated by misguided government programs and/or lack of government oversight in tropical regions.

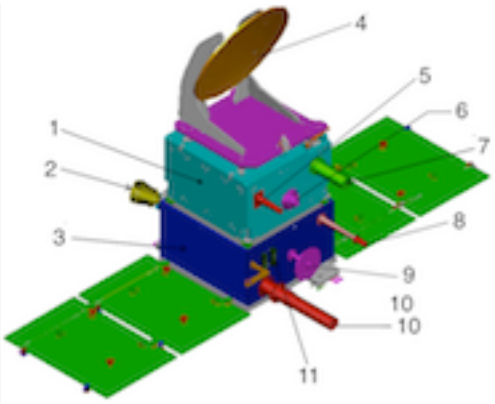
Without Earth observing satellites, we would not have as much information on what is happening.

##

India's ISRO launches Indo-French SARAL Satellite

SARAL: **S**atelilte with **AR**gos and **AL**tika: an Indian-French mission to **monitor Earth's oceans from space**
http://en.wikipedia.org/wiki/**SARAL** - http://smsc.cnes.fr/**SARAL**/**GP_satellite.htm**





KEY: 1 Integrated Payload Platform (IPP), 2 Star Sensors, 3 Main Platform (SSB),
4 Altika/Radiometer Antenna, 5 Argos L-Band Antenna, 6 LRA, 7 Doris Antenna, 8 TTC Antenna,
9, X-Band Antenna, 10 Argos UHF Antenna, 11 Magnetometer-M/R

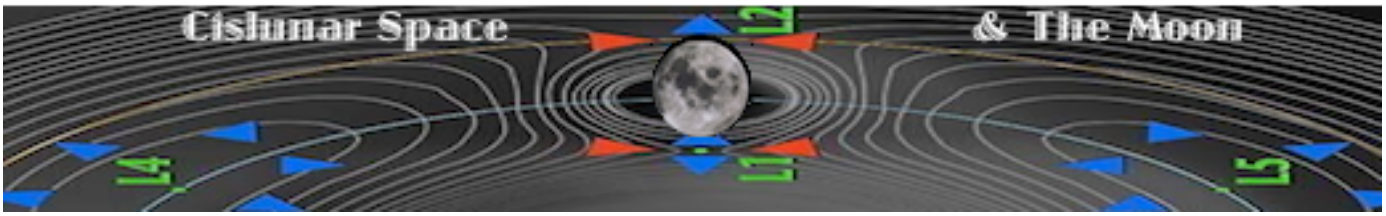
SARAL or **S**atellite with **AR**gos and **AL**tiKa is a cooperative altimetry technology mission of the Indian Space Research Organisation (ISRO) and CNES (Space Agency of France). The ISRO built satellite with payload modules (ALTIKA altimeter, DORIS, Laser Retroreflector Array (LRA) and ARGOS-3 (Advanced Research and Global Observation Satellite) data collection system provided CNES was launched by an Indian Polar Satellite Launch Vehicle (PSLV) a Sub_synchronous orbit (SSO). ISRO was responsible for the platform, launch, and operations of the spacecraft. A CNES/ISRO MOU (Memorandum of Understanding) on the SARAL mission had been signed on Feb. 23, 2007.

The SARAL mission is complementary to the Jason-2 mission of NASA/NOAA and CNES/ EUMETSAT, It will fill the gap between Envisat and the Sentinel 3 mission of the European GMES program. The combination of two altimetry missions in orbit has a considerable impact on the reconstruction of sea surface height (SSH), reducing the mean mapping error by a factor of 4.- Wikipedia reference above.

The SARAL will study the **sea surface heights**. Data from SARAL will be useful for operational as well as research user communities in fields like

√ marine meteorology √ sea state forecasting √ climate monitoring
√ operational oceanography seasonal forecasting √ ocean, earth system & climate research
√ management and protection of the marine eco-system √ continental ice studies
√ environmental monitoring and improvement of maritime securityXS √ protection of bio-diversity

Above: Saral Satellite and its farings prior to rocket assembly



CISLUNAR SPACE

Indian Air Force Developing Parameters for Astronaut Selection for Indian Manned Space Missions

http://articles.economictimes.indiatimes.com/2012-12-28/news/36036517_1_manned-mission-selection-process-iaf

NEW DELHI: **December 28, 2012** – [abridged by m3iq editor] NEW DELHI: Tests for sending India's first manned mission into space are in "advanced" stages with the Indian Air Force (IAF) developing necessary parameters for selection of suitable candidates. The tests will need another year to get fully validated and the selection process of the people for the manned mission will begin after that, Director General Medical Services (Air), Air Marshal Anil Behl told PTI here today.

At the **Institute of Aerospace Medicines, Bangalore**, IAF is doing all kinds of tests, now in an advanced state to fully validate the candidate selection Process. "In any project the first stage is conceptualisation, then procurement of infrastructure and training of people.

Behl said that the government has yet not decided on the number of people who will be selected for missions. People selected could be from any branch of the armed forces, but a pilot will be preferred because of his familiarity with aviation and other necessary parameters.

THE MOON

India to "go solo" on Second Chandrayaan Lunar Mission

http://timesofindia.indiatimes.com/india/**India-to-go-solo-on-second-lunar-mission**/articleshow/18124826.cms

AHMEDABAD: January 22, 2013. [abridged by m3iq editor] India has decided on its second journey to the Moon—Chandrayaan-2—without Russian participation. The tentative date for lift-off is 2015 from the Sriharikota facility. This was announced by space scientist S V S Murty of the Ahmedabad-based Physical Research Laboratory's (PRL) planetary exploration group during a conference on Monday.

The original mission envisaged the nearly Rs 425-crore Chandrayaan-2 having an Indian rocket and orbiter and a Indian rover carried to the Moon's surface by a Russian lander. That lander will now be replaced by one designed and built in India. The decision comes after the failure of a Russian space mission, Phobos-Grunt in January 2012, which was supposed to test the lander.

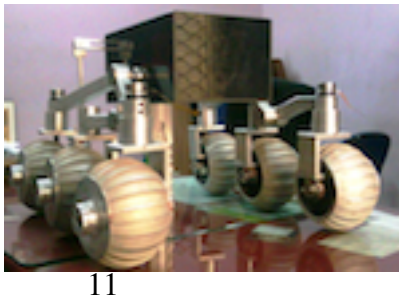
The replacement of the Russian lander with an indigenous one developed by the Space Applications Centre (SAC) in Ahmedabad will mean a change in the mission profile as well. The lander's preliminary configuration study has been completed.

The orbiter will have five payloads, while the six-wheeled rover has two. The orbiter will operate from an altitude of 200 km above the moon's surface. "Chandrayaan-2 will carry out an intensive investigation of a localized area of the moon having high scientific value," Murty said.

The rocket will be the proven three-stage Geo-Synchronous Satellite Launch Vehicle powered by an Indian-made cryogenic engine. All the payloads of Chandrayaan-2 are indigenous in contrast to Chandrayaan-1 which had six foreign payloads and five from India.

Editor: it is not clear whether or not a specific landing spot on the Moon has yet been selected

orbiter



lander prototype

China prepares for Chang'e 5 Lunar Sample Return with tests

http://www.asianscientist.com/topnews/**china-prepares-for-change-5-lunar-return-mission-2013/**

March 18, 2013

"An experimental version" of the Chang'e-5 lunar explorer will be launched before 2015 to carry out re-entry tests on the capsule, said its chief designer. It will consist of the Chang'e-2 lunar orbiter base structure and a return capsule, China's first sample return mission.

The Scenario:

After entering into lunar orbit, two modules will separate and land on the moon, with one collecting soil samples. Lunar soil samples retrieved from up to a depth of two meters will be placed in the ascending module that will make an automatic rendezvous and docking with the orbiting module. The samples will then be transferred to a re-entry module.

Meanwhile:

Chang'e-3 is expected to be launched later in this year, 2013, in a mission that will see China's first ever soft-landing on the Moon. The lunar explorer will spend 15 days on the surface where it will probe and explore, and carry out various environmental and space technology related tests.

Following Chang'e-3, Chang'e-4 will be launched. Together, they will complete t the second phase of China's lunar exploration program.

China's Lunar accomplishments to date:

China launched Chang'e-1 in 2007 and Chang'e-2 in 2010. The first retrieved lunar data and carried out an initial mapping of the surface, while the second created a full high-resolution map of the Moon. In December last year, Chang'e-2, during an "after mission" after leaving the vicinity of the Moon, took close-up images of near-Earth asteroid Toutatis, about seven million km from Earth. ##

China Releases White Paper On Plans For A Manned Lunar Mission

http://www.asianscientist.com/topnews/**china-space-activities-2011-white-paper-lunar-mission/**

January 3, 2013 **By Srinivas Laxman** - M3IQ co-editor

Article Summary Quotes: China will:

- Push forward human spaceflight projects and make new technological breakthroughs, and conduct studies on the preliminary plans for a human lunar landing."
- Launch orbiters for lunar soft landing, roving and a sample return mission from the Moon."
- Launch Shenzhou-9 and Shenzhou-10 spaceships and achieve unmanned or manned rendezvous and docking with the in-orbit Tiangong-1 spacecraft. China will launch space laboratories, ned spaceship, space freighters and make breakthroughs in and master space station key technologies
- Plans to operationalize its three-man crew space station by 2020, about the time the Interntional Space Station may be deactivated
- Continue to implement projects in the areas of human spaceflight, lunar exploration, high resolution earth observation system, satellite navigational and positioning system and new generation launch vehicles
- Emphasize "exploration and utilization of outer space for peaceful purposes," and space co-operation in the Asia-Pacific region.

Comments:

Though the document emphasizes a lunar mission, it is silent on a mission to Mars. Its Yunghuo-1 probe shared the fate of the Russian Phobos-Grunt mission's 2nd stage launch failure, upon which it was to get a free ride to Mars orbit. India is formulating plans for an unmanned flight Mars, with no target date yet published.

The white paper indicates that China plans to operationalize its three-man crew space station by 2020, just around the time when the 17-nation International Space Station will be deactivated. "It is clear that China plans to surge ahead of the U.S. in space sciences and technology.

China's space program has already made major breakthroughs in a relatively short time, although it lags behind the U.S. and Russia in the field of space technology.

The full text of the report can be found at: China's Space Activities in 2011

http://news.xinhuanet.com/english/china/2011-12/29/c_131333479.htm

Russia's Plan to "Reconnect" with the Moon

http://www.space-travel.com/reports/Russia_rekindles_Moon_exploration_program_intends_setting_up_first_human_outposts_there_999.html
http://science.nbcnews.com/_news/2013/04/02/17569795-russia-shoots-for-the-moon-with-new-wave-of-lunar-robots?lite

April 6, 2013 - Given its impressive record of successful moon missions when Russia was the core of the old Soviet Union, Russian space scientists are planning to revive its robotic moon exploration program.at the recent Lunar & Planetary Insitute Conference 1013 in Woodlands, TX, some 50 km north of Houston.

Microsymposium 54 on "Lunar Farside and Poles - New Destinations for Exploration" was organized by joint efforts of Brown University, Russia's Vernadsky Institute, Massachusetts Institute of Technology (MIT) and the NASA Lunar Science Institute. Igor Mitrofanov of the Institute for Space Research (IKI) in Moscow described the plan **Russian space scientists were working on "to reconnect with the Moon."**

The Soviet Union's **last moon mission, Luna 24, was launched 37 years ago in April 1976.** That probe returned to Earth with samples from Mare Crisium (Sea of Crisis).

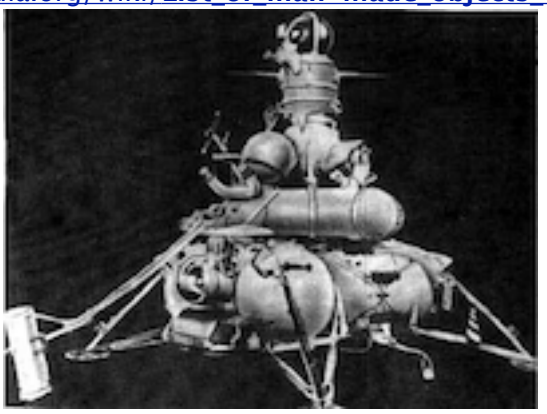
T**he renewed program would eventually lead to setting up outposts for humans on the Moon**, which the scientists believe would make Mars journeys more attainable.

Russia's moon mission schedule over the next several years.

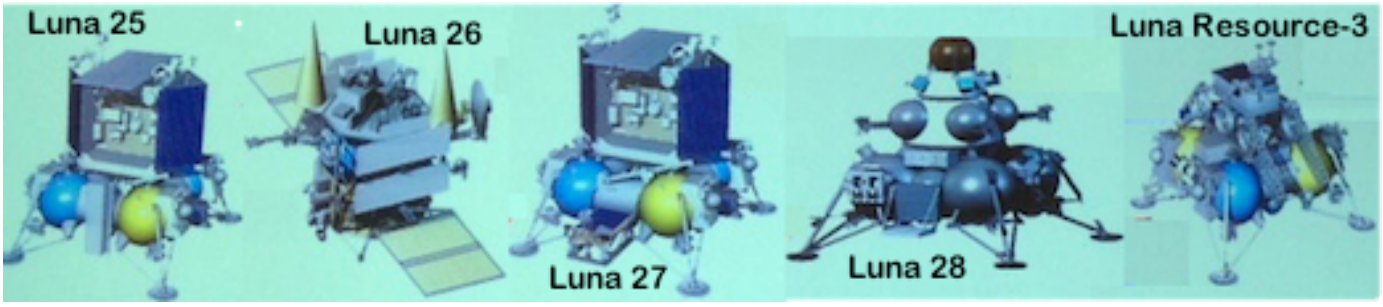
The first mission called **Luna 25 is planned for 2015** and would include the launch of **a lander designed to analyze the moon's surface and exosphere**. The next two missions **Luna 26 & 27** are scheduled for 2016 and 2017. If these three were successful, another two would follow. The Luna designation numbers themselves bespeak volumes about Russia's many achievement on the Moon.

The plan: http://i.space.com/images/i/000/027/661/original/russian-lunar-craft.jpg?1364843454

Links: http://en.wikipedia.org/wiki/**Luna_programme**
http://en.wikipedia.org/wiki/**Soviet_manned_lunar_programs**
http://en.wikipedia.org/wiki/**List_of_man-made_objects_on_the_Moon**

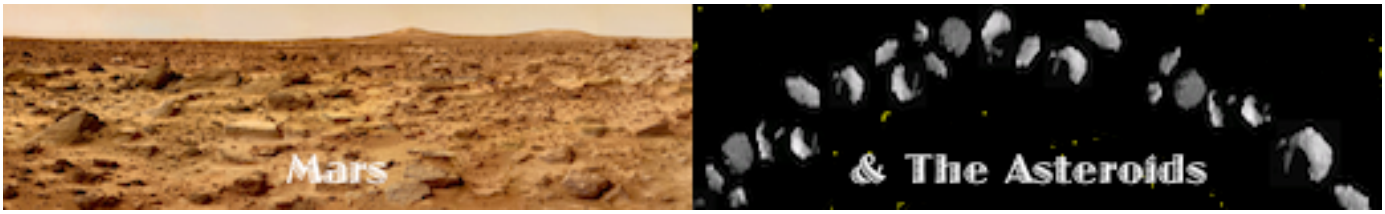




L>R: Luna 1 **Luna 16** **"Luna Glob" (Luna 25)**



Luna 25: (Luna-Glob-Lander) Polar soft landing technology, study of South Pole
Luna 26: (Luna-Glob-Orbiter) Global orbital studies of the Moon
Luna 27: (Luna-Resource-1) Studies of South Pole regolith and exosphere (2200/810 kg)
Luna 28: (Luna-Resource-2) Cryogenic samples return from South Pole (3000 kg)
Luna-Resource-3 Lunokhod mission (3000 kg

Image source: http://i.space.com/images/i/000/027/661/original/russian-lunar-craft.jpg?1364843454

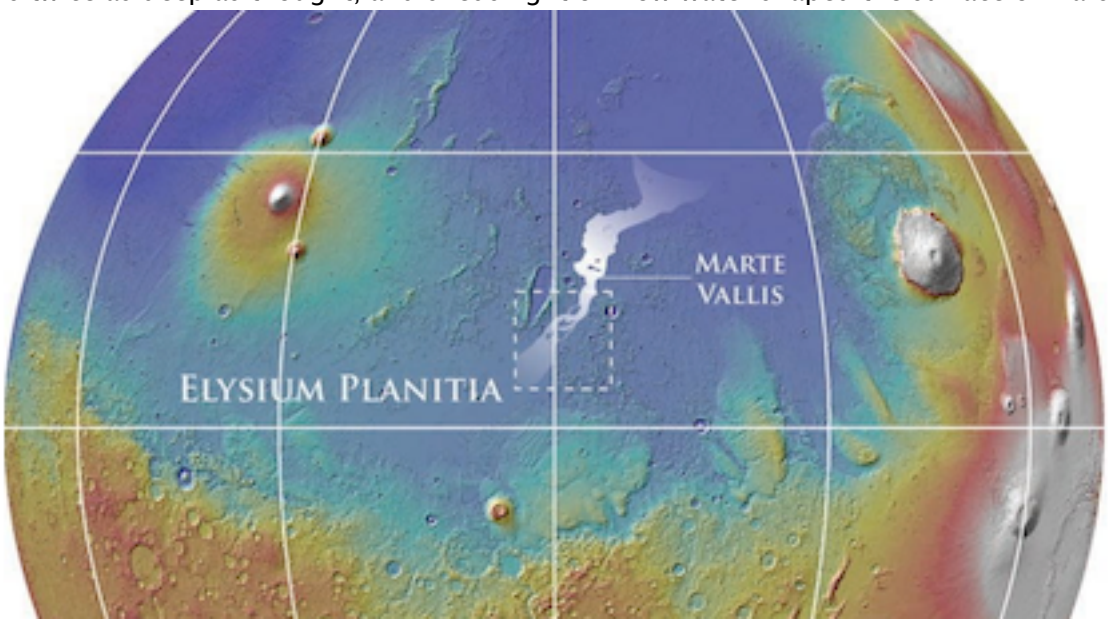


MARS

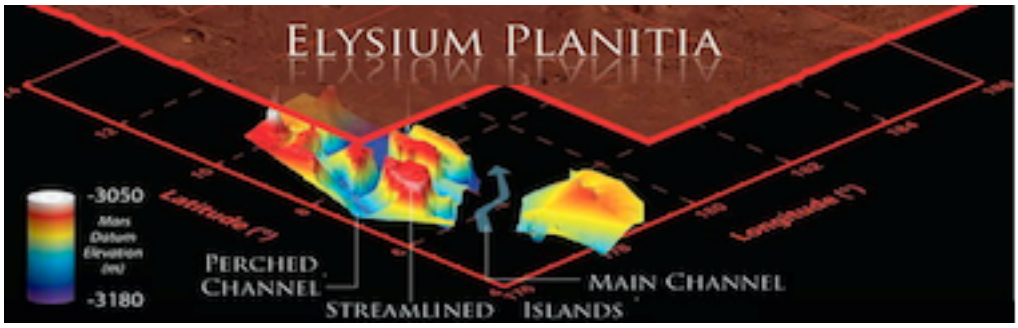
Discovery of an Ancient Megaflood on Mars

http://www.space.com/20111-**mars-megaflood-underground-radar**.html

The discovery shows that a major underground channel generated by an ancient mega-flood is twice as deep as thought, and sheds light on how water shaped the surface of Mars.



Radar scans of Mars have revealed the first 3D look at water-carved channels buried beneath Mars surface.



This 3D visualization shows the buried **Marte Vallis** channels beneath the Martian surface created during an ancient mega-flood. Marte Vallis consists of multiple perched channels formed around streamlined islands. These channels feed a deeper and wider main channel. In this illustration, the surface has been elevated, and scaled by a factor of 1/100 for clarity, with colors representing the elevation of the buried channels.

Today most of Mars' water is locked in polar ice caps, and the rest of its surface is "Antarctic Dry Valley cold and dry and" has probably been so for the past 2.5 billion years. But channels crisscrossing Mars surface suggest that water once flooded much of its surface.

The largest of the channels engraved into Mars within the past 500 million years belong to the 1,000 k (600 mi) long Marte Vallis system. Probing Marte Vallis could offer change our views of Mars' history. See http://www.space.com/12542-**mars-water-photos-red-planet-images**.html

Marte Vallis lies in Elysium Planitia, along the Martian equator. This is the youngest volcanic region on Mars, and massive volcanism throughout the past several hundred million years has covered most of its surface with lava, burying evidence of the source and most of the length of Marte Vallis.

Using the shallow radar on the Mars Reconnaissance Orbiter, scientists can scan beneath the surface of Elysium Planitia and use the data to generate a 3D reconstruction of Marte Vallis, revealing

many details long since buried under lava flow. This is the first time buried flood channels have been detected on another planet. Those in Marte Vallis are 70 m (230 ft) deep, twice as deep as expected.

Previous ideas of how much water have gone through Marte Vallis, have been underestimated, and there was more significant flooding than before thought. This water might have come from deep underground. Scientists expect to find more buried channels in areas on Mars, yet to be probed by radar.

29 Photo Clues to Water on Mars:

http://www.space.com/12542-**mars-water-photos-red-planet-images**.html

Mars "reddish" color may be only skin deep

http://www.space.com/19883-**mars-rover-curiosity-drilling-photos**.html

Photo 1 - http://i.space.com/images/i/000/026/404/i02/curiosity-first-sample-hole.jpg

Above: the first holes drilled by the Curiosity Rover uncovers gray soil just below the surface Many more drill holes, in many distinct areas of Mars, will tell a more complete story. Presumably we will find lighter and darker shades of gray, even black. These are "neutral accent" colors which will be useful in Martian color schemes. But the geochemical differences between the surface and subsurface soils will be both interesting and scientifically instructive.

Canada's Mars Rover May hunt for Martian Methane

http://www.space.com/19692-**canadas-mars-rover-may-hunt-for-martian-methane-video**.html

A prototype Mars rover explores CSA's Mars simulation field to demonstrate technology for seeking out methane on the Red Planet. **Video Credit:** University of Toronto Autonomous Space Robotics Lab.

The big question is whether methane on Mars is from **life** processes, **geochemical** processes, **volcanic**, or, **hydrothermal** activity, or from some combination thereof. This is not a matter of obtuse idle curiosity. The answer will determine how we go about establishing a human presence on Mars, how we relate to any indigenous life forms no matter how primitive, what assets we have for developing a chemicals industry, even what paths we take in "rejuvenating" Mars to make it a friendlier habitat for people. Methane, **CH4**, is also a potential fuel, not only for rockets, but also for vehicles. ###

Bold "Inspiration Mars" Project – 2 people skimming over Mars and back

http://www.inspirationmars.org – **Video Introduction** – http://www.youtube.com/watch?v=qc_RycDf6hU

The Mission – Mars presents a challenging, but attainable goal for advancing human experience and knowledge. The plan is to launch a mission that will use **existing space transportation hardware** and further drive technology development. It will generate knowledge, experience and momentum for the next great era of space exploration. It will encourage and embolden people to believe again, in doing the hard things that make our nation great, while inspiring the next generation of explorers to pursue their destiny through STEM education and exploration. Now is the time!

Overview – In 2018, the planets will literally align, offering a unique orbit opportunity to travel to Mars and back to Earth in only 501 days. **Inspiration Mars** would send a two-person crew – a man and a woman – on a historic journey to fly within 100 miles around the Red Planet and return to Earth safely.

Once underway, the crew will keep busy with hours of exercise daily, system maintenance, life support maintenance. As they will be in isolated confined environment for long periods, they must be by temperament resilient, upbeat, happy in face of adversity. The expectation is that the crew of two will be a married couple to provide mutual support and trust and sharing.

The trip home will require highest Earth reentry speed ever. Only existing hardware will be used, so that hardware development cannot delay the launch. All systems must be robust as there will be no way to abort the mission once underway.

The target launch date is January 5, 2018. This exceptionally quick, free-return orbit opportunity occurs twice every 15 years. After 2018, the next opportunity won't occur again until 2031. The mission will provide a platform for unprecedented science, engineering and education opportunities, using state-of-the-art technologies derived from NASA and the International Space Station. It will be financed primarily through philanthropic donations, with some potential support from government sources.

The Mission – This is a mission that will push back boundaries while taking the world along for the ride. Public participation, inspiration of youth are primary goals. Closing the "inspiration gap," both for kids and teachers, is primary. The intent is to think large, think beyond what has been done, to demonstrate audacity. Mars presents a challenging, but attainable goal for advancing human experience and knowledge. The plan is to launch a mission that will use **existing space transportation hardware** and further drive technology development. It will generate knowledge, experience and momentum for the next great era of space exploration. It will encourage and embolden people to believe again, in doing the hard things that make our nation great, while inspiring the next generation of explorers to pursue their destiny through STEM education and exploration. Now is the time!

Operations – This mission will be a flyby **passing within 100 miles of the surface of Mars**. Additional maneuvers will be minor course corrections only, using the gravitational influence of Mars to "slingshot" the vehicle onto a return course to Earth.

An inflatable habitat module will be deployed after launch and detached prior to re-entry. The habitat module, possibly a Bigelow Aerospace Inflatable, will be the size of a small Winnebego camper/ caravan, 35 cu meters (1,200 cu ft), half filled by supplies which will include 1,360 kg (3,000 lbs) of dehydrated food, recycled urine and stale air in process of being recycled.

NASA will partner in advisory role and in developing of new technologies. **Some subsystems may come from other countries. The money will come from individuals, foundations, movie rights, with Dennis Tito underwriting the first two years of the project.**

An inflatable habitat module will be deployed after launch and detached prior to re-entry.

Left: inflatable module which will be home to the couple for the duration of the flight

Right; its interior size will be comparable to a small Recreational Vehicle or caravan

Technology – Investments to date in human space exploration technologies and operations are converging in time to make such a mission achievable. The mission is being designed based on proven Low-Earth Orbit (LEO) systems and technologies that are available on the market today. We are currently in discussions with many of the leading U.S. commercial aerospace companies to tap into their existing launch engines and vehicles. Environmental and life support operations will be directly derived from International Space Station technologies, which have proven design, development and operational lessons to draw from.

Mission Importance – This mission will generate knowledge, experience and momentum for the next great era of space exploration. It represents an unprecedented, long-duration research opportunity that will lead to new, cutting-edge discoveries. It inspires the next generation of explorers to pursue their destiny through STEM [ ] education.

Rewards & Risks – The beauty of this mission is its simplicity. The flyby architecture lowers risk: √ no critical propulsive maneuvers √ no entry into Mars' atmosphere √ no rendezvous and docking.

It also represents the shortest duration roundtrip mission to Mars. **The 2018 launch opportunity coincides with the 11-year solar minimum providing the lowest solar radiation exposure.** The next launch opportunity for this mission (2031) will not have the advantage of being at the solar minimum.

There are risks associated with the mission. To be successful, the craft must "thread the needle" both as it passes behind Mars, to get on a path to hit Earth's atmosphere at just the right angle. The risks and challenges so far identified are well within the scope of our collective experience and can be overcome to achieve a safe and successful mission. The team is steadfastly committed to the safety, health and overall well-being of our crew. They will only fly this mission if we are convinced that it is safe to do.

Role with NASA – Proven LEO systems and technology that NASA and the industry have created will be used to seize this unique, once-in-a-generation opportunity to create public awareness, enthusiasm and momentum for a long-term commitment and vision for space exploration beyond LEO…all the way to Mars.

The Inspiration Mars Foundation has formed a partnership with NASA via a reimbursable Space Act Agreement between Paragon and the Ames Research Center to conduct thermal protection system and technology testing and evaluation. Foundation officials will also seek to tap into NASA's knowledge, experience and technologies to fine-tune and/or develop some of the more challenging elements of this mission, including environmental controls, radiation protection, and human health and productivity plans.

Additional Partners

- Applied Defense Solutions
- Space Exploration Engineering Corporation

Read three editorials about the Inspiration Mars Project in the Essays Section Below.

Curiosity Rover Finds Essential Ingredients for Life In Ancient Rock Sample

http://www.huffingtonpost.com/2013/03/12/**life-on-mars-evidence-nasa-curiosity**_n_2861505.html

http://www.space.com/20182-**ancient-mars-microbes-curiosity-rover**.html

12 March 2013: According to NASA, a rock sample analyzed by Curiosity in February contained **sulfur, nitrogen, hydrogen, oxygen, phosphorous** and **carbon**, critical **building blocks for a living organism**. An ancient stream bed, analyzed in September, also contained minerals likely to have formed in the presence of "**relatively fresh water**."

Recently, Curiosity's drill uncovered a sample of gray soil quite different from the typical heavily oxidized ground that gives the 'Red Planet' its famous color. [photo at far right, above.] "A fundamental question for this mission is whether Mars could have supported a habitable environment," added Michael Meyer, lead scientist for NASA's Mars Exploration Program in Washington. "From what we know now, the answer is yes." The conclusion? "**Ancient Mars could have supported living microbes**."

http://www.huffingtonpost.com/2012/12/03/**organics-on-mars-curiosity-rover**_n_2232436.html

Given that amino acids, the building blocks of life seem to be everywhere in space, and had to fall on Mars, it would be difficult to understand if future exploration found no signs of microbial life. How far microbes might have evolved on Mars will require continued exploration with equipment not yet on Mars, and probably supported by a growing human population on the planet.

It is possible that evolution of life on Mars reached a stage, when the planet was warmer and wetter than it is now, and that we will find signs of life more advanced than still survives today. ED. ###

Follow up: http://www.space.com/20190-**mars-mission-sample-return**.html

MarsOne Project Signs Deal to Study Spacesuits, Life Support

http://www.space.com/20164-**mars-colony-life-support-systems**.html

More images: www.space.com/20165-**mars-one-colony-images**.html - http://**mars-one.com**/en/

11 March, 2013. The Netherlands-based non-profit Mars One organization that aims to land four astronauts on Mars in 2023 has signed its first deal with a supplier for the ambitious space colonization effort that intends to put volunteers on Mars "to stay." Arizona-based Paragon will look into developing an Environmental Control and Life Support System, which would provide colonists with safe living quarters and clean air and water. The company will also investigate spacesuit designs that would allow Mars explorers to roam the Red Planet surface. They hope to finance this operation as a "reality show."

What do space.com readers think about this project? Here is the early voting: (Total Votes: 3487)

17. Yes — Sign me up! 64.27% (2241 votes)
18. No — I like life here on Earth just fine. 11.13% (388 votes)
19. Maybe — I need some time to think about it. 8.23% (287 votes)
20. Irrelevant — I don't think this mission will ever get off the ground. 16.38% (571 votes)

EXO-MARS ESA & Roscosmos Contributions Defined

http://www.esa.int/Our_Activities/Space_Science/**ExoMars_ESA_and_Roscosmos_set_for_Mars**_missions
http://en.wikipedia.org/wiki/**ExoMars** - http://en.wikipedia.org/wiki/**ExoMars_rover**
http://www.space.com/20240-mars-missions-russia-europe.html

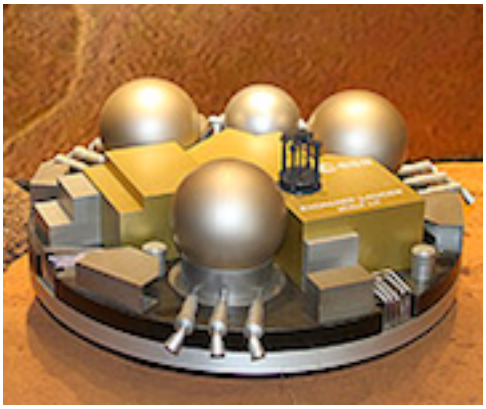
14 March 2013: The European Space Agency, ESA, and the Russian federal space agency, Roscosmos, have signed a formal agreement to work in partnership on the ExoMars programme towards the launch of **two missions in 2016 and 2018**.

EXO-Mars top priority is to determine whether or not life has ever existed on Mars
The European-Russian partnership splits the responsibilities:

- **ESA** will provide the **Trace Gas Orbiter (TGO)** and the **Entry, Descent and Landing Demonstrator Module (EDM)** in **2016**, and **the carrier and rover in 2018**.
- **Roscosmos** will be responsible for the **2018 descent module and surface platform**, and will provide **launchers for both mission**s.
- **Both partners will supply scientific instruments** and will c**ooperate closely in the scientific exploitation of the missions.**
- **Planning ahead:** ExoMars will also demonstrate core technologies under development by European industry such as landing, roving, drilling and sample preparation that are an essential part of **paving the way for the next big step in the robotic exploration of Mars: a sample-return mission.**
- The 2016 mission has two major ESA elements: TGO and EDM.
  - **TGO** will search for **evidence of methane and other atmospheric gases that could be signatures of active biological or geological processes.**
  - **TGO** will also serve as a data relay for the 2018 mission.
  - **EDM** will land on Mars to prove key technologies for the 2018 mission.

TGO   **EDM**

- In 2018, the ExoMars rover, to be provided by ESA, will search the planet's surface for signs of life, past and present. It will be the **first Mars rover able to drill to depths of 2 m**, collecting samples that have been shielded from the harsh conditions of the surface, where radiation and oxidants can destroy organic materials.



Lander rover package

Lander ready to rove

- **NASA** will also deliver important contributions to ExoMars, including **the Electra UHF radio package for TGO**, and **Mars Proximity Link telecom and engineering support to EDM**. ###

ASTEROIDS & COMETS

Biggest Meteorite found in East Antarctica for 25 years

www.huffingtonpost.com/2013/03/01/**huge-meteorite-found-antarctica-rock**-largest_n_2789850.html

An international team of researchers in Antarctica (known collectively as SAMBA) searching an area known as the Nansen Ice Field, found an 18 k (40 lb) rock on the surface of the ice. The largest such meteorite found in the region in close to a quarter century. Scientists from Université Libre de Bruxelles (ULB), Vrije Universiteit Brussel (VUB), Japan's National Institute of Polar Research (NIPR) and Tokyo University was working out of Belgium's Princess Elisabeth Antarctica research station. [map above] The team had been searching this ice field since December, 2012. The current project is to collect large meteorites and study them. Eventually, the meteorites will be publicly displayed.

Coming from the Asteroid Belt, meteorites have recorded information on how other planets formed and evolved through time; from undifferentiated primitive asteroids to differentiated small planets, showing the development of a crust, a mantle, and a metallic core just like those of the Earth.

Further Reading: **http://geology.cwru.edu/~ansmet/why_ant/index.html**

http://geology.cwru.edu/~ansmet/

Ansmet: ANtarctic **S**earch for **MET**eorites

Why is it that Antarctica is the premier place to hunt for meteorites?

A combination of explanations: Much of Antarctica is kilometers-thick ice cap. Any rock found in this ice almost certainly fell from the sky. Also, the wind "sweeps" them across the ice, so there are spots where the meteors are concentrated! Finally, in most parts of the world, meteorites and other interesting geological features like dikes, sills, fault lines and rift valleys are obscured by vegetation. It's only in a few places like the Icelandic tundra, the Ethiopian desert and Antarctica that you can see them clearly.

Could a Comet Hit Mars in 2014?

http://www.slate.com/blogs/bad_astronomy/2013/02/28/**mars_impact_the_red_planet_may_get_hit_by_a_comet_in_october_2014**.html

Not "an itty-bitty dinosaur killer 10 km/6mi diameter like the little object that hit the Earth 65 million years ago, a monster comet (perhaps 50 km/31 mi in diameter) straight from the Oort Cloud, on a hyperbolic retrograde orbit (i.e. head on collision at 203,000 kph) is aiming for Mars.

Even if the nucleus misses the odds are good Mars will past through its coma. Earth has passed safely through comet tails often enough. They are of little consequence.

And if it hits it will create a crater more than 500 km (310 miles) in diameter sending a shower of debris into orbit and around Mars. All spacecraft in orbit and on the surface may be lost.

With Mars well visible in the southern evening sky it may be possible for everyone on Earth to see it happen without any telescopes. Right now, the indications are that it will be a near miss. Mars, slightly more than half the diameter of Earth and only 28% of Earth's cross section, and only 10% of Earth's mass will not be able to pull the speeding comet off-course.

If it were to hit, the debris cloud could eventually give Mars its own set of rings. It is good to know this is a possibility, but also to realize that a bullseye strike is unlikely. ###

Two Asteroid/Comet Close Calls in one day get planners' attention

http://www.space.com/19864-asteroid-threat-atlas-warning-system.html

After the close shave asteroid 2012 DA14 gave Earth last week and the unexpected meteor blast over Russia all in one day, serious brainstorming has been getting much more attention, both as to weaknesses (including blind spots) in our early warning system, and on the dozen or so suggestions to date on how we can divert a threatening asteroid or comet to a new, non-threatening orbit.

The devastation in the Chelyabinsk, Russia metro area was caused by a 55-foot (17 m) asteroid

Canada's new NEOSat removes some of the early detection blind spots [article above]

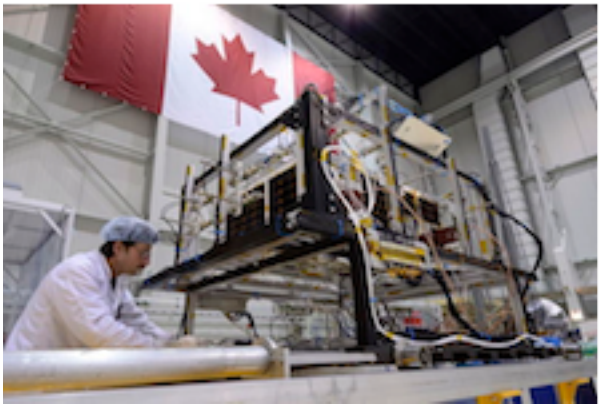
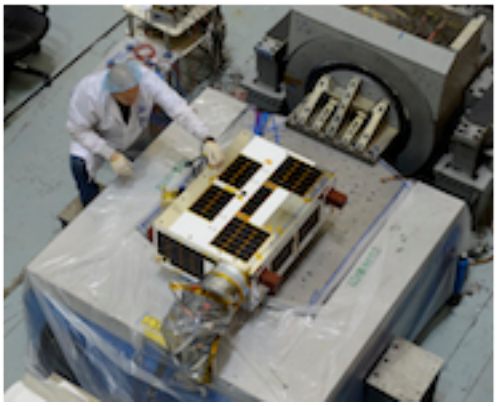
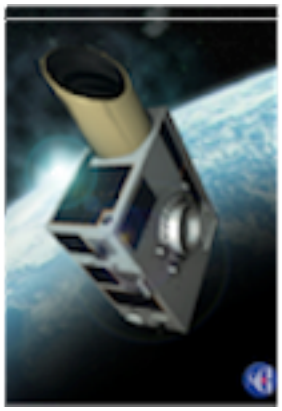
A University of Hawaii astronomy team is developing an asteroid warning system to help guard against surprise impacts. Once ready in 2015, the new Asteroid Terrestrial-Impact Last Alert System (or ATLAS) will consist of eight small telescopes, each equipped with cameras of up to 100 megapixels in resolution. The telescopes will be on fixed mounts at one or two locations in the Hawaiian Islands.

The system should provide a one-week warning for a 45 m/50 yd asteroid that could wipe out a whole city and three weeks for a 150-yard (137-meter) space rock capable of wiping out a whole country. That's enough time to evacuate the area of people, take measures to protect buildings and other infrastructure, and be alert to a tsunami danger generated by ocean impacts," per Hawaii astronomer John Tonry. ###

Canada builds, India launches first satellite designed to track asteroids

www.space.com/19680-**canada-building-first-satellite-designed-to-track-asteroids-video**.html

http://www.space.com/19930-**asteroid-tracking-satellite-neossat-launch**.html

February 24, 2013: The Canadian-designed **NEOSat** (Near Earth Object Surveillance Satellite) is a **mini-satellite** that will be **able to track the skies day and night**, and send back early warning of dangerous asteroids approaching Earth. Up until now, all asteroid tracking is done on Earth. The sun blocks astronomers' view and they can study asteroids only at night. NEOST's 15 cm-diameter telescope will do 24-hour tracking from space. The $25 million NEOSSat is about the size of a suitcase and destined to circle the Earth every 100 minutes in an orbit about 497 miles (800 kilometers) above the planet

India's ISRO provided the launch, along with half a dozen other satellites (link below) from the Satish Dhawan Space Centre in Sriharikota, India.

Small but vital. NEOSat should be able to detect many potentially threatening asteroids well before we would otherwise be able to spot them and plot their orbits from on Earth's surface. So this "little satellite that could" is now a vital part of our early warning system.

What is not yet in place are any of the many proposed ways of diverting a threatening objects path. **Links:**

http://en.wikipedia.org/wiki/**Asteroid_impact_avoidance**

http://news.discovery.com/space/asteroids-meteors-meteorites/**top-10-asteroid-deflection**-130130.htm

http://www.rediff.com/news/report/**isro-successfully-launches-saral-6-other-satellites**/20130225.htm

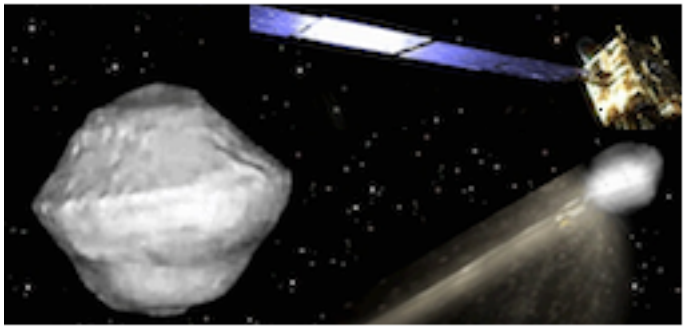
Asteroid-Smashing Mission Picks Space Rock Target

http://www.space.com/19933-**asteroid-deflection-mission-aida-didymos.html**
http://www.space.com/20341-**asteroid-collision-aida-spacecraft-2022.**html
http://www.space.com/19809-**meteor-hits-central-russia-900+-hurt-video.html**
video: http://www.space.com/19809-**meteor-hits-central-russia-900+-hurt-video.html**

A mission that aims to slam a spacecraft into a near-Earth asteroid now officially has a target — a space rock called **Didymos**, actually a binary system, in which an 800 m {2,625-ft) wide asteroid and a 150 m (490ft) space rock orbit each other. Didymos poses no threat to Earth in the foreseeable future.

The joint European/U.S. Asteroid Impact and Deflection Assessment mission, or AIDA, will work to intercept Didymos in **2022**, when the space rock is about 11 million km (6.8 m mi) from Earth, European Space Agency officials announced on February 7, 2013.

The AiDA mission will send one small probe crashing into the smaller asteroid at about 22,530 kph (14,000 mph) while another spacecraft records the dramatic encounter. Meanwhile, Earth-based instruments will record so-called "ground-truthing" observations.



Artist concept for the Asteroid Impact & Deflection Assessment (AIDA) mission CREDIT: ESA

The goal is to learn more about how humanity could ward off a potentially dangerous space rock. The necessity of developing a viable deflection strategy was brought home by the events of February 15, 2013, when the 40 m (130-ft) asteroid 2012 DA14 passed close by just hours after a 17 m (55-ft) object, entering the atmosphere at a shallow angle at great speed and then exploded above the Russian city of Chelyabinsk, injuring 1,200 people and damaging thousands of buildings.

The AIDA impact will unleash about as much energy as that released when a big piece of space junk hits a satellite, so this mission could also improve models of space-debris collisions.

The European Space Agency (ESA) has asked scientists around the world to propose experiments that AIDA could carry in space or that could increase its scientific return from the ground.

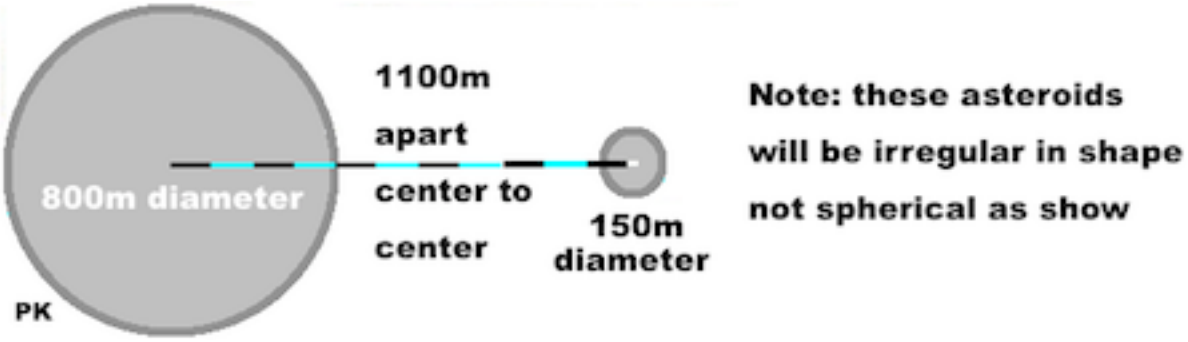
Johns Hopkins' Applied Physics Laboratory will provide AIDA's impactor, DART (**D**ouble **A**steroid **R**edirection **T**est). ESA will provide the observing spacecraft, AIM (Asteroid Impact Monitor.)

More on asteroid Didymos

http://en.wikipedia.org/wiki/**65803_Didymos**

"It has a satellite orbiting it with a period of 11.9 hours, hence the appellation "Didymos", meaning "twin." The primary asteroid is about 800 m in diameter, the satellite is about 150 m in diameter in an orbit about 1,100 m from the primary. The rotation rate of Didymos is fast, 2.26 hours. Its density is 1.7±0.4 g/cm^3. Didymos is the **most easily reachable asteroid of its size from Earth**, requiring a delta-v of only 5.1 km/s[2] for a spacecraft to rendezvous compared to 6.0 km/s to reach the Moon.

Its approach to Earth in November 2003 was especially close with a distance of 7.18 million km; it will not come that near until November 2123, with a distance of 5.9 million km."



Potentially Hazardous Asteroids

http://www.space.com/20151-**potentially-dangerous-asteroids-images**.html

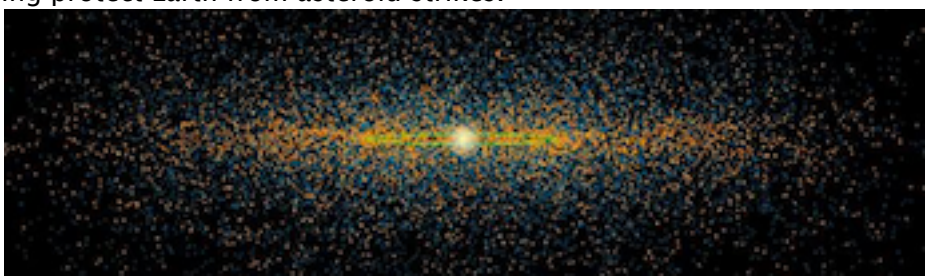
Humanity's ability to develop the technical know-how to deflect a killer asteroid away from Earth is one thing. Getting the world to come together to pull it off in time, once a near term threat has been identified may be another matter.

Actual hits doing major damage are few and far between, once a century for local damage, once in thousands of years or even longer for damage over hundreds of miles, once in a hundred million years for global catastrophe, makes it hard to marshall international resources to mount a preventative program to deflect potential impactors into less threatening orbits. One is reminded of the children's fairy tale of "Chicken Little" excited warning that the Sky was falling."

Part of the problem is that on the one hand, an effective project to alter the orbit of a potential impactor will take a lot of lead time needed to learn as much as possible about an object so that we can design the most effective means of altering its orbit. But an object which allows us that much lead time, will also make it more difficult to marshall the political and financial support to do something about it.

Most nations will have their hands full with competing urgencies, budget and resource-wise, and may be reluctant to divert resources into anything so "iffy."

"There are a million geopolitical questions that are really, really, really tough," said Rusty Schweickart, co-founder and chairman emeritus of the B612 Foundation, a nonprofit organization dedicated to helping protect Earth from asteroid strikes.



http://i.space.com/images/i/000/017/528/i02/**asteroid-census-wise-edge-on**.jpg

A cosmic shooting gallery: the image above is an approximation of the distribution of "PHA"'s - **P**otentially **H**azardous **A**steroids that could come nervously close to Earth at one time or another.

"While astronomers have spotted 95 percent of the 980 near-Earth asteroids at least 0.6 miles (1 km) wide, which might end civilization if they hit us, many smaller but still hazardous space rocks remain undetected."

These asteroids may have been in their current orbits for billions of years without hitting us.

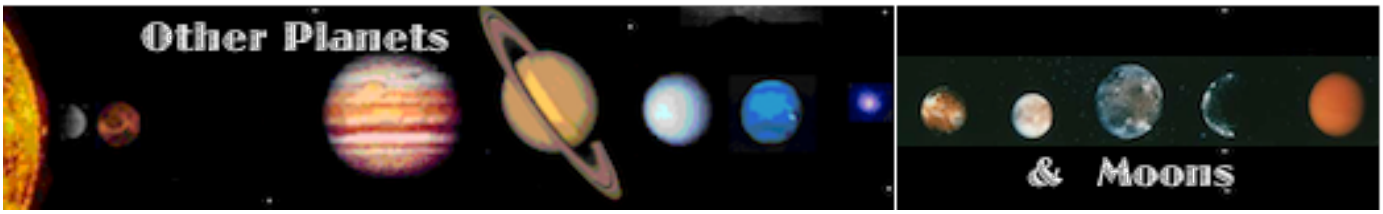
We have discovered "less than 30 percent of the close-flying 330-foot-wide (100 m) objects, for example, which could destroy an area the size of a state if they hit us. And they've mapped out the orbits of less than 1 percent of the 130-footers thought to be out there, which could wipe out a city."

"In all, just 9,700 near-Earth asteroids have been catalogued to date, out of a population numbering in the millions."

- We need more resources put toward asteroid detection.
- We also need more money spent developing a stable of asteroid orbit modification methods: one method does not fit all situations
- These deflection means must take into consideration the great range of asteroid sizes, simple to multiple axial rotations, different physical-chemical makeups, and more.

Asteroids come in all sorts of irregular shapes and sizes and orbits and in a variety of makeups Some few may be solid, many more will be loose rubble piles, a greater challenge to steer - ED.

"We're going to solve the technology," says Schweickart, the lunar module pilot on NASA's Apollo 9 mission in 1969. "But to get a geopolitical decision made in a timely way, and not just debate all the way down until it's too late to act, is going to be a real challenge." ###

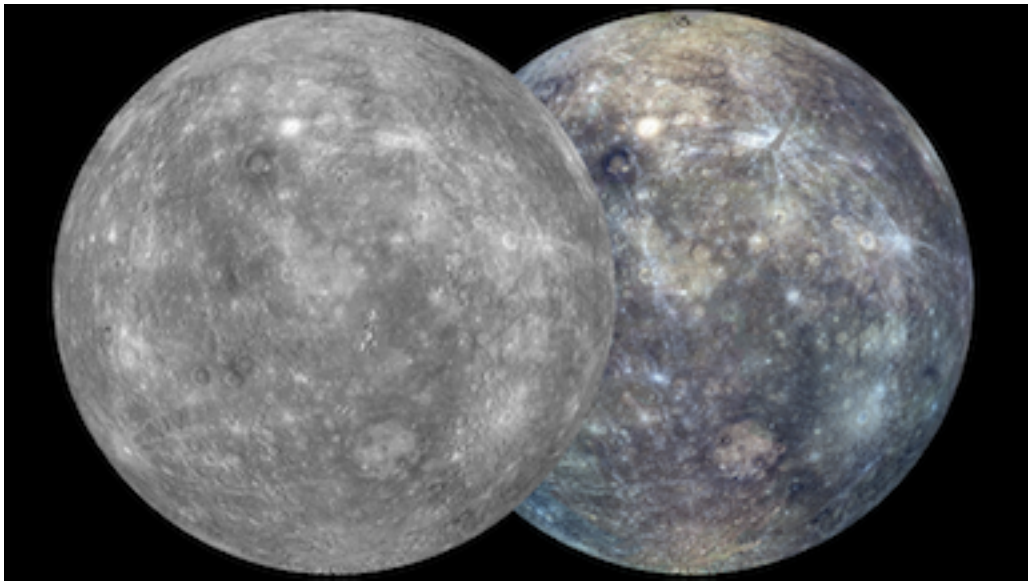


MERCURY

Messenger Completes Map of planet Mercury

http://www.space.com/20086-**mercury-map-nasa-messenger**.html

"**Messenger**": **ME**rcury **S**urface, **S**pace **EN**vironment, **GE**ochemistry, and **R**anging



The surface of the planet Mercury has been completely mapped for the first time in history, by NASA's Messenger Mercury Orbiter. In orbit around Mercury since March 2011, the probe has filled in the gaps not photographed by Mariner 10, which passed by the planet without gong into orbit. Messenger's photos are at a substantially higher resolution, as well as answering many mysteries. Messenger showed that not only had the planet experienced volcanic activity int he past, but it might have been widespread.

Video: http://www.space.com/19863-**spinning-mercury-map-from-orbiter-snaps-video**.html

Image of Overlapping Hemispheres

http://i.space.com/images/i/000/026/586/original/**mercury-glob-map-meessenger**.jpg?1361965547

Also revealed are never-before-seen types of terrain on the planet, such as surface pockmarks called hollows that scientists suspect are created when volatile materials sublimate off the surface.

"Unstable material is exposed to the temperatures and space environment, and slowly over thousands, maybe millions, of years, it's lost to Mercury's atmosphere and to space, to create a depression or hollow in an area where there are often many such hollows that etch the terrain," says the report.

Extensive lava flows, similar to the Moon's maria, are mapped near the north pole, almost certainly riddled with lava tubes within which moderate temperatures may exist. These lava flows are close to the North Pole which, like the Moon, have craters, whose bottoms never experience sunlight and are now known to possess water ice and other comet-derived ices. Mercury's temperature varies from a low of -170°C (-270°F) in these polar craters, to 450° C (840°F) near the equator

Messenger's primary mission through March 2012 was extended until March 2013 and may be extended for two more years, until the spacecraft runs out of fuel and crashes into Mercury's surface.

Further Reading:

http://www.space.com/11002-**enduring-mercury-mysteries**.html

http://www.space.com/11102-**mercury-nasa-messenger-mission-infographic**.html

Mercury Once Covered in Magma, Study Suggests

http://www.space.com/19911-**mercury-volcanic-magma-messenger.**html

Experiments in a lab at MIT suggest Mercury's puzzling surface makeup is most likely explained by a huge ocean of magma that existed shortly after the planet formed about 4.5 billion years ago. The crust is estimated to be more than 4 billion years old, so the magma ocean is a really ancient feature.

Messenger's X-ray spectrometer identified the two rock types in the planet's surface. Mixing them together in the right proportions produces a synthetic copy of what's on the surface of Mercury. The likely scenario is that an early ocean of magma created two layers of crystals, which eventually solidified and then re-melted into magma that was spread onto the surface of Mercury through volcanic eruptions. ###

Scientists hope to extend Messenger Mission to Mercury

http://www.space.com/20140-**mercury-mission-messenger-spacecraft**.html

11 March, 2013. Researchers have petitioned NASA for a two-year mission extension on the Messenger orbiter, which has already spent two years studying Mercury. As of now, the mission would end March 17. The request is for two more years, and it would end when it runs out of propellant and eventually impacts the surface, having slowly lost altitude after about another year. If the probe's instruments remain operating, these closer approaches provide an unprecedented opportunity.

When the orbiter has descended to **25 km or less away from the planet, it will have 10 times the resolution** of its best images to date and see things never seen before. Messenger could make targeted observations of areas of interest such as the intriguing "hollows" features the probe discovered in 2011, which may have formed when volatile elements sublimated off the surface.

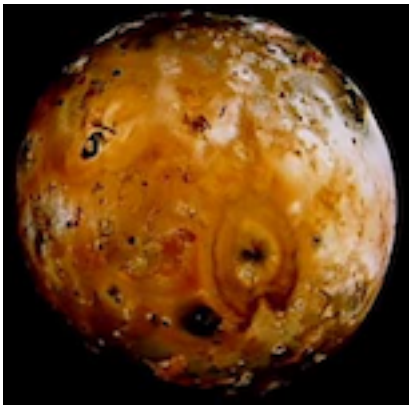
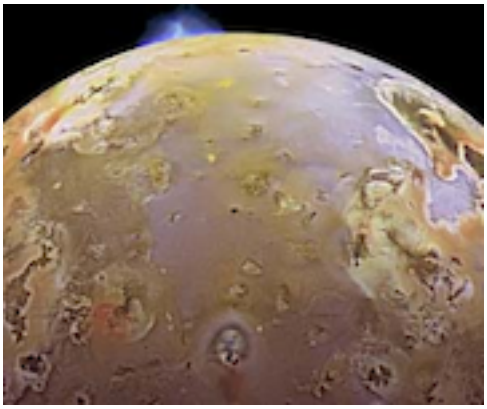
Editor: If it is just a matter of money, it would be a crime not to approve this extension. Sending another probe at some later date would cost immeasurably more. ###

JUPITER: IO

Io's Volcanoes are not concentrated where they're "supposed to be"

http://www.space.com/20528-**jupiter-moon-io-volcanoes-location**.html

There are hundreds of volcanoes on Jupiter's moon Io and they are not where theory says they should be. Most of Io's active volcanoes are concentrated 30° to 60° farther east than our models of the moon's internal heat profile predict, according to a recent study. Evidently, Jupiter's closest major moon is even more mysterious than we had previously thought.

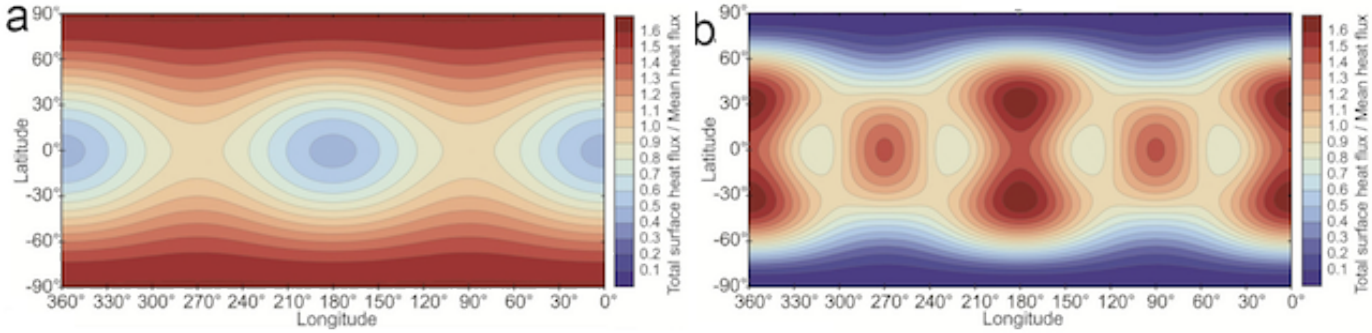
Left: a moon pockmarked by volcanoes and lava flows **Right:** an eruption plume (top) caught in the act Io, slightly larger than the Moon, is by far the most volcanically active body in the Solar System

"The unexpected eastward offset of the volcano locations is a clue that something is missing in our understanding of Io," study lead author Christopher Hamilton, of the University of Maryland, said in a statement. "In a way, that's our most important result. Our understanding of tidal heat production and its relationship to surface volcanism is incomplete."

Io is the most volcanic body in the solar system, 25 times as volcanically active as Earth. Some of its volcanoes spew plumes of sulfur and other debris 400 km above the surface, and we have observed many such eruptions from Earth, as they happen.

Video: http://www.space.com/20525-jupiter-moon-s-volcanic-plume-seen-by-spacecraft-video.html

The source of this eruptive energy is gravitational tidal heading of Io's interior by Jupiter. Io is about the same distance from Jupiter as the Moon is from Earth, but Jupiter is a 318 times more massive than Earth. A comparatively minimal disturbance comes from its sister moons, Europa and Ganymede..

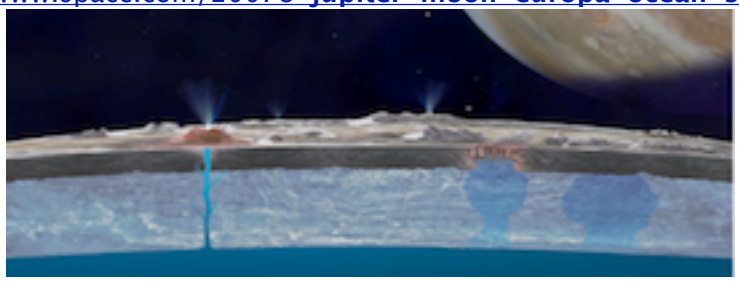


Above are maps of the predicted heat flow at the surface of Io from different tidal heating models. **Red** areas are where more heat is expected at the surface **blue** areas are where less heat is expected. **Left: Figure A** shows the expected distribution of heat on Io's surface if tidal heating occurred primarily within the deep mantle. **Right: Figure B** is the surface heat flow pattern expected if heating occurs primarily within the asthenosphere.CREDIT: NASA/Christopher Hamilton ## www.space.com/images/i/000/027/763/original/jupiter-moon-io-volcanic-heat-map.JPG?1365159091

JUPITER: EUROPA

On Jupiter's Moon Europa, Underground Ocean Bubbles Up to Surface

http://www.space.com/20078-**jupiter-moon-europa-ocean-surface.**html



Video: www.space.com/17820-europa-jupiter-s-icy-moon-and-its-underground-ocean-video.html

New evidence indicates that chloride salts bubble up from the icy moon's global liquid ocean and reach the frozen surface where they are bombarded with sulfur from volcanoes on Jupiter's moon Io. Thus we may not have to drill several kilometers through Europa's ice shell to learn about the chemistry of the ocean below, with many times as much water as all of Earth's oceans combined.

The chemical evidence was found by investigators at NASA's Jet Propulsion Laboratory, who scrutinized Europa's surface with Hawaii's Keck II Telescope. "We now have evidence that Europa's ocean is not isolated — that the ocean and the surface talk to each other and exchange chemicals." These surface clues open a window into an environment that may be capable of supporting life as we know it.

It had been thought that we would have to drill through several kilometers of hard ice to find such evidence, a considerable engineering feat, not something easily done in the near future. Yet this evidence is sure to tease scientists and exo-biologists even more, and instead of shelving such a drilling project, it is likely to put such a project higher up on the priority list. ###

Could hydrogen peroxide on Europa's surface feed life in Ocean below ice?

http://phys.org/news/2013-04-**chemistry-life-europa.html** - see image p. 61, below

"Life as we know it needs liquid water, elements like carbon, nitrogen, phosphorus and sulfur, and it needs some form of chemical or light energy to get the business of life done.Europa has the liquid water and elements, and we think that compounds like peroxide might be an important part of the energy requirement. Oxidants like peroxide on Earth was critical to the rise of complex, multicellular life."
Note: Some researchers feel the opposite is true, that surface acids could prevent life in the ocean: http://phys.org/news/2012-03-acidic-europa-chances-life.html

Ambitious Mission to Jupiter's Icy Moons Gets Science Instruments

http://www.space.com/19925-**jupiter-moons-spacecraft-instruments-selection**.html
VIDEO: http://www.space.com/18400-**jupiter-s-moons-some-icy-some-volcanic-and-some-larger-than-our-moon-video.html**

The **European Space Agency** has picked **11 instruments** for the planned **JU**piter **IC**y moons **E**xplorer, or **JUICE** spacecraft. The mission is expected to reach Jupiter in 2030 and spend at least three years studying three of the four gas giant's major moons: **Europa**, **Callisto**, and end up orbiting **Ganymede**, the largest moon in our solar system, to study its surface and internal structure. Ganymededis also the only known moon in the solar system with its own magnetic field **Ganymede**. These three Jovian satellites are thought to have vast oceans beneath their icy outer crust.

The approved instruments include cameras, spectrometers, a laser altimeter and an ice-penetrating radar, as well as a magnetometer, plasma and particle monitors, and radio science hardware. Teams from 15 European countries and the United States and Japan will develop the tools.

These instruments address all of the mission's science goals: in-situ measurements of Jupiter's vast magnetic field and plasma environment; and remote observations of the surfaces and interiors of the three icy moons. ###

JUPITER: GANYMEDE

International Ganymede Lander Workshop Advances Jupiter System Exploration

Source: http://**glcw**2013.cosmos.ru

International Colloquium and Workshop**: "Ganymede Lander: scientific goals and experiments,"** Space Research Institute (IKI), Moscow, Russia, **4-8 March 2013** - http://**glcw**2013.cosmos.ru
The main topics of the Colloquium/Workshop were:

- Current knowledge about Ganymede (interior, surface and exosphere). Results from previous missions (Pioneers, Voyagers, Galileo, New Horizons) and Earth-based observations;
- Ganymede or Europa? Astrobiology vision of Ganymede;
- The Lander project including radiation protection issues;
- Scientific payload for Ganymede Lander: scientific goals, scientific requirements, resources needed, technical aspects. Applicability of instrument proposed for Europa to Ganymede;
- Synergy with JUICE mission spacecraft. Orbital constraints, radio relaying options;
- Landing site selection priorities.

SATURN: TITAN

Cassini continues search for Subsurface oceans on Titan

http://saturn.jpl.nasa.gov/mission/flybys/titan20130217/

On Feb. 17, 2013, the Cassini spacecraft performed a **gravity-measuring flyby** of Titan, one of only four in the entire Solstice mission. During the Solstice mission, a main science objective was **to measure Titan's gravitational field in order to confirm or deny the presence of an underground ocean**.

Additional radio science (RSS) gravity observations are needed both to answer this question and to help determine if Titan's crust is thick and rigid, or thin.

Titan is emerging as the most intriguing moon in the Solar System.

See **Map of Titan's mountains:**

http://saturn.jpl.nasa.gov/multimedia/images/moons/images/IMG004702-br500.jpg

STARBOUND TELESCOPES

World's Largest Ground-Based Telescope Array Opens in Chile Soon

http://www.space.com/12477-world-highest-newest-radio-telescope-ready.html



http://www.space.com/19098-**alma-telescope-array-photos**.html

To date, the largest ground-based astronomy project in the world, an array of 66 radio dishes in Northern Chile's high Atacama desert, officially opened for business with a cosmic debut on March 13th. The Atacama Large Millimeter/submillimeter Array (ALMA) is a $1.3 billion international collaboration.

Alma will provide unprecedented views of distant galaxies formed shortly after the Big Bang, and will examine clouds of gas and dust where new planets are even now being formed around distant stars.

ALMA is a hundred times more powerful than any similar millimeter telescope. It will be able to see “extremely distant objects that are speeding so quickly away from us that their light has been stretched into this range of the electromagnetic spectrum. To get the crispest pictures possible, the observatory has been built high on a mountain more than 5,000 meters (16,500 ft) in elevation, above much of Earth's image-blurring atmosphere, which. At this height, employees who work for long at the site have to breathe supplemental oxygen to make up for the scarcity of oxygen in the air there.

Because this project in an international collaboration, it's much grander than any individual region could have achieved. The scientific need drove Europe, Japan and the United States in the same direction. With its superior power, ALMA will allow astronomers to image the disks of gas and dust orbiting young stars where planets may be in the process of forming and detect planets roughly the size of Earth, and glimpse distant objects that are too faint for most telescopes to see, such as some of the first galaxies that formed, which existed just millions of years after the birth of the universe roughly 13.7 billion years ago.

http://www.space.com/13146-**alma-radio-telescope-1st-image**-released.html

http://www.space.com/20130-**alma-telescope-cool-facts**.html

Full Size: http://i.space.com/images/i/000/012/452**8**/original/SP_111003_alma_first.jpg?1317412974

ALMA Array able to see Birth of Planets around other Stars

http://www.space.com/20170-**giant-radio-telescope-alma-exoplanets**.html

The ALMAl radio telescope array in Chile's Atacama Desert will be able to peek through "the dusty veil obscuring planet birth." Additonal antennas - and hence greater resolution - have been and are being added over the past two years. ALMA, the Atacama Large Millimeter/submillimeter Array, officially opens for business in mid-March 2013. It is already producing breakthrough science on alien worlds.

- Protoplanetary dust circling a brown dwarf "failed" star. ALMA
- Measuring planets orbiting the star Fomalhaut "smaller than previously thought"

When all 66 ALMA antennas are ready, astronomers expect a bonanza of discovery. Submillimeter waves — shorter than radio waves, but longer than visible light — will reveal the cold dust surrounding young stars, and let us watch the process of planets come together. Scientists expect to detect young planets as small as the Earth's mass

"ALMA already has seen dust rings around stars that are very narrow, and by modeling ... you can infer the dust ring has planets inside and outside the ring" said James Ulvestad, director of the National Science Foundation's astronomical sciences division

"Even though you can't see the planet, you can see the effects of the planet. That would be the predominant way that ALMA will study extrasolar planets."

Star birth obscured

Telescopes usually track down exoplanets through two methods:

- Gravitational wobbles a star experiences as planets whip around it
- changes in brightness when a planet passes directly in front of its host star.

The Kepler space telescope alone listed 2,740 candidates as of January. At first we were finding Jupiter-size exoplanets, but with experience we've now seen planets as small as the Moon. But we still do not have an understanding of the early stages of planet formation. Our solar system began as a spinning disk of dust and gas - the solar nebula. As particles clumped, grew and crashed into other the planets formed.

"A young star system full of dust is practically impenetrable to visual or optical telescopes. That's the area where ALMA can really shine." European Southern Observatory (ESO), which hosts the ALMA array.

What we expect to emerge is an understanding of "the early processes of converting cold gas clouds into protostars, and then watch planets forming in the disc surrounding the baby stars.

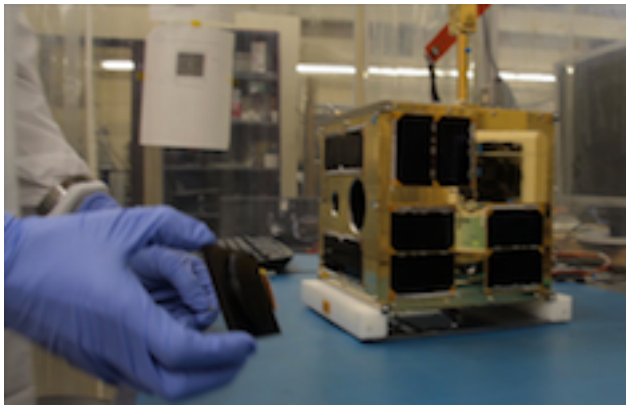
A mountain view

The ALMA array is being erected on a plateau some 5,000 meters (16,500 feet) above sea level, far above most of Earth's obscuring atmosphere and water vapor. The astronomers themselves work from a facility 16 kilometers (9.9 miles) down the mountain at 2,900 meters (9,500 feet) altitude, in ALMA's facility. Some 50 of the planned 66 of receivers are in place.

A supercomputer combined the signals from the individual antennae to snag astronomical signals from the sky individually, then combine their results for precise information: stereo, if you will, about on a universe-size scale. ALMA will also \hydrogen and other life-building blocks in gas clouds and its data will reveal how galaxies evolve. ##

World's Smallest Space Telescopes Launched

http://www.space.com/19927-**worlds-smallest-space-telescopes-brite**.html



Full size: http://i.space.com/images/i/000/026/501/original/BRITE-satellite.jpg?1361572968

Monday Feb 25, 2013

Two tiny satellites billed as the world's smallest space telescopes have been launched into orbit on a mission to study the brightest stars in the night sky.The **Bright Target Explorer** (**BRITE** and **UniBRIGHT**) nanosatellites look like little cubes and blasted off atop an Indian Polar Satellite Launch Vehicle (PSLV) from the Satish Dhawan Space Centre in Sriharikota, India. They shared the ride with five other satellites.

Previously, nanosatellites have launched into space mainly to study Earth or test new spaceflight technologies The BRITE satellites will be the first to peer into the cosmos. The tiny spacecraft are less than 20 cm (8 in) wide and weigh less than 7 kg (15.5 lbs). In orbit, they will observe the brightest stars (from Earth's perspective), including the those of well-known constellations like Orion.

“BRITE is expected to demonstrate that nanosatellites are now capable of performance that was once thought impossible for such small spacecraft," said Cordell Grant, manager of satellite systems for the Space Flight Laboratory at the University of Toronto Institute for Aerospace Studies (UTIAS), where the satellites were designed. One of the BRITE satellites was designed and built at the Space Flight Laboratory. The other was designed by the center, but assembled in Austria. A nanosatellite can take anywhere from six months to a few years to develop and test.

Only small telescopes could fit inside, so they won't be sending back high-resolution images of the cosmos. But they will be able to observe and record changes in a star's brightness over time, observations that could help scientists find spots on the star, an orbiting planet or secondary star, or even "starquakes" caused by oscillations events within the star itself.

The orbit they are put in will not matter. They can monitor their target stars from any position. above the atmosphere to avoid the twinkling effect that overwhelms the relatively small changes in a stars brightness.

The two BRITE satellites are the first wave of a planned constellation of six space telescopes to study the brightest stars in the night sky. In all, the six-spacecraft constellation will include two Austrian nanosatellites, a pair from Poland and a pair provided by Canada. These small satellites can be built faster and at a lower cost than their larger counterparts, and launched as piggyback payloads on rockets carrying larger spacecraft. ###

SEARCH FOR EXO-PLANETS & LIFE

Extraterrestrial Life May be Common Around Binary Stars

http://www.space.com/19962-habitable-planets-binary-stars.html

Planets in binary star systems deal with the gravitational and illumination levels of more than one star. But new research reveals that “close binaries” could serve as single suns in hosting habitable planets.

Low-mass twins could make the best hosts, because their combined energy extends the habitable region farther away than would exist around a single star. After modeling a variety of binary systems, two astronomers determined that stars 80 % as massive as the Sun, if close enough together, could allow for conditions that would be ideal for hosting habitable planets.

Llife could be more common in close binary systems than in single star systems. In this context Alpha Centauri A & B would not be a close binary as each could have its own set of inner planets.

Trade-offs

Low-mass stars are two to three times more common than stars the mass of our Sun. Their sheer numbers may give them greater odds of having planets. (The brighter the star type, the less of them there are.) But smaller size suns emit more ultraviolet radiation early in their life and dangerous solar winds in the habitable zone. Planets must lie very close to small single stars to reap the benefits, and such planets are more prone to be tidally locked, with one face permanently turned toward its sun, and receiving the brunt of any stellar activity. In contrast, planets around close binaries may escape this tidal locking.

But when two such lower mass stars orbit each other closely, their combined energy extends the habitable region farther away and makes it larger, minimizing some of the threats faced by planets orbiting low-mass stars.

Binary stars that are widely separated, are likely to have their own planetary systems. In between are systems where each has its own “inner planets” but both share a common set of “outer planets.” Alpha Centauri AB fits this category. ###

Alien Moons Could Host Life Outside 'Habitable Edge'

http://www.space.com/**20096-exomoons-habitable-alien-life**.html

Astronomers hope that the haul of data collected by NASA's Kepler mission will contain signatures of exomoons among the nearly 3,000 possible exoplanets so far detected. The discovery of alien moons would open a new frontier in the hunt for habitable worlds outside our solar system.

Because exomoons orbit a larger planetary body, they have an additional set of constraints on potential livability than the exoplanets themselves, any of which can affect a moon's climate and geology:

√ eclipses by their host planet

√ reflected sunlight and heat emissions;

√ gravitationally induced tidal heating by the host planet

Compared to their host planets, exomoons have additional sources of energy that can alter their "energy budgets, which, if too high, can turn a temperate, potential paradise into a scorched wasteland. "

Big-picture problems to habitability

For exo-planets there is a circumstellar "**habitable zone**," the temperature band around a star within which surface water neither boils off nor freezes — not too hot, not too cold: "the Goldilocks zone."

For exo-moons, the "**habitable edge**" is rather different: the innermost circumplanetary orbit in which an exomoon will not undergo what is known as a runaway greenhouse affect, with its climate warming up inexorably due to positive feedback loops. Habitable moons orbit their planets outside of the habitable edge.

Typically, stellar illumination is by far the greatest source of energy on a moon in a wide planetary orbit. But if a satellite orbits its host planet very closely, then the planet's stellar reflection, its own thermal emission, eclipses and tidal heating of the moon's interior can be substantial."

A planet can get a little extra energy from its moon(s) as moonlight, reflected light from its sun. But moons get much more sunlight from their planets. "Planetshine" can add a not-insubstantial amount of energy to an exomoon's overall intake.

Interestingly, because most moons (including ours) are tidally locked to their planet — that is, one side of the moon constantly faces the planet — eclipses, as well as planetshine, would only darken and lighten one hemisphere. This phenomenon could modify the climate, inducing wind and temperature patterns as well as the behavior of life forms, in ways not seen on Earth. ###

Earth-like Planets May be Right Next Door

http://www.cfa.harvard.edu/news/2013/pr201305.html

http://www.cfa.harvard.edu/news/2013/pr201305_images.html

Editor's Comments:

√ Yes, Red Dwarf stars are the most numerous type.

√ Yes, Red Dwarf stars can have planets.

√ Yes, the closest Red Dwarf star with an "Earthlike" planet could be just 13 light-years away.

The trouble with planets in the habitable zone of a red dwarf star, is

- not only the challenge of dealing with radioactively lethal solar super flares,
- but that the planet is so close to its sun that it will become tidally locked, one side in permanent sunlight, the other in permanent darkness. Any water on the hot side would quickly vaporize and then condense on the dark side, quickly transformed into cryo-cold diamond-hard ice. Hardly what we would cal an "Earth-like" planet. Now we can conceive of an ingenious "plan" to put a base on such a world, but the idea of life originating there would seem to be a non-starter. Readers are welcome to prove me wrong.

For how settlers from afar might engineer a precariously safe outpost on such a planet, read "**Proxima Centauri**" from MMM #44 in the Starbound Theme collection: (free download pdf file)

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

SETI finds no messages from ExoPlanets

http://www.space.com/19703-**intelligent-alien-life-exoplanets-seti**.html

Alien life is likely to be relatively rare throughout our Milky Way galaxy, with fewer than one in a million solar systems harboring civilizations advanced enough to send out radio signals, a new study reports.

Editor's comments: DUH!

Do we know how long civilizations last in that phase of their history in which they are capable of sending signals? This could vary from case to case from "momentary" to "eons." Currently, because those in power are motivated by short-lived profits, we are letting our own biosphere decay at an accelerating rate.

With only one worrisome example, we do not know what percentage of civilizations destroy themselves before they get to that stage, or shortly thereafter.

Are we taking into consideration that the equipment and power needed to listen is relatively small, while the equipment and power needed to broadcast in all directions for eons on end is expensive beyond all measure? Duh! Everybody is listening, no one is sending, except, perhaps, messianic civilizations! It makes economic sense to listen but not to send, and in that sense both sending and listening makes little sense. Why bother to listen when it is likely that nobody is sending except those to whom we would do well not to listen.

"It is likely that nobody is sending except those to whom we would do well not to listen."

ON THE OTHER HAND, there will be "signals" automatically sent at no cost that should be observable, as, quite the opposite, it would cost to block them: **detection of compounds in an atmosphere that can only come from industrial processes, should be possible at least from nearby (definition?) contemporary civilizations.**

Thus we could detect other civilizations while receiving no message or information other than that they are in an early stage of civilization. Radio signals in narrow, focused bands are a possible indication of intelligent life, given that humans generate such signals here on Earth.

But there could still be millions of civilizations out there waiting to be found, the scientists added, since billions of Earth-like planets are thought to populate the Milky Way.

AND THERE ARE COUNTLESS BILLIONS OF GALAXIES! ###

RELEVANT LINKS

Past MMM Articles

http://www.moonsociety.org/publications/mmm_themes/mmmt_**starbound**.pdf

Exo-Planets

http://www.space.com/19610-**exomoons-alien-planets-photography**.html
http://www.space.com/19421-**backward-alien-planet-orbit-discovery**.html
http://www.moonsociety.org/publications/mmm_themes/mmmt_**starbound**.pdf

James Webb Space Telescope

http://www.space.com/19438-**james-webb-space-telescope-construction**.html
http://www.space.com/19441-**james-webb-space-telescope-photo-tour.**html

Most exo-planets will be found in the plane of our galaxy: The Milky Way

Planck Space Probe Data Pushes Back Date Of Big Bang 80 million years earlier

www.huffingtonpost.com/2013/03/21/**universe-age-planck-space-probe-date-big-bang**_n_2922818.html

"ESA's Planck space probe looked back at the afterglow of the Big Bang, and those results have now added about 80 million years to the universe's age, putting it at 13.81 billion years old.""

"The probe, named for the German physicist Max Planck, the originator of quantum physics, also found that the cosmos is expanding a bit slower than originally thought, has a little less of that mysterious dark energy than astronomers had figured and has a tad more normal matter. But scientists say those are small changes in calculations about the universe, whose numbers are so massive."

"The Planck space telescope, launched in 2009, has spent 15 1/2 months mapping the sky, examining so-called "light" fossils and sound echoes from the Big Bang by looking at background radiation in the cosmos. The spacecraft is expected to keep transmitting data until late 2013, when it runs out of cooling fluid." For more, read the article. ###

Moon Miners' Manifesto India Quarterly Editors

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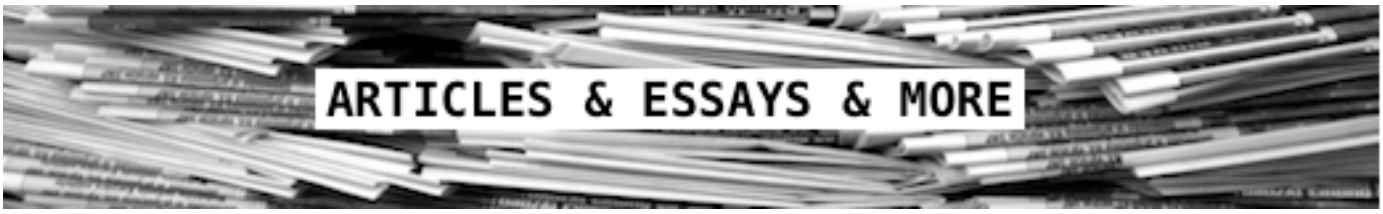
We welcome additional co-Editors, Contributors, and reporters from various nations and student groups



Three views of the "Inspiration Mars" Mission Proposal

First, read the Report on pp. 16-17 in the Mars/Asteroids News Section

"Inspiration Mars:" All Aboard for Mars Now! A Good Idea or Not? First, a Skeptical View

By David Dunlop - February 26, 2013

Trumpets and Flourishes

A Dennis Tito press Conference was held in late February to announce a Human Expedition to Loop Mars leaving in 2018. To some this may seem like the boldest human excursion yet devised, an audacious extension of the human impulse to explore! Grand Vision in the great traditions of the Great Explorers! To me however it sounds at best like the script of the a film in the great tradition of Alfred Hitchcock thrillers. At worst such a flight must confront substantial technical risks to the crew from ambient radiation during an extended flight of over 500 days and demonstration of the same extended capacity for life support and the uncertainties of human interaction in an extremely confined environment of long duration. An expedition that could surmount such difficulties however would be a significant demonstration of an increase in the state of the art.

This seems as much a great gamble with the lives of those that wish to think of themselves and self select themselves as intrepid explorers but who may just as likely wind up having a bad and inglorious ending and in fact achieving very little. The history of exploration is replete with stories of failure and death as well. Those who are willing to gamble with their lives are often a breed apart. But such self apportioned glory begs the skeptics to ask a few questions about whether this actually makes much sense or is even a credible idea.

Mars is the Next Antarctica

Mars is much like Antarctica was at the beginning of the 1900s. A cold forbidding continent and a place mostly unknown to human presence, extremely difficult to get to and literally at the end of the Earth. There was a forbidding glamor to know and "master" this environment by getting to the South Pole itself and crossing the extensive and high plain of interior ice. Scott tried and died on the heels of Roald Amundsen's success.

For about the last twenty years Bob Zubrin has appropriated this Antarctic Romance epic pushing this historical comparison with his Mars Direct book and maintaining this mystique of Manifest Destiny with the Mars Society, and the analog operations of that Society at the Mars Desert Research Station near Hanksville Utah and also on Devon Island, Canada. The latter is close by to the Haughton-Mars analog site on Devon Island operated by the Canadian Space Agency and NASA.

There are some so intrigued by The Challenge of Mars that they would boldly proclaim a "One way to Mars endeavor. There are also some who would gladly send them. I would ask why is that a good idea? What is served by this? Most certainly self aggrandizement with a little bit of science leavening the thin cold gruel that they would serve up to the more timid remainder of humanity. Thank God **we** will be alive to polish their statues! I would suggest that such egoism is largely silly and not worthy of our taxes but perhaps worthy of our entertainment dollars for those willing to witness the risks of a space reality show. I think much the same of an Expedition to Loop the Red Planet because the risk of the crew is not worth the stunt.

If I sneer at this sort of stuff I do it intentionally because I think it is largely shallow and disrespectful of the true challenges of Mars Exploration: the safe and routine transit from the Earth to Mars and access to Mars orbit, Mars' Moons, and Mars surface . I think that our experience of Antarctic Exploration is a more realistic picture of how Mars Exploration is likely to proceed, evolve, and succeed. Mars will no doubt become the province of human physical presence . It should not be done in the manner of the Apollo expeditions (which were there mostly for a footprints and flags demonstration (The political purposes overshadowed the scientific bonanza of the 382 kg of lunar rocks collected) and which were the most audacious "camping trips of humanity" into the cosmos to that date. They did not demonstrate however a capacity to stay through political will, or with a model of sustainable economics.

The first lesson of "the quest to open Mars" analog story of the Antarctic is that this enterprise is mostly the stuff of the persistent work of a century! By contrast The Moon Race of the Cold War was a sprint spanning roughly a decade or two of efforts to push the boundaries of what could be done with large rockets. The drama of the Apollo 11 triumph has its darker companion drama of Apollo 13, a harrowing and successful escape from disaster. The success of Amundsen in obtaining the South Pole, also has its own analog of Apollo 13, the harrowing and successful escape from disaster of the Ernest Shackleton expedition, a story that stretches the capacity of human ingenuity and endurance to the extreme.

Why Not Alfred Hitchcock's Best

The Tito Expedition might just well become the Mars companion piece to Apollo 13 or worse. What would Alfred Hitchcock do? Let's try to imagine for a minute or two?

Act I: Might he send out a heroic duo on a five hundred some day journey to if not exactly Plant the Flag of Humanity on Mars at least to Wave the Flag of Humanity at Mars while these two both wave and stick their tongues out at Mars , The God of War?

Act II: How will the gods respond to this human insolence?

A: Will there be technical failures perhaps induced by a computer virus on their Microsoft software (version 12.0) by random galactic cosmic rays? (If only they had used Linux and gone Open Source)

B: Will the Sun launch the "lightening bolt" of a coronal mass ejection toward our dynamic duo and make theirs a fatal journey and die en route back on a ship on a Buzz Aldrin cycling orbit that will remain an orbiting tomb? (Think: 2018 A Mars Odyssey!)

C: Will a navigational error plunge them into an unexpected surface impact on Phobos or Deimos? (So close but yet so far!)

D: Will they tire of each other to the extent that the story becomes a sordid Who's Afraid of Virginia Wolf with a murder suicide Greek tragedy of "Mars crossed lovers"? (An adult rating for this one)

E: Will they become slowly poisoned by the lead in canned food and water supplies they take? and die as they pass overhead of the Face on Mars? Oh, sorry, (that one was stolen from the lost British expedition to the Canadian arctic to search for the Northwest passage lead by John Franklin) and that could never happen with NASA's freeze dried ingenuity right?)

F: Will they instead die from culinary boredom as a result of the cosmic misadventure the "Mars Kitchen" cooking show?

G: Will they return, reentering the Earth's atmosphere successful against all odds, only to be shot in the end by a jealous former boyfriend of the heroine(played masterfully by Joaquin Phoenix?)

A cameo appearance by Alfred Hitchcock in mission control might of course be possible by High Definition CGI or failing that by a cameo by a reluctant X-Corps President Jeff Greason, pushed into an unexpected acting career.

Wait a minute! If these movies are **really** successful they could launch a whole movie series: Mars Treks! James Cameron! Please phone home. Bob Zubrin and Dennis Tito are calling!

The Success of the Great Arc of Mars Exploration

The Grand Exploration Enterprise of the Solar System has been the glory of NASA's Science Mission Directorate which has not neglected Mars. NASA has scored a stunning series of successes over almost five decades with Mars flybys, then orbiters and then landers and rovers:

Mariners 4 (1965) , 6 (1969) , 7 (1969) Flybys
Mariner 9 (1971) Orbiter
Mars Global Surveyor (1997) Orbiter
Mars Odyssey (2001) Orbiter
Mars Viking I (1976) & Viking II (1976) Landers
Mars Pathfinder (1997) Rover
MER (Mars Exploration Rovers) Spirit & Opportunity (2004)
Mars Reconnaissance Orbiter (2006) Orbiter
Phoenix (2008) Lander
MSL Curiosity (2012) Rover

NASA has replaced the hero with the "heroic robot! Perhaps this demonstrates that there is no need for the colorful and unnecessary human deaths (that's what makes them tragic after all) that a "Hitchcock movie provides.

Other Mars Analog Models: ISS The First Permanent Human Outpost

We have looked to the Antarctic for parallels to "The Saga of Mars Exploration." But we can also look overhead to the International Space Station. This effort has taken over thirty years to propose, sell politically, design and redesign, and then build over a decade of effort with a shuttle failure thrown into the mix.

This cost over $115 Billion dollars and has resulted in six permanent positions as the first continuously occupied human outpost above the planet. There is talk of this station's obsolescence via the implication that NASA's commitment it extends to only 2020. That is unlikely for political reasons after so much political capital has been expended in its creation. Some put Humans on Mars by the 2030's. Don't hold your breath! I'm guessing that's at least twenty years too soon.

The Earth Moon Lagrange Gateway as a Mars Stepping Stone

An Earth Moon Lagrange Gateway station is also now being considered. The economic difficulties of the present may make this a difficult sell to the ISS partner nations as the Europeans, Japanese, US, and Canadian publics face cutbacks. But it might also serve the purposes of Keynesian economic stimulus to the aerospace sectors of these countries. This E-M Lagrange Gateway could serve as a point from which the lunar surface could be further explored by human telepresence. It could also serve as the forward base for renewed human sortie missions to further lunar exploration goals while providing a potential for rescue of stranded crews or for an "abort to orbit" option for early lunar surface expeditions. It may serve as the test bed for radiation protection technologies and as a demonstration of extended life support technologies. It can also serve as a point for the development of the first use of in situ resources from the lunar surface by providing rocket fuel and the life support of water and oxygen. It could also help to establish lunar surface science and engineering sites for materials and biological sciences in 1/6 G. Tourists will no doubt follow in time.

We will learn if the Moon can be a destination for human settlement with the biology that has evolved on a 1 G Earth. There seems little doubt that microorganisms should make this transition but human gestation and physiological development is an open question. This is a project at least the political and economic equal of the ISS but perhaps if more partners are recruited and launch costs are lowered it may also take some years less to pull off this one. The Earth Moon Gateway is also a demonstration of that model applied to Mars exploration and settlement.

Asteroid Opportunities

This E-M Lagrange Gateway might also serve as a market destination for the first use of asteroids brought back into cislunar space. It might serve the similar objectives of providing refueling for missions from the the Gateway to the lunar surface, to rockets leaving the Earth-Moon system, and with some time to develop the massive fuel and material requirements to build large solar power satellites in GEO.

Developing a Mars Gateway Infrastructure

How is all this relevant to the Mars saga? The Earth-Moon Gateway could demonstrate all the engineering requirements to replicate this strategy in Mars orbit where two asteroids are already present and where a Mars Gateway station would similarly enable a sustained human presence first above the Mars surface, then human robotic telepresence, then human sorties, Mars ISRU for fuel production, and finally a sustained human presence on the Mars surface itself. Human settlement on a 0.4G Mars seems as a speculative conjecture a bit more likely even if humans might be far less robust in this adaptation to a weaker field of gravity. If we are successful with an Earth Moon Gateway as a Next Big Thing space enterprise we will have some of the building blocks needed for Mars already in place.

Lets not kid ourselves or especially the young generation of Mars enthusiasts and advocates. High risk human dashes to Mars are deserving of scorn for they are unlikely to really accomplish much. They might actually do great harm for the long run. We in the community of advocacy for a permanent human return to the Moon should know. The Saga of the Moon does not sell well today. "Been there and done that" critics say so smugly, ignorantly, and superficially. The Footprints and Flags Apollo Missions have frustrated two generations of advocates of lunar return. They range from those of the planetary science community who have spent two decades beginning to unwrap the mysteries contained in the lunar samples to those such as the National Space Society and Moon Society with a longer term vision of lunar economic development and human settlement.

If Dennis Tito somehow pulls off this unlikely Mars Loop stunt, critics could similarly say "Been there and done that!" It might destroy the mystique of "The Red Planet as a Second Home Planet to Humanity" with an natural attraction at once more distant and difficult than Earth's companion Moon. That reason is an alluring, persuasive argument for a necessary safe haven to humanity and all its co-dependent terrestrial species. This is not a trivial endeavor or argument. It is the substantive work of at least the next six or seven generations.

Where's the Money?

"Let's not forget the money. Where will that come from? If one is an optimist one can forecast that somehow such activities are "inevitable", have the force of history and evolution behind them, and will sweep away the small minded skeptics that resist the march of human progress. Yet human history is also full of collapsed civilizations, of failed states and empires, and momentum lost.

For example after dispatching great exploration fleets across the Indian Ocean to Africa the Chinese withdrew from exploration activities early in the 1400s and ceded global exploration to the Western Europeans. Will the Americans and their ISS partners repeat this process in this Century. Will China pick up a fallen flag of exploration from the ISS coalition? I would like to think that India China, Korea, and upcoming countries like Brazil and South Africa can join an expanded exploration effort with the ISS nations but there is little to suggest politically that this potential is inevitable even if it is an entirely rational and logical way to enable this great human ambition.

Enabling Future Growth

The growth of the world space economy will make the burden of Mars exploration more likely because the infrastructure mentioned above will provide the foundations of those efforts. To me the most likely scenario is that the growth of the Earth Moon economy and especially the development of solar power satellites will address the acute needs for clean energy of world economy. Such things may develop around mid century.

The explosive growth of space based energy supplies may create a long boom in economic development. It is that development that will provide the economic surpluses that are needed for the Mars enterprise. These future developments are not mutually exclusive and Earth-Moon development, GEO development, and Mars exploration can to some extent occur together. Mars is the weak leg of this economic growth scenario however because there is at present no compelling economic case that would support Mars exploration on its own terms. No spices to return, no obvious stores of precious metals that would justify the exploration.

The challenges of gaining Mars as a part of humanity's heritage are not to be under-estimated. This will take time, several generations at least of sustained efforts. To think that this can be done quickly or kick-started with a stunt or two is the thinest of tissues. Those who pretend to these ambitions had best prepare themselves for the long haul. We have not yet settled Antarctica on our home planet. This is in many ways a gritty and precursor model of Mars exploration and development. We have long term bases and numerous outposts after a century of effort on our Southern-continent but no real settlement. No real human communities that sustain an economy where children are born and raised.

There is no rush or sufficient justification to leave your bones on Mars in the next few years unless perhaps you think this would increase their value on E-Bay for your heirs or unless you value your legacy in a Hitchcock style movie enough that your footnote in history would be assured. Opening Mars to human utilization, occupancy, and a sustainable terrestrial biosphere will be a long, difficult, but exciting human saga with many stages of necessary infrastructure development remaining ahead.

Steady as she goes. DD

What Might The Tito "Inspiration Mars" Loop Mission Accomplish?
A more positive outlook

By Dave Dunlop - March 2, 2013

In the Counter Point article above, I expressed skepticism about the significance, the risks, and even the wisdom of the proposed Mars Loop Mission. I will argue the opposite position in this article with my own "top ten list" or more of challenges.

One: Mars Beckons. For the US public Mars has a strong attraction. It is the Next Step, the Next Giant Leap beyond the Earth Moon system. To get to Mars in 2019, 50 years after the feat of Apollo 11 would be another audacious advance.

For much of the rest of the world the Moon landing remains an unconquered objective. The US achievement perhaps looks more towering after more than forty years as the years tick by and no one has returned humans to the surface. A recent slate of probes yes had orbited the Moon, but it is likely that fully fifty years will pass before any human from any country returns to the lunar surface. The return to the Moon however has not generated much US political support since Apollo ended but it remains a potent symbol of US leadership and one that other newly emerging space powers use as a measuring stick.

So a human mission to loop Mars provides another quantum level advance for any country or organization that can pull it off. Few other countries other than the US have even orbited Mars much less landed robots on its surface. NASA has indicated that its own projection of a human mission to Mars will not be until the 2030's.

Second: If Dennis Tito and his Inspiration Mars Foundation can pull this off it may well spur global interest and engage another generation with Mars fever.

Third: A privately developed mission proposing and achieving such a bold initiative will embarrass the national space agencies of the world's space faring nations. This embarrassment would perhaps spur them to some collective effort to capture some of the public Mars fever generated by Dennis Tito and his colleagues and reinforce their relevance to their publics. One of the greatest but also more underrated achievements of the International Space Station was forging and maintaining a partnership with countries that had been bitter rivals and enemies. A Mars coalition could further advance such collaboration building on the foundation of ISS and include India, China plus newly developing space faring countries such as Brazil, Korea, and Ukraine, and South Africa. Can Tito marshal the political capital and also demonstrate a measure of international political genius?

A Mars Loop mission may also focus interest and funding in some of the technology challenges that must be met to make routine access to Mars feasible and affordable.

Fourth: Radiation protection is a matter of grave risk to spacecraft beyond the protection of the Earth's magnetosphere and Van Allen belts. Overcoming this challenge for human crews is a significant obstacle to a routine human access to Mars and its environs.

Fifth: An extended life support system is mandatory for space craft carrying crew for voyages that are often 18 months one way or longer. Maturing this technology would open human access to Mars on the type of Mars cycling spacecraft the Buzz Aldrin has long advocated.

Sixth: An extended cryogenic storage system for rocket fuels and life supports gases can be demonstrated and that can also provide an important adjunct for radiation protection.

Seventh: With some fast work on a precursor Mars robotic mission, a demonstration of human telepresence on Mars could be demonstrated in the brief window of human close transit. This mission could also provide feedback to Earth bound audiences of what it would be like to virtually experience Mars and advance Mars exploration from orbit. This could build understanding and political support for the establishment of an orbital infrastructure at Mars. A safe forward base where humans can observe, and work via telepresence while the capability for direct surface exploration and a permanent human presence is developed and matured.

Eighth: The experience of extended Mars transit existence would provide lessons on human factors management. A successful mission will vindicate the survival margins, the process of crew selection, and the operations management aspects of this venture. A failed mission should provide insights on potential reasons for mission failure. Either way this mission may advance the state of the art.

Ninth: The very audacious nature of this adventure may prompt a careful set of science objectives that can be undertaken during the Mars transit out and back by the human crew.

Tenth: This mission might perhaps generate a bandwagon level of support for such activities by national space agencies that realize that their publics will expect them to take advantage of this privately initiated endeavor and that shared international efforts would be both a pioneering use of private and public capital. It seems at first that the capital requirements that are needed beyond the first year or two will require more resources that those available to the Inspiration Mars Foundation. This effort might stimulate a follow-up bandwagon effort in both the public and private sectors to strengthen the goals and dreams of it's participants.

Eleventh: A loop the Mars mission that flies by 2018 provides an opportunity to demonstrate the project management capability to plan, develop, and execute a mission on the fringe of feasibility in an extremely compressed five year development window. This will also require extremely skillful project and financial management that would in traditional government hands lead to expensive stretch outs of the development timetable and escalating cost spirals. Those that “want to catch this train” will have to run to do so.

Should this initiative not succeed in this narrow development window the next short Mars cycle opportunity will not occur again until after 2030. Even a organizational “dry run” will focus attention on the challenge for the next window. This is beyond the practical planning horizon for US Presidents and those of most leaders in other countries as well. This might also serve as a common focal point for a grand international political objective that the publics in the major space faring nations can embrace and expect from their leaders. Perhaps this can become the first G-20 space initiative!

Twelve: The five year development window will not permit the luxury of a $100Billion project. It will have to exploit things now at the cusp of delivery such a a full scale Bigelow 330 module, a Falcon 9 Heavy, a Dragon or CST-100 recovery capsule, a large solar power array that can provide the juice for the capsule at Mars distances from the Sun, and even the early deployment of ion propulsion systems for spacecraft pointing and maneuver.

Thirteen: this mission will have to demonstrate a practical mission architecture that designs around the single points of failures. A mission that does not compute a reasonable gamble of success and that transparently withstands public scrutiny will discredit its designers if it fails. It must not appear to reasonable people to be a suicide mission but one with a credible chance of success.

Fourteen: This mission will also have to demonstrate a public engagement strategy and a communications plan that both protects the crew and promotes public understanding and involvement, and education.

Fifteen: This is a chance for Dennis Tito to demonstrate that he is the next Werner Von Braun and that the Inspiration Mars Team can propose, inspire, plan, develop, and execute in a way not seen since the days of the Apollo team.

The most important aspect of this mission is that it sets up further advancement to Mars. It must demonstrate that its success is and was no accident. It must increase the world's appetite for a permanent human presence on Mars and the possession of a second planet as an asset for the survival of humanity and the extension and preservation of terrestrial life.

The point of this pair of Point and Counter Point articles is that the same challenge can be viewed with very different lenses. One is from the standpoint of the rational Skeptic and has a Show Me attitude. The second is one that finds way to overcome obstacles and to forge a path where others cannot see one. Those that are the true pioneers succeed not because they are unaware of the challenges but rather that they embrace the challenges and accept the risks of breaking both psychological, material and political barriers.

Making the Most of an "Inspiration Mars" Mission

By Peter Kokh

First, recklessly dangerous or not, only "Mars to Stay" can succeed, long term

This is one point on which I profoundly disagree with my colleague David Dunlop. "Mars to Stay" missions, high risk or not, are the only way to escape the "Flags & Footprints" destiny suffered by the Apollo Mission program. With each mission, even if only some of each crew elects to stay behind on Mars, the population on Mars will slowly grow, meaning more and more science and exploration will get done. Science and exploration are goals of any population, not just of explorers. Mars will be explored far more exhaustively by its settlers, than by infrequent noncommittal visitors.

That said, no human mission, especially one in which some or all crew members are determined to stay for an extended duration, should be considered until we have identified sites from which all needed raw materials (water and the major types of minerals) are easily accessible, and a site from which overland access to much of the planet is feasible. Nor should it be launched until atmosphere-mining and 3D printers have accumulated extensive stockpiles of supplies and spare parts: The "yolk sac" approach.

In any population, there are those comfortable enough where they are, to want to take chances as explorers and pioneers. But the reason we are not "all" still in sub-Saharan Africa is because in any population, there are those with talent and ability who nonetheless have difficulty advancing in a society where "all the good slots" are taken. These are the people who pioneer. Those who see "settling Mars" as too risky and liable to tragic failure, can stay at home. But they have no right to insist that others stay home, specifically, those willing to take the chance to pioneer a new frontier where life may be harder but yet more rewarding, also stay home. We are where we are because the restless and thwarted have found outlets in new frontiers.

Indeed, one major world-class city was founded by prisoners who went on to become citizens - of Sydney, Australia. Not all prisoners in for "life" would be willing to be "pardoned to Mars." But some may, boosting those who've had enough of life on Earth and are willing to take the plunge. And if the settlement effort fails? It wouldn't be the first time! The point is that there are people with the "right stuff" and no one else, not so inclined, has the right to shut the door in their face.

Where is the money? Inspiration Mars will be privately funded.

If the funds are not forthcoming from individual donors and corporations, it will not happen. This mission is not a challenge to any other government agency proposed mission. It is likely that foodstuffs and other supplies and equipment will be donated by corporations as a tremendous advertising opportunity. That this mission has a definite date by which it must lift off or wait a generation or more for an equal opportunity (orbit alignments plus low solar activity) will prod potential donors not to hesitate.

Our one big chance to inspire the current generation of young people.

The countdown has begun. If in two years, preparations are not well underway for this mission which "must fly" January 5, 2018 - in less than five years - then it won't fly at all. And that would be a major disappointment. Why? Because **this mission has the capacity to gain the attention, support, and involvement of young people** - a population now engrossed in smart phones and other electronic = distraction sink holes. If we are going to do international missions such as building an International Lunar Research Park on the Moon, and a first, second, and following human landing missions to Mars, we will need the support of young people who will soon be a significant portion of the electorate.

Yes, this is just a flyby mission. They won't be landing. Neither did Apollo 8, and that mission had a tremendous psychological effect on the public at large in December 1968. Currently, the record distance from Earth humans have ventured is only a quarter of a million miles, still within the Earth-Moon system.This mission will carry humans for the first time out into the Solar System at large, in the area of a hundred million miles, hundreds of times further.

So what can we suggest to make this 2-person swing around Mars both more captivating and more productive?

- **Messages from home** to someone elsewhere on Earth could be rerouted via the ship in flight, the price going up with the distance from home, highest just before and after the craft flied behind Mars, then lowering on the way home.
- **Your name on a list of supporters** – unlike names on disk aboard the New Horizons probe bound for Pluto, you would get your signature back, from Mars11 Now that's a souvenir!
- **Advertising from deep space**, out by Mars.
- **Experiments with the increasing time delay** in a conversation between Earth and Marscraft: at what distance does conversation become too-continuous to maintain? How far out is the "colloquipause?"
- **Launch a fireworks display into Mars atmosphere on the nightside,** hopefully visible to the crew, and by delay-telecast to people on Earth.
- Experiments with zero-g games: ping pong, others 3-D sports, and "board games?"
- Zero-g tethered dancing experiments by the couple, to a variety of music
- Display of relative apparent sizes of Earth-Moon and Mars (normal at half way point)
- Milestone ceremonies: a million miles out, 5 million, 10 million, half way, etc.
- Clock that shows time delay, apparent vs. real.
- Earth-Moon, Mars display slowly getting bigger, smaller etc.
- Questions sent, then answered, daily. Posted record thereof;
- Pets brought along from species that have adapted well to zero-g on Skylab, Mir, ISS.
- Plants brought along, that have flourished in zero-g on Mir or ISS
- Individual sleeping bags, and and a sleeping bag for two (assuming the crew is a married couple) with private reports, published summary at end of mission.
- **Send your activity or experiment suggestions to inspiration-Mars@nss.org**

PK

Other Comments on the "Inspiration Mars" Mission: Foust, Zubrin

Jeff Foust: "A Martian adventure for inspiration, not commercialization"

Last week, a new organization founded by a pioneering space tourist announced plans for a crewed Mars flyby mission to launch in 2018. Jeff Foust describes the background of the mission and the various challenges to turn this unique concept into an actual voyage. www.thespacereview.com/article/2253/1

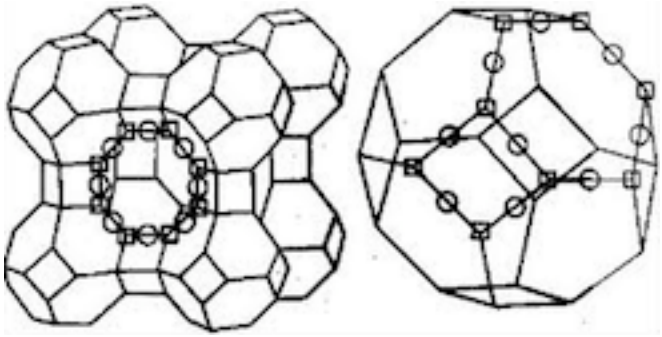
Robert Zubrin: "The idea of a minimalist Mars flyby mission has been around for some time."

In fact, I pitched one such concept, the Athena mission, directly to NASA Administrator Dan Goldin in his office in 1995, and subsequently published it widely:" **http://members.marssociety.org/TMQ/TMQ**

Researching the Potential of Zeolites for Lunar Energy Storage

By Dave Dunlop

Zeolites are microporous, aluminosilicate minerals commonly used as commercial adsorbents. http://en.wikipedia.org/wiki/Zeolite] – http://minerals.usgs.gov/minerals/pubs/commodity/zeolites/



Introduction:

With regard to the energy storage potential of these new commercial zeolites there is a difference between terrestrial applications and practical cost effectiveness and the long term potential of their use on the Moon. The heat storage potential of zeolite might have great strategic significance in the long term for the industrial development of the Moon. Clearly the potential of this zeolite system is to be **a major solution for energy storage of solar energy for use in both space heating and electrical power during the lunar night and ultimately produced from lunar materials.**

Series of research and development steps:

A. Modeling of performance differences between Thermal wadi systems based on microwave sintering of surface regolith and thermal storage and cooling process during the lunar night of a zeolite based system would be a useful first step. **The early hope is that these zeolite system could provide a major practical "solution" to the problem of energy storage and use during the lunar night.** Models of the comparative performance could provide some theoretical predictions.

Before jumping to conclusions a specific program of research and development is needed to achieve this potential "solution," which would appear to be applicable to Mars and asteroidal bodies as well.

B. Thermal vacuum chamber performance tests of both sintered simulant (regoith) versus these zeolite systems could be a second step. These tests could be compared to the theoretical models to provide a better understanding of the lunar potential.

C. Another practical result of thermal vacuum chamber tests would be a determination of the performance of the zeolites as a function of the number of cycles of energy storage and release.

D. A bench top system which could both take concentrated solar energy and heat the zeolites and a heat extraction system with addition of water would need to be developed so that the full cycle could be tested under lunar temperature and vacuum conditions.

E. The effects of gravity on this cyclic transition would be best done on the lunar surface under operational conditions.

F. Testing robotic systems that would be used on the lunar surface might be done in the the International Lunar Research Park so demonstrate how a zeolite system as an engineering element of a lunar power system might be deployed.

G. Early R & D effort on the lunar surface for system prototypes. There will be an almost universal need for such lunar day time power storage on the lunar surface for things ranging from stationary ILN stations, to rover protection and recharge, and for later human sortie and extended base operations. A number of deployments of these zeolite systems should be done in order establish their performance under lunar surface conditions.

H. Engineering various design packages to protect:

1 Small mobile rovers

2 Small robotic research station on the lunar that could be provided both power and heat to provide a long term surface operational solutions.

3 Larger modular systems which could provide both heat and power for lunar outpost. This systems could be added incrementally as a base grows so that such systems would provide a redundant powr supply function to a complex avoiding single point of failure. Heat and power systems should be designed with sufficient margins to overlap "failures" of some modules

4. It might also be something that could be trailered behind a manned module so that there would be an immediate emergency power and heat supply designed to ensure survival during the lunar night in case of a breakdown

5. Might be a "modular power packages" that could provide industrial power during the night for lunar mining or processing of materials such as frozen volatiles that are mixed with regolith. In short this technology the potential to revolutionize heat and power engineering across the spectrum of lunar surface applications.

I. The potential of making high performance zeolites from in situ materials should also be investigated. Mature deployment of an end to end production system based on both imported equipment needed to use lunar materials to produce a zeolite energy storage system from potential

DD

Investigating An Analog Material for Lunar ISRU Considerations

By David Dunlop [ISRU: In Situ (on location, i.e. the Moon) Resource Utilization]

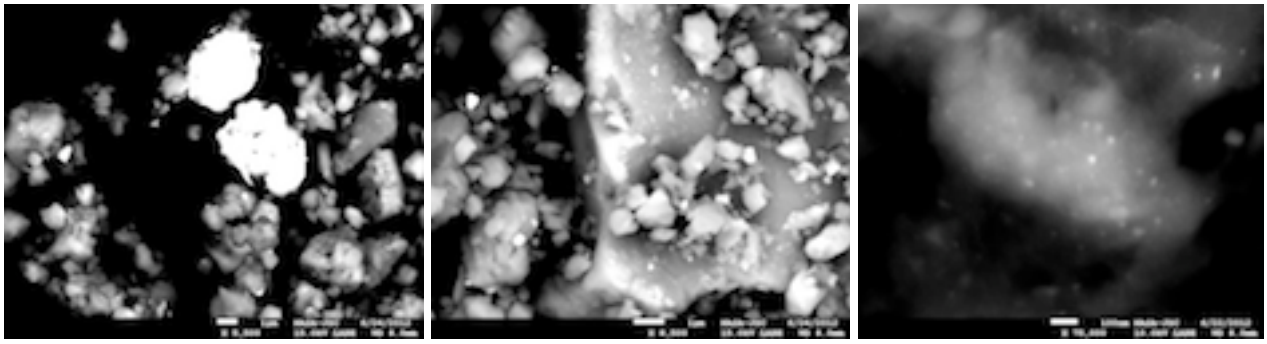
Some extremely fine grained material which is coal black was obtained from the mine tailings, near the former Groveland iron mine [1], about 50 km north of Iron Mountain-Kingsford Michigan. This material is the consistency of talcum powder and it black color results from the magnesium content of the iron materials. This material was collected because its small particle size is not unlike much of the lunar regolith and its iron content might also stand in as a potential lunar analog material for meteoritic iron particles known to be in lunar regolith. Also this material was freely available and thus a potential "poor man's regolilth analog."

Preliminary Comparisons

We knew that significant differences between this Groveland Mine material and lunar materials exist. Lunar materials have never experienced the weathering that occurs on the Earth's surface from abrasion of the wind and water. Plants, although hard pressed to establish themselves in this material contribute organic material by their proximity. With water and organic materials bacteria would likely be present in these materials which existed exposed to the fresh air in an embankment for at least 25 to 30 years.

This material was unsurprisingly susceptible to magnetic attraction from small magnets and in that regard was similar to samples of lunar regolith shown to me by Dr. Lawrence Taylor, that jumped to the movement of a magnet place alongside their glass tube container.

Jayashree Sridhar, one of our Moon Society members in Chennai, India, reported on her internship experiences at Johnson Space Center last summer in the last issue of TTSIQ-and M3IQ. We have provided a link ([2] below) to her research article that resulted from that opportunity that describes her successful work separating meteoritic iron particles from an undifferentiated sample of lunar regolith. This is pioneering work in beginning to learn how to separate materials that could be used for industrial processes from the regolith blanket! We have provided a link to her article posted on the Moon Society web-site. Included below are three of her Scanning Electron Microscope pictures from that study showing:



L; Meteoritic iron particles (image 006.tif) which are the large white particles surrounded by smaller rock and melted glass particles stuck together (agglutinates),

C: Iron particles (small white particles) surrounded by other rock dust fragments (image027.tif)

R: Nanophase particles (small white dots in glassy fragment) (imagenpf_75kx_10kv_bei.tif

Dr. Lawrence Taylor, at the University of Knoxville, Tennessee, Geophysical Sciences Institute had discovered that lunar samples would also efficiently soak up microwave energy and heat up very quickly in a microwave oven. We discovered that this Groveland mine material would similar soak up microwave energy and sinter when heated in a microwave oven.

Future Investigations

1. Additional work will be done with Groveland samples to provide a series of tests on the cohesion of samples that have been heated by microwave and sintered to see if useful objects might be produced in that fashion.
2. Samples of this material have been recently provided to Dr. Gertrude Koennings-Dudin at the Transmountain Campus of El Paso Community College, in El Paso Texas, who has graciously agreed to provide SEM images of this materials and some measurements of both the size and angularity of the particles.
3. An additional area of investigation is the potential use of this material as a feedstock for a 3-D printer. This is of potential interest as this material might be an "analog" for ISRU of regolith on the lunar surface which contains nanophase iron.

The nanophase iron in lunar deposits results from processes resulting from micrometeorite bombardment in the airless vacuum on the lunar surface in an entirely different process of formation than the materials with iron-magnesium composition of the Groveland mine materials was formed in the Earth's ancient igneous rocks found in Michigan's Upper peninsula.

In discussing these Groveland materials with Dr. Taylor at the 2013 LPI SC he indicated that the susceptibility of lunar samples to the absorption of microwave energy was not only a result of the nanophase iron composition but also a result associated with the structure of the angular unweathered surfaces of the lunar particles. While these differences in origin and formation are clear the Groveland particles scale, iron composition, and magnetic and microwave absorption properties make further investigation of the Groveland mine material as a stand-in analog for iron associated properties of lunar regolith warranted.

The potential for the use of this material in a 3-D laser printing system is another area of interest. These printer's use a laser heating-fusion process which may differ in its impact from sintering-based on microwave-heating.

4. Further characterization of this material as to its mineral composition, and elemental composition will also make further comparison with both lunar and other materials possible

ISRU Consideration on the use of Lunar Surface Materials

The Moon's surface is "premined" in that it is covered with with a blanket of pulverized rock particles that have been flung across it and mixed in the ejecta blankets of the countless impactors that have struck the Moon. The beneficiation of lunar regolith has been considered with regard to the collection of solar wind implanted volatiles, the collection of frozen volatile reservoirs in the extremely cold polar regions, and particles of meteoritic iron and nickel that might be susceptible to magnetic separation. Much work remains to be done to demonstrate how these goals can be achieved for useful industrial purposes with a positive economic return. The major elemental composition of the Moon provides a treasure trove of oxygen, silicon, iron, aluminum, titanium, and calcium, with likely stocks of nickel from iron nickel meteorite impacts.

` These treasures however require an investment in infrastructure that can separate such materials from the mixed regolilth deposits and yield useful products. The development of analog materials that represent the range of lunar surface materials is an important step in the capacity to do to useful work on the Moon. Demonstrating the ability to take such analog materials and derive useful products is a significant step in preparing to try out these techniques on the Moon and other solar system bodies.

NOTES:

[1] Closed for some time, this resource area may be put to "spin-off" use. See the following news report.

October 8, 2012 New Use for Old Mine: Groveland Mine owner hopes to sell aggregate products
https://www.ironmountaindailynews.com/page/content.detail/id/537104/**New-use-for-closed-mine**-.html?nav=5002 -

A current "space" use: http://www.kingsford.org/khsweb/rfs/tripoliuppermichigan/dnrlanduse.htm

[2] Jayashree Sridhar's poster paper at Lunar & Planetary Conference (March 15-18, WOODLANDS, TX, US
http://www.moonsociety.org/research/regolith_metals_extraction.pdf

PDF FILE: http://www.moonsociety.org/research/regolith_metals_extraction.pdf

Could the first Martians be Marooners?

By Peter Kokh

Most humans to Mars scenarios envision a number of exploratory missions, followed, if all goes well, by planned settlement. But the chances of something going wrong, no matter how intensive and thorough the planning, are real and should not be ignored in "defining" a first or following "exploratory" missions. **The number one risk is that exploration for exploration sake will not be followed by settlement.**

Yet that it could happen that the first human crew to visit Mars would be marooned for whatever reason, however unlikely and unintended, is reason enough to prepare for the eventuality by the choice of

- **Crew: male/female mix, age mix, gene mix, expertise mix, talent mix, personality mix, hobby mix**
- **Amount and variety of supplies and tools and equipment* etc.** to send with them.

* See '**Yolk Sac Logistics**" article, MMM #113, March 1998, reprinted **in**
http://www.moonsociety.org/publications/mmm_themes/**mmmt_Mars.pdf**

If we do this, and get them back safely, this "just in case preparation" will shape and enrich Martian culture, lore, and history. **That it makes sense to prepare for the eventuality of being marooned and of forced settlement, makes it all the more logical to plan for settlement in the first place.** In that light, **any plan to**

explore only, makes no sense. Only "Mars to Stay" plans deserve our support.

For many, that is a big leap, but as most of us soon learn about life, "anything that is worth doing is worth doing well." And **to thoroughly explore a planet as old, as large, and as varied as Mars is a task for endless generations.**

Just the facts:

The Moon is only **3 travel days** away, so we can build our presence there at the end of an "umbilical cord." Mars, in contrast, is **6-9 months** plus "remaining window time" before the next return opportunity or for resupply and rescue. And any emergency response could easily be delayed if a cosmic ray outburst or solar flare intervenes. But these are not the only eventualities which could force such a situation. Political or economic collapse or military conflict could result in postponement of resupplies and/or of rescue. And a rescue mission could fail on the launch pad or en route. Once you take off from Earth, there is no guarantee you will ever return. It will be a gamble.

There are simply too many things that could go wrong given the interval between rescue and resupply windows and the many months-long travel times involved. But things could also go wrong on Earth with economic or natural catastrophes interfering with "timely" rescue, "timely" meaning not "soon," but as soon as possible which could be from half a year to a couple of years, more if a solar outburst intervened during the next rescue window.

If the first crew does come back safely, their "just-in-case lode" will be of great use for the next crew. And that is all the more reason to send a new crew to the same location. (Contrary to the suggestion in Robert Zubrin's "Mars Direct" proposal.) That in turn is a significant reason to pick a site with all the plusses appropriate for the first major settlement. **That means not picking a site solely for its scientific interest.** In the end, we will do far more exploration of Mars if we go there to settle, than if we go only to satisfy our scientific curiosity.

Did Mars once harbor life? Are primitive life forms still present? Did Mars once have an ocean?...., and on and on. Exploration and Science are human activities in all societies. If we settle Mars, there will be far more explorers and scientists doing far more research, than if we only send one, two, or a few sortie parties.

Thus, paradoxically, **science is best served if the primary reason for humans to go to Mars is not science, but settlement.** The corollary is that the first crew must be prepared for the eventuality of being marooned. It is most likely that **"being marooned in new territory" is one of the ways humans spread across this planet**.

Marooned on Mars in Science Fiction

Being marooned, or almost marooned on Mars has been a frequent theme in movies (e.g. "Mission to Mars," "Red Planet") and novels about humans on Mars, and not just because it makes for a great story with drama and suspense, but also because there is a very real chance, that despite precautions, it could happen. The more complex something is, the more ways something can go wrong. And human Mars missions will be very complex, much more so than past or future Moon Missions, because of the very much greater (and ever changing) distance and time factors that make "timely" rescue or resupply all but impossible.

Only those volunteers should be selected who are emotionally and personally prepared for such an eventuality. We don't need a crew of bitter, angry, and depressed persons stranded on Mars. **We need to pick people who will be okay with such an eventuality.** Given all this, would **you** still volunteer? If all volunteers answer this up front question truthfully, any marooners will do okay. And we'll bet that some will choose to remain behind even if their flight home is assured. **These are the kind of volunteers we need in the first place. PK**

Where are they? SETI finds no messages from ExoPlanets - Duh!

An Essay by Peter Kokh

http://www.space.com/19703-**intelligent-alien-life-exoplanets-seti**.html

A new study reports that alien life is likely to be relatively rare throughout our Milky Way galaxy, with fewer than "**one in a million solar systems**" harboring civilizations advanced enough to send out radio signals, a new study reports. (Is that "now," or throughout our galaxy's lifetime?)

Editor's comments: Duh! The above statement is loaded with challengeable presumptions.

Do we know if it is possible to keep messages coherent, without becoming lost in a growing volume of static the further away from the sender the message carrier signal gets? If messages can remain intact and decipherable only for a few light years out, we have a problem.

Do we know how long civilizations last in that phase of their history in which they are capable of sending signals? This surely varies from case to case from "momentary" to "eons." Currently, because those in power are motivated by short-lived profits, we are letting our own biosphere decay at an accelerating rate. Will we come to our collective senses and become a long-lived technological civilisation?

With only one questionable example, our own, we do not know what percentage of civilisations destroy themselves before they get to that stage, or shortly thereafter. Or what percentage of civilisations are wise enough to settle for a moderate but sustainable level of technological and social stability?

Are we taking into consideration that the equipment and power needed to listen is relatively small, while the equipment and power needed to broadcast in all directions for eons on end is expensive beyond all measure? Duh!

It is very likely that everybody is listening, and no one is sending, except, perhaps, messianic civilizations to whom we may or may not want to listen! Optimistically, there could be civilizations who have found the right formula that lets them sustain a healthy and happy civilization indefinitely over hundreds, thousands, millions of years and would be highly motivated to share that formula even if most listening civilizations chose to ignore such a "Way!"

It makes economic sense to listen but not to send, and in that regard, both sending and listening makes little sense: why bother to listen when it is likely that nobody is sending except for those rare civilizations who have found a "way." We would be lucky to find a few such in our galaxy.

Why do we need to know? The odds are that there are many civilizations out there in our galaxy in some stage of maturation or decay. Is it not enough to know that? Is it not enough to look at the starry sky and say "Hi!," certain that out there around countless other stars, now or whenever – it does not matter – there are counterparts looking out at the heavens from their home planet, saying the same thing? We all share the "creatural condition." Is it not enough to look up and smile, knowing that in countless other places in our universe in every time and space, there must be others doing likewise?

And then consider that there are countless billions of galaxies in "our own universe" and there might be countless other universes with no spatial or temporal relationship to our own, in which some few countless other civilizations must waaaish to share the same greeting, feel the same spiritual brotherhood?

Beyond deliberate messages: chemical signature giveaways

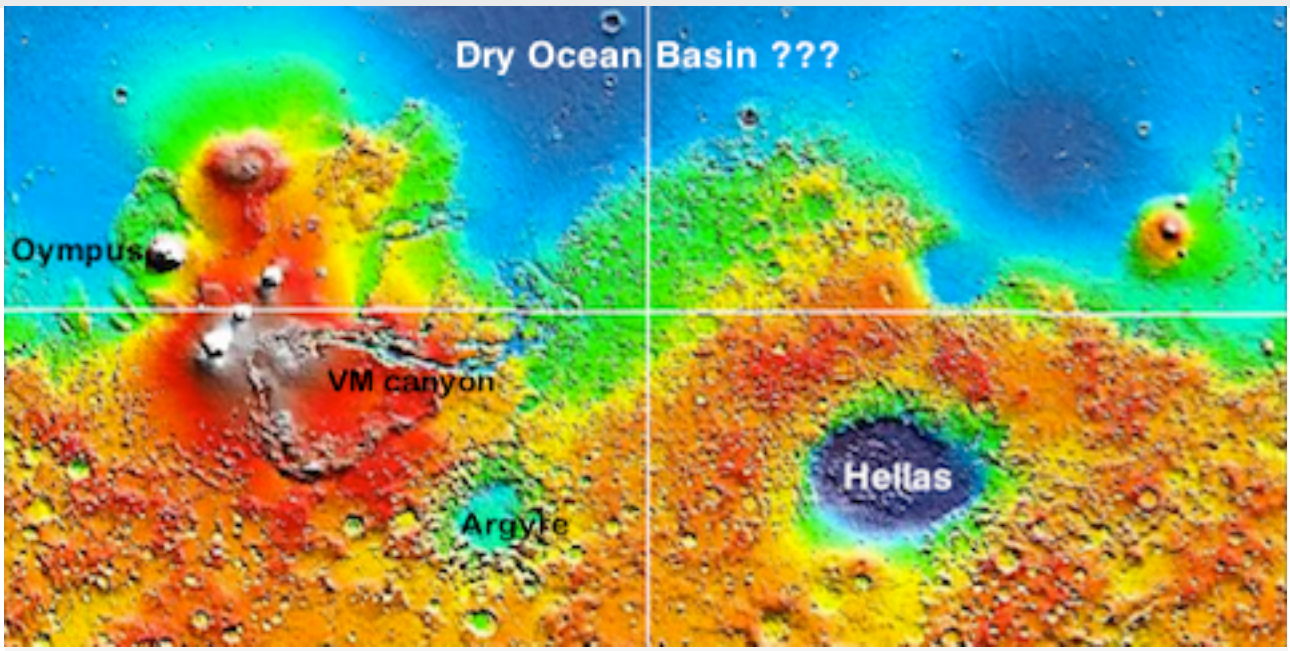
But just as an animal can remain out of sight or disguise itself somehow, but betray its presence by smell or uncontrollable noises (yes, a fart comes to mind), there will be "smells" automatically sent at no cost that should be detectable, as, quite the opposite, it would cost to block them:

> **Detection in an alien atmosphere of compounds that can only be generated by industrial processes: these revealing "clues' should be possible to detect at least by relatively nearby "contemporary" civilizations.**

Thus we could detect other civilizations while receiving no message or information other than that they are in an early stage of industrialization and are being as juvenilely sloppy their waste emissions as we are with ours.

Billions of Earth-like planets are thought to populate the Milky Way Galaxy. And there are countless billions of galaxies. And an untold number of universes. It is not conceivable that we be alone. We do not need to "establish contact" to wish each other well, or to "sense" them doing likewise. ####

More on Mars' Hellas Basin – [see m3iq#17 pp. 32-33]



By Peter Kokh

Many a flying enthusiast has wondered if we could design aircraft (not balloons, mind you) to fly on Mars. Here are some relevant statistics: http://en.wikipedia.org/wiki/**Atmosphere_of_Mars**

"The atmospheric pressure on the Martian surface averages **600 pascals (0.087 psi)**, about 0.6% of Earth's mean sea level pressure of 101.3 kilopascals (14.69 psi)

"It ranges from a low of 30 pascals (0.0044 psi) on Olympus Mons' peak to over **1,155 pascals (0.1675 psi)** in the depths of Hellas Planitia" or 1/87th of Earth sea level pressure

And there you have it. It could be that in Hellas Basin, a deep relic of a major asteroid impact, where sustainable flight will first be demonstrated on Mars. It will take more capable craft to fly elsewhere on the Red Planet.That suggests that in early days, Hellas Basin (badly misnamed a "Planitia") will be a major tourist destination, at least until more capable craft are able to fly over the length of Valles Marineris at a higher altitude with thinner atmosphere. Hellas will be where we are first able to breed plants that can take root in Mars thin atmosphere. Settlements in Hellas basin could take the names of "seaports" in Edgar Rice Burroughs novels. **Aanthor**, for example.

So when it comes to choosing a site for a first settlement on Mars, proximity to Hellas Basin will be a plus, worth taking into consideration other important issues such as proximity to a water source. Next, would-be settlement sites handy to the "shore" of the "suggestively ocean-like" basin that occupies most of Mars Northern Hemisphere. Flights between settlements along that "altitudinal" "shore" would be possible sooner than at higher altitudes (green, yellow, orange, red.) Roads and railroads could connect low-altitude airports with settlements at higher altitudes.

Current high altitude flight record – http://www.nasa.gov/pdf/64317main_helios.pdf

"In August, 2001, the lightweight solar-electric aircraft "Helios" (above) reached an **official world record altitude for non-rocket powered aircraft** of **96,863 feet** during a maximum-altitude flight, the first of two major flight milestones set for the craft by NASA under ERAST." The craft was unmanned.

http://www.nasa.gov/centers/dryden/news/ResearchUpdate/**Helios**/index.html

Achieving manned airflight on Mars, and advancing it to the point where further exploration of Mars and the advance of pioneer civilization on Mars from existing settlements can be advanced by air transportation will be a major milestone, giving pioneers global access to resources. From that point, Martian settlement will advance to some level of self-sufficiency.

We need not wait until we get to Mars. We can further develop Helios-type planes and crafts of alternative designs, here on Earth, until they can fly at ever higher altitudes. **PK**

An Orbiting Depot Station – Resurrecting a Forgotten Stepping Stone

By Peter Kokh

Goals of the space enthusiast community in the Post-Apollo period

Many of us old enough to have lived through the glory days of the Apollo Moon Mission period were devastated when the remaining three Apollo moon landing missions, #18, #19, and #20 were cancelled. Prior to this cancellation, some of the major contractors were working on plans for permanent Lunar Outposts. The disappointment was intense enough to eat the insides of those of us whose hopes that Apollo would be the grand beginning of permanent human presence beyond Earth orbit were dashed.

When Gerard O'Neill published his "High Frontier" vision a few years later in the 1970's many of us took heart. We organized and began to campaign to have the United States adopt Wernher von Braun's plans for an orbiting Space Station that would serve as both a depot to the great beyond, and as a shipyard of sorts, where large lunar landers could be assembled.

The Space Station idea had a rough time in Congress, and was on the verge of defeat by one vote when President Bill Clinton found a way to save it: the Space Station, if we brought the Russians aboard as equal partners, would be a great way to keep unemployed Russian scientists and engineers busy doing something constructive, instead of hiring out to other countries with less honorable intentions. Space Station "Freedom" passed by one vote.

The Cost We Paid for this Accommodation

But because the Russian spaceport, Baikonur in the Kazakhstan Republic (formerly part of the Soviet Union: the U.S.S.R.) is at the substantially more northern latitude of 46° North, for the Russians to be able to launch to the Station required that ISS have an orbit around Earth which had that high inclination to the equator.

The price was high:

- **High Inclination Orbits are great for studying the Earth below as they pass over most of the populated area of our planet between the Arctic and Antarctic circles.**
- **But that excluded the one top priority space station use for which we campaigned so hard: serving as an assembly point and depot for missions to deep space**

Make no mistake, most space enthusiasts feel that the International Space Station (despite the high cost of the unnecessary deorbiting of Russia's MIR station (which could have been boosted to a safe high orbit as the first International Space Monument) has been a very positive project, keeping manned space in the public limelight. But this type of station has nothing to do with von Braun's vision of it purpose and function.

What Space Enthusiasts and their Societies have been doing wrong

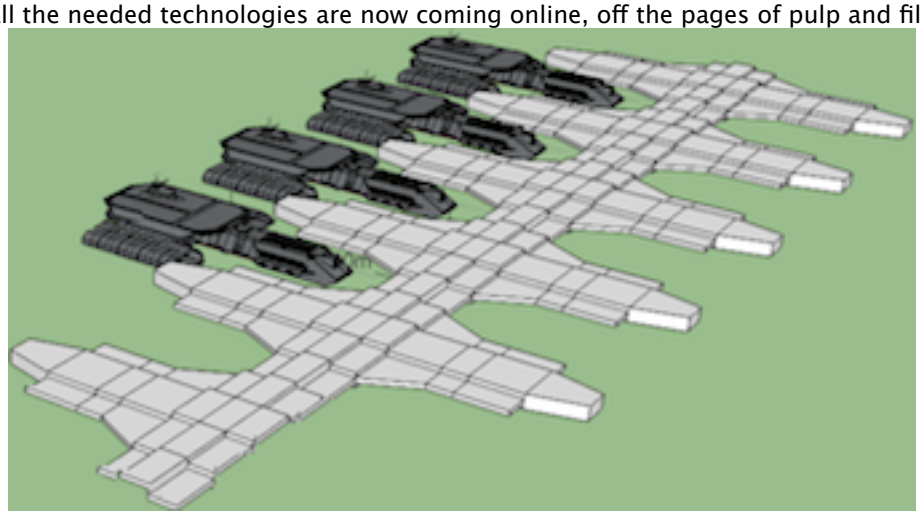
We seem to have forgotten von Braun's plans, or to have dismissed them as politically impossible. So we restrict ourselves to supporting proposed human deep space missions and space transportation systems that do not need orbital assembly or an orbital depot. Perhaps our strategy should not be to campaign anew for an Orbital Assembly and Depot for Deep Space Missions, but to reinvent the concept, given a possibly enabling revolution which has been going on for almost a decade: Commercialization.

A Commercial Orbiting "Shipyard & Port" for Deep Space Missions, unmanned and manned

It is not politically possible, within the United States or within the World at Large, to float the idea of an "ISS 2" in an equatorial orbit. The World Economy is too fragile, and most space-faring nations are doing all they can to keep supporting our existing magnificent station. No, governments are not whom we need to be looking to!

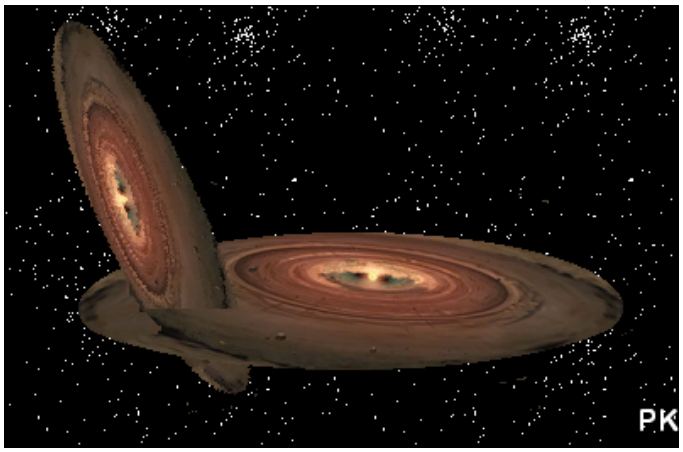
Now two years ago, we would have been laughed at and dismissed, but given the now substantial record of one success after another by Space-X both in building new more economical rockets, and now after two successful cargo missions to the International Space Station, and with the pending successful debut of other commercial space vehicles, we need to be aggressively looking beyond the status quo.

1. We need to be lobbying Congress to mandate that NASA open "ALL" bids to Commercial companies as well as to the traditional aerospace contractors. There is nothing so effective as competition. It is the Commercials who are most motivated to try ingenious new methods and techniques and technologies.
2. A proposal to build the start of an Orbiting Shipyard is unlikely to come from NASA, but there is every reason to expect it from a consortium of commercial companies. Why? To put together in orbit all these proposed "commercial space stations" (think Bigelow, think Excalibur Almaz) and orbital hotels (once a route to realization appears, the serious proposals will follow.)
3. Consider. For decades now we have been imagining an era when orbital space will be populated with space hotels and industrial parks. Who will build them? Where will they be built? The answer is so obvious that it is curious that there have been no proposals. We need a startup orbital shipyard, small at first.
4. Consider that plans for an integral element of such a shipyard - an orbital refueling facility - are already in an advanced stage of planning by Dallas Bienhoff at Boeing.
5. Consider that key components are already in use at ISS: solar panels for power and the two Canadarms (2nd with Dextre)
6. Consider that the first robonaut is now at ISS and learning new tricks there. In order to be financially feasible, any Orbiting Shipyard will have to minimize human staffing and maximize robotic and telerobotic staffing
7. Consider that automated docking systems are now advanced
8. Consider that all the needed technologies are now coming online, off the pages of pulp and film science fiction.



This illustration is out of Star Trek or something similar, but you get the idea! It would grow as "business" demanded.

Are our Planets the offspring of a tryst between ProtoSun and another protostar?



By Peter Kokh

The consensus from time immemorial has always been that the Sun and our family of planets from Mercury out to Neptune formed from the same rotating disk of gas and dusk, the Sun forming at the center and the planets at intervals further out in the condensing disk.

Suddenly, scientists have found an unexpected mismatch in the solar and planetary "DNA" so to speak. The percentages of the isotopes of Oxygen and Nitrogen in the planets do not match those in the Sun. At this stage, everyone is perplexed, if not taken aback.

We propose a simple scenario whereby this might have happened. The disk of matter around our protostar, the condensing Sun, intersected the disk of gas and dust in the process of forming another solar system. The two embryonic stars did not touch or exchange matter, but their two surrounding disks did, and in the process exchanged gas and dust, each disk peppering or seasoning the other with their unique signatures of elemental and isotope ratios. Here is what that tryst might have looked like.

Would such a sexual stellar encounter have been unique? Consider that many stars are formed in clusters as the host gas cloud forms little eddies that begin to condense. In such stellar nurseries, near passes and actual collisions with an exchange of dust and gas may be relatively common. While all the stars forming in a cloud may have similar characteristics, if the cloud is not homogenous in its composition throughout, systems with "mixed genes" may occur.

L: The famous Pleiades cluster of young stars **R:** This stellar "nursery" is the famed Lagoon Nebula

In MMM #MMM #61 December 1992, page 7, [MMM Classics #7, page 5 – a free download from www.moonsociety.org/publications/mmm_classics/] We ran an article with the title "Heliades Cluster" which posed the possibility that the Sun was not an only child but may have been born in a cluster. Helios being the Greek word for "Sun" we dubbed our hypothetical birth cluster the Heliades. Since the Sun and our Solar System were born 4.5 billion years ago, we have circled the galactic core perhaps 18-20 times, and any differential velocity and vector between the Sun and its hypothetical cluster-mates may well have dispersed them so widely that we would be fortunate to identify any solar siblings.

The Evidence: So what is this difference in isotopes? The article we saw was this, dated June 26, 2011.

http://www.enewspf.com/latest-news/science-a-environmental/25123-**nasa-mission-suggests-sun-and-planets-constructed-differently.html**

"Researchers analyzing samples returned by NASA's 2004 **Genesis mission** have discovered that our sun and its inner planets may have formed differently than previously thought. Data revealed differences between the Sun and planets in oxygen and nitrogen, which are two of the most abundant elements in our solar system.

Although the difference is slight, the implications could help determine how our solar system evolved. We found that Earth, the Moon, as well as Martian and other meteorites which are samples of asteroids, have a lower concentration of the O-16 than does the Sun," said Kevin McKeegan, a Genesis co-investigator from UCLA, and the lead author of one of two Science papers published this week. "The implication is that we did not form out of the same solar nebula materials that created the sun -- just how and why remains to be discovered."

And so we propose the scenario above. As a rule the most probable hypothesis is that for which the odds are the highest, and the explanation the simplest. We think we nailed it, but it will be interesting to see what other hypotheses surface and if there is any way to settle the question with a high degree of confidence. We are all interested in our ancestry, and that goes for out solar system too. **PK**

Bootstrapping Industrial Research at an International Lunar Research Park

By Dave Dietzler

Editor's Introduction (Peter Kokh)

How to gear up for full-scale industrial operations on the Moon is a daunting challenge. At the start, we will be concentrating on these cornerstone technologies:

- Oxygen production,
- Basalt based industries √ **cast basalt pipe** needed to handle abrasive moon dust for all mining and industrial operations;√ **cast basalt tile**s, tabletops, planters, tableware; √ **basalt fiber** products like rockbar;
- Volatiles mining (H, He, C, N, Fl, Ne etc.;
- 3D manufacturing techniques of smaller (including replacement)
- Contour crafting of clearspan unpressurized shelters. [Importing inflatable modules including connecting corridors to be placed under such shielded clearspan structures]
- Graded, compacted, sintered roadways made out of in-place moondust.

In this ambitious article, Dave Dietzler tackles what will be needed to go beyond the above startup operations to establish a more capable lunar industrial complex, as a primary goal of an International Lunar Research Park.

Author's Introduction (David Dietzler) The givens are that launch costs to LEO are reduced by factors of ten to one hundred, solar electric tugs for cargo transit from LEO to L1 are operational and space propellant depots are located in LEO and at L1 for fueling manned spacecraft and landers. It's hard to envision a lunar colonization and industrialization program without this infrastructure.

Before diving headlong into the murky waters of lunar construction and industrial development with in situ resources ("bootstrapping") it will be wise to establish an international lunar research park. The cost of this facility and remote outposts on the Moon will be shared by numerous nations as has been done with the ISS. The ILRP will be administered not by politicians but by a board of expert commissioners. It will function like a port authority and derive income by leasing its facilities to private companies that wish to do research on the Moon with the intentions of establishing profitable operations there in the future. Physically, the ILRP will consist of a core that supplies energy, communications and life support to "plugged in" lab modules and vehicles owned by paying customers.

Research projects might include but not be limited to:

- **Prospecting**
- **Polar crater ice mining**
- **Telepresence and telerobotics**
- **Production of materials** (silicon, aluminum, phosphorus and glass) for making solar panels and actual manufacturing of solar panels
- **LUNOX production.** Twenty-some ways to do this have been proposed; which are most cost effective and reliable?
- **Nightspan energy storage** with fuel cell systems, flywheels, iron-nickel alkaline batteries made with lunar materials on the Moon, molten salt heat storage, etc.
- **Mining for meteoric iron-nickel** particles present in the regolith at a few tenths of a percent
- **Scavenging for solar wind implanted volatiles** (H, H2O, CO, CO2, CH4, N2, He4, He3, Ne)
- **Mining for sodium, potassium and sulfur** by digging up and roasting large tonnages of regolith.

It already becomes apparent that numerous expensive machines will have to be designed, developed, manufactured and transported to the Moon for testing just to get this small number of basic bootstrapping challenges worked out in detail. Machines would be tested on Earth in vacuum chambers that simulate lunar thermal cycles before shipment to the Moon and operation in low gravity and dusty conditions.

Biological research would also be conducted along with industrial research to determine what the long term effects of low gravity are on humans, animals and crops. A small centrifuge in LEO that generates 1/6th gravity equivalent to that of the Moon's could tell us a lot about this before tackling life on the Moon. [Potassium-rich KREEP deposits are found in the Marie Imbrium "splashout."]

Additional research projects would include:

- **Manufacturing methods.** Mass production results in large numbers of a single product at low cost. Bootstrapping on the Moon will require not only local materials but also the fabrication of hundreds, perhaps thousands, of different products. Many of these products would be parts for assembly into finished goods like mining shovels, vehicles, machine tools, etc. Skilled human workers along with robots and robonauts controlled by Earthside crews equipped with lunar materials, machine shops, some sort of foundry, tools, garages, 3D printers that use powdered metals, glass and ceramics rather than plastics and CNC machines should be able to replicate the machine shops, mining 'dozers, vehicles and tools landed initially to get things started as well as new products needed for bootstrapping up space industry. This will not be simple. Building a Moon 'dozer will involve thousands of parts and thousands of motions. Teams of manufacturing experts will have to work all this out on Earth ahead of time at **lunar analog research stations.** Procedures devised to make products on the Moon will become the intellectual property of companies that fund this research.
- **Testing solar and electrical furnaces.** Solar furnaces will use parabolic foil or sheet metal reflectors and high temperature ceramic crucibles. Electrical furnaces will use microwaves, induction, conduction and electron beams. Furnaces will be at the heart of many materials production processes and efforts will be made to make them on the Moon with lunar mats.
- **Sintering basalt roads, landing pads, bricks, tiles, etc.** Also complete melting and casting of basalt products in iron molds produced on the Moon perhaps with 3D printers and meteoric iron-nickel particles. Production of basalt fibers in the vacuum; a task that will require platinum bushings. Other writers have proposed extracting platinum from meteoric iron fines on the Moon. If successful they would not only impact platinum markets on Earth; they could supply this useful metal to lunar industries.
- **Production of glass** and lunar appropriate glass formulations.
- **Production of iron** from A) meteoric fines B) as a byproduct of oxygen production from ilmenite and C) by roasting regolith to 1200+ C. in the vacuum to volatilize FeO followed by hydrogen reduction to get iron and oxygen. Pure iron is not very strong or hard but could be used for low stress items. We might actually want to add slag to pure iron to make what will essentially be wrought iron which was good enough for rail roads in the 19th century before the advent of the Bessemer process and large quantities of steel.
- **Production of carbon steel** by the old crucible or cementation process and production of carbonless maraging steel with iron, nickel (18% to 25%), titanium and aluminum.
- **Production of iron and nickel carbonyls** and Chemical Vapor Deposition manufacturing. This will require sealed chambers in which we can recover valuable carbon monoxide gas when decomposing and depositing iron and nickel at moderate temperatures of about 150 C.
- **Production of titanium** metal with the FFC process and insoluble or non-consumable electrodes rather than consumable carbon electrodes.
- **Production of aluminum.** There are several candidate processes for doing this; too many to go into detail on here. All of them have pros and cons and require chemicals from Earth as well as lots of energy. A) Fluorine reaction and reduction with potassium B) sulfuric acid leaching to obtain aluminum oxide followed by electrolysis in imported cryolite with insoluble electrodes too expensive to use on Earth where carbon is cheap C) electrolysis of aluminum chloride in a flux of lithium and sodium chlorides D) electrolysis of aluminum sulfide in a chloride flux E) roasting anorthite at 2000 C. to get calcium aluminate and electrolysis in a lithium-calcium fluoride flux F) solar carbothermic reduction G) thermite reaction of aluminum oxide with magnesium
- **Production of iron, titanium and nickel aluminides.**
- **Production of magnesium** by silicothermic reduction of magnesian minerals with ferrosilicon obtained by magma electrolysis. If this works out, it might be cheaper to use magnesium instead of aluminum for vehicle frames and wheels, sheet metal solar reflectors, even explosives. Slurries of magnesium and LOX are shock sensitive and will detonate. This kind of explosive has been demonstrated with aluminum and LOX ("oxyliquit" explosives).
- **Production of electric motors** for mining machines, pumps, compressors, vehicles, etc. from aluminum wire and other lunar sourced materials.
- **Out-vac operation of extruders, presses and rolling mills** to fabricate things with iron, steel, aluminum, magnesium and titanium and lunar sourced alloys.
- **Metal casting.** Low vapor pressure metals like aluminum and magnesium must be cast in pressurized modules. Cooling those modules will be a real challenge. Titanium can be cast in the vacuum if zirconium and yttrium oxide sand is imported. Sand casting iron and steel will require synthetic clay for binder and water, thus a sealed chamber with condensors to recover moisture from the air is needed along with powerful cooling systems.
- **Cement for construction.** This is promising. The lime and alumina contents of anorthositic highland regolith can be increased by roasting at about 1500 C. in the vacuum to produce a mix similar to Portland cement. Since highland regolith will be as abundant as basalt at a highland/mare "coastal" base this material holds promise for the construction of habitat, perhaps foundry structures, even rails for trains if clad with iron.

  However, water is required. As the cement dries water will be lost into the vacuum and this will be like throwing away money. One possible solution is to use sulfur cement. This does not require lime based materials as does hydraulic cement. Sulfur is mixed with sand and gravel, then heated to melt the sulfur and poured. If some sulfur evaporates in the vacuum this will not be as critical as loosing precious water.

The major drawback is that sulfur cement will melt in the heat of lunar day. Perhaps large foil or sheet metal solar shields could protect sulfur cement structures until they set and are buried a couple of meters deep where temperatures are a stable minus twenty Celsius (minus 4 F). Another possibility is the casting of hydraulic cement inside pressurized inflatables. When the cement parts have set and water has been recovered by dehumidifiers the inflatables can be depressurized, unzipped and the cement piece hoisted out and covered. Similarly, rapid setting cement could be sprayed on the insides of spherical and sausage shaped inflatables to make habitat and work modules. Monolithic domes hundreds of feet in diameter are made by spraying cement on the insides of inflatables on Earth today. Swimming pools are sometimes made by spraying cement. This is not fictional technology. In low lunar gravity slumping of cement will be minimized. Cement or concrete structures will be buried and not exposed to thermal extremes that would lead to cracking.

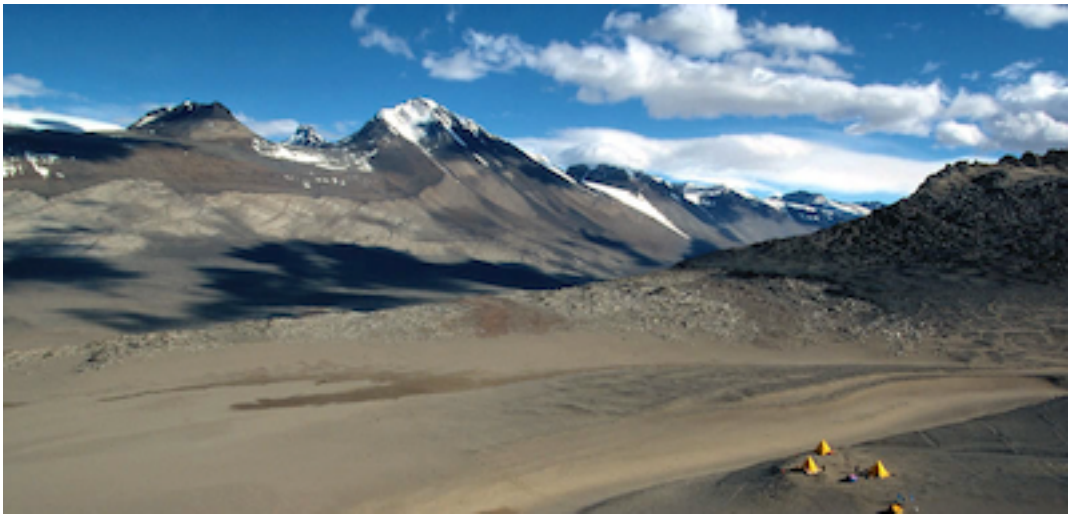
- **Contour crafting** is another cement construction technology that could be investigated at an ILRP. This is similar to 3D printing but on a very large scale. Hydraulic cement would not be used on the Moon. Proposals have been made to use cement bound with polymers imported from Earth for "printing" lunar structures. Imports mean increased costs. Obtaining lots of hydrogen and carbon for polymers from polar ices comes to mind but ice mining has its caveats. A "wait and see" attitude is called for while we look at other options. Mars has sufficient carbon and hydrogen for polymers so contour crafting might find use on the red planet. On the Moon we must consider contour crafting with sulfur cement and adequate protection from extremes of heat.

Another possibility is the use of Moon made sodium silicate (an inorganic adhesive) mixed with glass fibers for cement binder instead of water, sulfur or imported polymers. There is plenty of silicon dioxide on the Moon to be extracted and respectable quantities of sodium and potassium to make sodium silicate. If sand, gravel, glass fibers and sodium silicate "glue" can make a strong concrete formulation there seems to this writer that there is no reason that this could not be extruded from contour crafting gantries to "print" lunar structures. All options—hydraulic, sulfur, polymer and sodium silicate cements should be investigated first in lunar environment simulation chambers on Earth and finally on the Moon.

- **Technologies that pass the "acid test"** of working effectively, reliably and economically on the Moon at an ILRP will convince potential investors that the job of industrializing the Moon and outer space is more than idle speculation. If we prove positively that the job can be done we can attract money. A private enterprise/international government partnership to expand Earth's econosphere to the Moon and beyond is favored. It has been a bit over forty years since humans worked on the Moon. In another forty years we must see humans working on the Moon again to develop technologies like solar power satellites to prevent continued environmental degradation. **DDz**

Mars poses Frequently Overlooked Climate Challenges

Many Mars enthusiasts are looking at the planet with rose-colored glasses



Antarctica's Dry Valleys (view above) are "climate-wise" the most "Mars-Like" areas on Earth.

But despite fresh breathable air and abundant food in nearby seas, available wind power, fresh glacier melt water, few Mars fans seem eager to settle there. And what is even more ironic, some Mars advocates have relocated from 4 season climates (with cold snowy winters) to sunny warm locations on Earth, giving the lie to their enthusiasm. That Mars may look like some familiar desert areas on Earth, is irrelevant. Yet humans will settle Mars someday, but hardy volunteers are more likely to come from cold desert areas on Earth than from places with mild balmy climates. **PK**

Exciting Program for the Lunar Track at ISDC 2013 in San Diego

By Dave Dunlop

April 9, 2013: There will be an exciting lunar track at the 2013 International Space Development Conference in San Diego California on Thursday May 23 and Friday May 24th.

Day One Thursday, May 23 - Lava Tube Exploration

The first day is dedicated to the Exploration of Lava Tubes on the Earth, Moon, and Mars. Lava Tubes often resulting from lava flows from large shield volcanos can be found in many places in the Western Continental United States and as well on Hawaii Island, State of Hawaii.

There existence has also been confirmed on Mars from the Mars Hi-Rise cameer on the MarsRO and on the Moon from the recent slate of lunar orbital Missions: LRO Narrow Angle Camera, Chandrayaan I, and Kaguya. This program has been developed with the generous participation of many of the speakers:

- Dr. Heather D. Smith of NASA AMES has served as the Chair of the Scientific Organizing Committee.
- Dr. Jose Hurtado, of the University of Texas El Paso will hare recently published research on detection of lunar lava tubes with remote sensing data sets from the WAC camer, Diviner temperature instrument, and LOLA (laser altimeter) instrument on LRO.
- Dr. Penelope Smith, headquarted at New Mexico Tech, is Academic Director of the National Cave and Karst Research Institute, will do a presentation on planetary protection and cave protection protocols and astrobiology sample collection.
- Dr. Pamela Clark of Catholic University and Goddard Space flight Center will discuss the emerging Lunar Cube Hitchhiker architecture paradigm of cislunar and lunar surface exploration.

Other presentations will include the engineering challenges associated with robotic exploration of lava tubes, Apollo style sorties with the technology available today, and analog opportunities that can advance the state of both technology. A demonstration of the Lunar Mapping and Modeling Portal software is also planned as a special incentive for research engagement by an anticipated large audience of international students and the participation of Google Lunar X-Prize Team Stellar making an appeal for a competitive landing site competition.

Day Two Friday May 24 - The Economic Development of the Moon

- Moon Society President Ken Murphy will start with a presentation on the Economic Foundations of cislunar economic Development.
- We have also invited a presentation by Michael Lane of Liftport to discuss the roadmap of development of a lunar elevator.
- Al Anzaldua, President of the Tucson NSS-Moon chapter will present a picture of an Earth-Moon L2 Gateway
- Astronomer Dan Lester of the University of Texas- Austin will discuss astronomy and telepresence operations from L2.
- Paul Graham has been invited to discuss the research on space suit development by the Open Lua Foundation and also the management of lunar-Mars analog operations.
- Dave Dunlop will present a proposal for the initiation of an International Lunar Geophysical Year in 2017 at the 60th Anniversary of the First Geophysical Year in 1957.

Student Interest Events at The International Space Development Conference, May 22nd -27th, San Diego, California

A chance to work on the robot on the International Space Station - p. 54

All scheduled events for students at the conference can be found at:
https://sites.google.com/site/isdcfor**studentcompetitions/isdc-information/schedule**
They include required and optional events.

- Wednesday, May 22nd 6:30-9:30 pm Student Space Settlement Forum & Orientation
- Thursday, May 23rd 9 am Conference Opening Session
- Friday, May 24th 7-10 pm Grand Prize student award presentation at Gala Dinner - Keynote speaker will be **Dr. Abdul Kalam**, former president of India and India's leading aerospace engineer/scientist.
- Sunday, May 26th 10-12 am Student Awards Event - Keynote is astronaut **Christopher Ferguson**, commander of the last space shuttle.

Left: Dr. Abdul Kalam **Right:** Astronaut Christopher Ferguson

- Monday, May 27th 10-11 am Student/Teacher Training on how to form a chapter
- Monday, 11-12 am International Student/Teacher Open Forum

ISDC 2013 Space Settlement Contet Schedule (check website for latest schedule)
https://sites.google.com/site/**isdcforstudentcompetitions/isdc-information/schedule**

NASA launches Exploration Design Challenge to Students Worldwide

http://www.nasa.gov/home/hqnews/2013/mar/HQ_13-071_**Exploration_Design_Challenge**.html

11 March, 2013 **WASHINGTON** -- NASA unveiled an Exploration Design Challenge on Monday to give students from kindergarten through 12th grade the opportunity to play a unique role in the future of human spaceflight. The innovative educational opportunity was announced in a special event at NASA's Johnson Space Center in Houston.

The challenge asks students in the U.S. and abroad to think and act like scientists to overcome one of the major hurdles for deep space long-duration exploration -- protecting astronauts and hardware from the dangers of space radiation.

"America's next step in human space exploration is an ambitious one and will require new technologies, including ways to keep our astronauts safe from the effects of deep-space radiation," says NASA Administrator Charles Bolden.

The Exploration Design Challenge is a unique way to capture and engage the imaginations of tomorrow's engineers and scientists.

NASA's Exploration Design Challenge brings cutting-edge learning to educators and students using standards-based activities, as well as print and video resources developed by leading education experts. Students taking part in the challenge will discover how to plan and design improved radiation shielding aboard the new spacecraft.

Younger students, in grades K-4 and 5-8, will analyze different materials that simulate space radiation shielding for Orion and recommend materials that best block harmful radiation and protect astronauts. Students in grades 9-12 will learn about radiation and human space travel in greater detail. Using what they have learned, they will be asked to think and act like engineers by designing shielding that protects a sensor on the Orion capsule from space radiation.

To learn more about the Exploration Design Challenge and sign up to become a virtual crew member, visit: http://www.nasa.gov/education/edc

Star Trek's Captain Kirk calls ISS Commander

Star Trek's Captain Kirk (William Shatner) calls ISS Commander Chris Hatfield of Canada
A marvelous **Video:** http://www.space.com/19677-**captain-kirk-calls-space-station-video**.html

School/Chapter Project: Help Classify Images from Lunar Reconnaissance Orbiter

https://www.zooniverse.org/project/moonzoo - http://www.moonzoo.org

Explore the surface of the Moon

We hope to study the lunar surface in unprecedented detail. Thanks to the help of the Moon Zoo community we have already visually classified 3,450,547 images from NASA's Lunar Reconnaissance Orbiter (LRO). Already 780,000 people worldwide are involved.

Real Science Online

The Zooniverse and the suite of projects it contains is produced, maintained and developed by the Citizen Science Alliance. The member institutions of the CSA work with many academic and other partners around the world to produce projects that use the efforts and ability of volunteers to help scientists and researchers deal with the flood of data that confronts them.

Welcome to the Moon

With your help, we hope to study the lunar surface in unprecedented detail.

Read and Listen to the Tutorial at http://www.moonzoo.org/about

Zooniverse supports several other astronomy focused citizen projects including

- **Exploring the surface of Mars** (southern polar region) https://www.zooniverse.org/project/planet_four

Finding planets around stars https://www.zooniverse.org/project/planethunters

Make this a Chapter Project

If one or more members of your chapter or outpost are involved in a Zooniverse project, this activity can get you in doors at local schools and astronomy clubs, and help attract members. ###

NASA Wants Help in Re-coding Vision of Robonaut-2 on the Space Station

If you have experience in coding and enjoy it, the US National Air and Space Administration has a job for you. You could be the one who teaches Robonaut-2 what he needs to see and correctly interpret.

You have a chance to become "Top Coder!" - http://www.topcoder.com/iss/robonaut/


Robonaut-2 on ISS since February 2011

http://en.wikipedia.org/wiki/Robonaut - http://www.nasa.gov/mission_pages/station/main/robonaut.html

The NASA Robonaut Challenge is your ticket and it is now live!

http://community.topcoder.com/tc?module=MatchDetails&rd=15611

Robonaut 2, the first humanoid robot in space, was sent to ISS to take over tasks too dangerous or too boring for astronauts. There's one problem: Robonaut 2 needs to learn how to interact with the types of input devices the astronauts use on the ISS, called "taskboards," each with a number of LEDs that turn on when the power switch is flipped or the buttons are pushed.

The challenge:

Write algorithms to control Robonaut and teach him how to interact with the taskboard. You must teach Robonaut how to recognize the state and location of several buttons and switches on the taskboard. To discover the current state of a taskboards, Robonaut will need to look at it to figure out what LEDs are on/off and to locate them in "robot space".

You will be given a set of imagery from Robonaut here on Earth, on the ISS, and in the simulator. The camera system is slightly different for each system and has different lighting conditions as well. Your algorithm must work for every application. Strong performance on the real imagery will translate best to software that works on the ISS.

First Contest:

For each test case you will be given two images – a "left eye" image and a "right eye" image – and a string array containing the names of the buttons/switches/LEDs you have to locate. In your return you have to define the button/switch's state and (x,y) location in pixels relative to the upper left corner of the image you choose ("left eye" or "right eye"). You will be judged on Accuracy and Time:

Accuracy

- What is your false alarm rate vs. detection
- How far from actual position is your computed position

Time

- How long does it take to determine the state of the LEDs

Second Contest:

This contest will ask competitors to use the "seeing" algorithm produced in the first challenge in order to write an algorithm that actually controls the robot's motion. The algorithm will need to "see" an object, recognize it, and correctly operate it in the most efficient (and safe) manner.

Stay tuned for details on the Robonaut 2 Controller Challenge!

http://community.topcoder.com/tc?module=MatchDetails&rd=15611

Bangalore Students Track UK-built Satellite

http://timesofindia.indiatimes.com/india/**Bangalore-students-track-UK-built-satellite**/articleshow/18704308.cms

27 February, 2013: Bangalore (Mysore state, India): Some 90 minutes after ISRO's launch of the **Indo-French satellite SARAL** and 6 other satellites on Monday, the 26th, staff and students at the Bangalore-based Nitte Meenakshi Institute of Technology erupted in cheer. The students had successfully tracked the UK-built **STRand-1** satellite which passed over Bangalore. **SARAL**, built by ISRO, will **study the ocean surface and environment**, using two French devices — **ARgos** and **ALtila**, based on the radar principle.

The request to track the satellite had come from the Surrey Space Centre in the United Kingdom. ISRO supplied the tracking parameters and they had fed it into their tracking system. The transmission was received as SARAL passed over Bangalore at 7.30pm. In the next few days, the Nitte Amateur Satellite Tracking Centre would acquire transmission from the satellite and the data will be shared with Surrey Space Centre. **The tracking system was designed by the students themselves**, a considerable learning experience for the students. ###

Space Outreach Opportunity – Moon Landing Day – July 20, 2013

By Peter Kokh

What's Special about July 20th? – On that date in 1969, two men from Earth, Neil Armstrong and Buzz Aldrin, set foot for the first time on the Moon.

This event was a major watershed mark in the long history of human expansion out of Africa to one continent after another. In as much as the Moon is permanently bound to Earth in its orbit, unlike any of the other planets, the Moon might be considered as the 8th and last continent, part of "Greater Earth."

"The Moon – It isn't Earth, but it is Earth's"

The Moon is the place where "inter-continental space" ends and "inter-planetary space" begins.

Unlike exotic Mars, which orbits the Sun independently at a distance from Earth that varies from 56 – 401 million km and is in position to be visited from Earth only every 25 and a half months, the Moon circles our home world at a distance less than 1 percent as great, from 356 – 407 thousand km, and can be reached in 3 days or less, at any day. (NASA preferred to arrive when the sun was at an "early morning" position in the sky at the chosen landing site. But in emergency, we can get there at any time with 3 days notice, and less as with nuclear thermal rockets on the drawing boards.) A trip to Mars will take 9 months.

We can converse with people on the Moon with only a 3 second time delay. You will already have noticed a time delay lag on television newscasts when two reporters in different parts of the world talk to one another, their messages being relayed by communications satellites in orbit, some 37,000 km above Earth's surface. Conversations with explorers on Mars will experience an awkward time delay of from 6–40 minutes. That's minutes, not seconds!

NASA preferred to arrive when the sun was at an "early morning" position in the sky at the chosen landing site. But in emergency, we can get there at any time with 3 days notice, and less as with nuclear thermal rockets on the drawing boards. **Video:** http://www.youtube.com/watch?v=snwSU2-KYiE

Bangalore Students Track UK-built Satellite, STRand-1

http://timesofindia.indiatimes.com/india/**Bangalore-students-track-UK-built-satellite**/articleshow/18704308.cms

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For a report on the SARAL Indo-French Satellite, see page 10

For more on **STRand-1** see http://amsat-uk.org/satellites/strand-1/

Selections from the Moon Miners' Manifesto GLOSSARY "MMM Speak"- New Words & Old Words with New Meanings http://www.moonsociety.org/publications/m3glossary.html

Colloquipause - The Moon is in Earth's "Conversational Space" But how much further out does that go?

The further out we go, the more difficult it will be to carry on a conversation. Between Earth and Mars we can only trade reports, as the time delay is a minimum of 6 minutes, and can be as long as 40 minutes - time to take a good break. To Jupiter's moons, the delay will will range from 70 to 104 minutes" time to go out for lunch. To Pluto, the delay will range from nearly 8 hours to nearly 14 hours - leave it to the next shift!
Mars is beyond Conversational Space, but within Hourly Report space. **Pluto** is within Daily Report Space.

Communications lag with **Alpha Centauri** A prime (hypothetical) is 8.6 years, well within "Co-generational or **Contemporary" space**. A a reply from star 50 light years out would get to us a century after we sent it. And that's still very much in our own backyard! Call that **Consecular space** (i.e. seculum = century.) Conversation loops of up to a thousand years would take place in **Co-millennial space**; it gets even more pointless as we go still further out, yet we are still in a tiny pocket of our own galaxy.

This creates a series of "onion peels" of space centered on our Solar System. The laws of Physics, science fiction fan hopes notwithstanding, set a practical limit to visiting, and even to conversation, even to just "keeping in touch."

Beyond a certain point, we can only study and "w**o**nder," and perhaps in time, "w**a**nder" in a migration that will inevitably lose contact with its roots, staying in touch only with other migrating pockets of humanity nearby.

P.S. "Afterthoughts:" We may someday receive/intercept messages sent from far away,long ago, over times and distances that make replying not an appropriate reaction. Rather than reply to senders who may longer exist, we should pass such messages on. **A cosmic version of "paying forward" if you will.** ED.

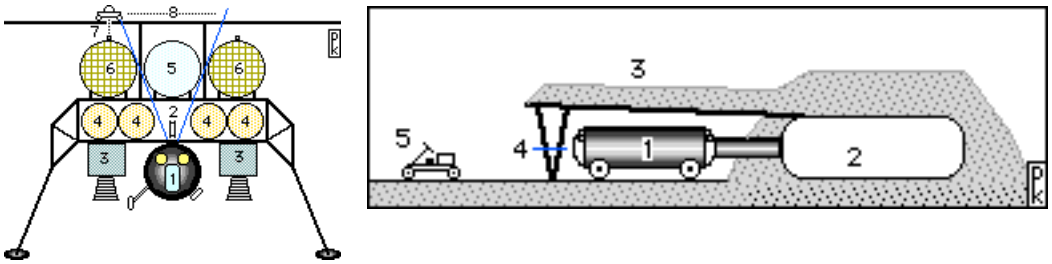
"Earth-like planets", "M-Class Planets" - We've all heard these phrases but no one seems to have tried to get at the essence of what they mean. For our attempt at a precise, get-to-the-essence definition, see Hydotectonic Worlds

Hydrotectonic Worlds - "Earth-like planet" - "M-Class Planet" - We've all heard these phrases but no one seems to have tried to get at the essence of what they mean. "**Hydrotectonic"** is our definition: **active tectonic processes in the presence of water**, i.e. continents and oceans. Mars does not even come close. Any tectonic activities on Mars ground to a halt long ago, probably due to insufficient water and too swift an internal cooling.

Amphibious Space/Surface Vehicles - In ordinary usage, an animal that is at home both in the sea and on the land. An Amphibious Vehicle on Earth means a craft that can ply the seas as well as land like the "Duck" of World War II familiarity. Here we apply it to **a space craft that has an extendable chassis that allows it to drive on the lunar surface after landing**.

See "The Lunar Hostel" and "Hostel" at http://www.moonsociety.org/publications/m3glossary.html

The **Frog** version is one designed for repeated use both in space and on the lunar surface where its use would be confined to trips between the landing-launch site and a lunar surface habitat with which it would dock, sharing systems aboard the craft with which the waiting habitat had not been provided.



Below: Pat Rawlings has a similar, improved concept: the lander's crew module is lowered **onto a waiting chassis**, the chassis remains on the Moon, when the lander returns to space.

http://www.patrawlings.com/images/large/S245.jpg

GREAT BROWSING LINKS

SPACE STATIONS + COMMERCIAL SPACE+ TOURISM

http://www.space.com/72-iss-module-russian-mrm-1-rassvet.html
www.space.com/73-**orion-capsule** - www.space.com/**73-orion-capsule-emergency-escape-system-test.html**
http://www.space.com/19017-**space-tourism-medical-standards**.html
http://www.space.com/19918-**space-google-hangout-nasa-astronauts**.html
http://en.wikipedia.org/wiki/**Interplanetary_Internet**
http://www.space.com/19960-**china-space-station-europe-cooperation**.html
http://www.space.com/19416-**hypersonic-spaceliner-fly-passengers**.html
http://www.space.com/73-**orion-capsule**
http://www.space.com/20327-**spacex-private-rocket-engine-ready**.html

MOON

http://news.discovery.com/space/**print-me-a-moon-base-130201.**htm
http://www.planetary.org/**explore/projects/microrovers/microrovers-catalog.**html
www.fastcodesign.com/1668962/**no-joke-these-guys-created-a-machine-for-printing-houses-**on-the-**moon**#1
Microrovers for assisting humans: http://www.planetary.org/explore/projects/**microrovers/**

MARS

http://www.planetary.org/blogs/guest-blogs/20120516-mcs-**three-mars-years**.html
http://www.planetary.org/blogs/guest-blogs/update_20111025.html
http://www.space.com/16575-**mars-exploration-robot-red-planet-missions-infographic.**html
http://www.space.com/19342-**space-hedgehogs-mars-moon-phobos**.html
http://www.space.com/16851-**most-audacious-mars-missions-ever**.html
http://www.space.com/19451-**nuclear-thermal-rocket-petition**.html
http://www.space.com/19689-**mars-rover-curiosity-first-drill.**html
http://www.space.com/19875-**mars-rover-curiosity-drill-discoveries**.html
http://www.space.com/19932-**mars-color-gray-curiosity-rover**.html
http://planetfour.org - a Zooniverse Project (https://www.zooniverse.org)
http://www.space.com/20133-**olympus-mons-giant-mountain-of-mars.**html
Mars water map coming: http://www.space.com/19507-**mars-moon-flyby-europe-space**.html

ASTEROIDS + COMETS + OTHER PLANETS + MOONS

http://www.huffingtonpost.com/phil-plait/**defending-earth-from-asteroids_b_2341804.**html (& Video)
http://news.discovery.com/space/**asteroids-meteors-meteorites/could-asteroid-mining-drive-21st-century-space-industry**-130204.html
http://www.space.com/19933-**asteroid-deflection-mission-aida-didymos**.html
http://www.space.com/19767-asteroid-vesta-violent-collision-history.html - see video in section below
http://www.space.com/19799-**can-earth-trigger-an-asteroid-quake-video**.html
http://www.space.com/19864-**asteroid-threat-atlas-warning-system**.html
http://www.space.com/18924-**how-big-is-neptune**.html - with links to much more about Neptune
http://www.space.com/19630-**saturn-moon-titan-smog**.html
http://www.space.com/19905-**dangerous-asteroid-deflection-paint**.html
Comet Ison could rival full moon in brilliance in November
http://www.space.com/**19656-comet-ison-nasa-spacecraft-photos.html**

ASTRONOMY + ASTROBIOTICS

http://www.space.com/18916-**telescope-buying-advice-binoculars.html**
http://www.space.com/19703-**intelligent-alien-life-exoplanets-seti**.html
http://www.space.com/19874-**smallest-alien-planet-moon-size**.html
http://www.space.com/19915-**milky-way-galaxy.**html
http://www.space.com/19962-**habitable-planets-binary-stars**.html
http://www.space.com/20096-**exomoons-habitable-alien-life**.html
http://www.space.com/19610-**exomoons-alien-planets-photography**.html
Earth-like planets are right "next door!" - http://www.cfa.harvard.edu/news/2013/pr201305.html

GREAT SPACE VIDEOS

http://www.space.com/20302-**dark-moon-craters-lro-spacecraft.**html - **Must watch!**
http://www.space.com/10405-**hunting-alien-earths-kepler-stares-stars**.html
http://www.space.com/19499-**american-space-program-revitalized-by-private-firms-video**.html

http://www.space.com/19041-**jewel-in-the-night-astronauts-1st-song-in-space-video**.html
http://www.space.com/19692-**canadas-mars-rover-may-hunt-for-martian-methane-video**.html
http://www.space.com/19680-**canada-building-first-satellite-designed-to-track-asteroids-video**.html http://www.space.com/19677-**captain-kirk-calls-space-station-video**.html (must watch! Marvelous@!)
http://www.space.com/19799-**can-earth-trigger-an-asteroid-quake-video**.html
http://www.space.com/19872-**skylon-space-plane-human-spaceflight**.html
http://www.space.com/19920-**mercury-color-video-messenger-spacecraft**.html
http://www.space.com/20086-**mercury-map-nasa-messenger**.html http://www.space.com/10223-**xcor-flight-lynx**.html
http://www.space.com/20144-**dark-craters-of-the-moon-get-lit-up-video**.html
The Lunar Base Race http://www.youtube.com/watch?v=B-6GF_uVhA4&feature=player_embedded
Rocket Science explained for non-rocket scientists http://youtu.be/XwaGW-x7hS0
Charli Robot Gangman Style http://www.youtube.com/watch?v=kmeJvkN4ntI&feature=player_embedded

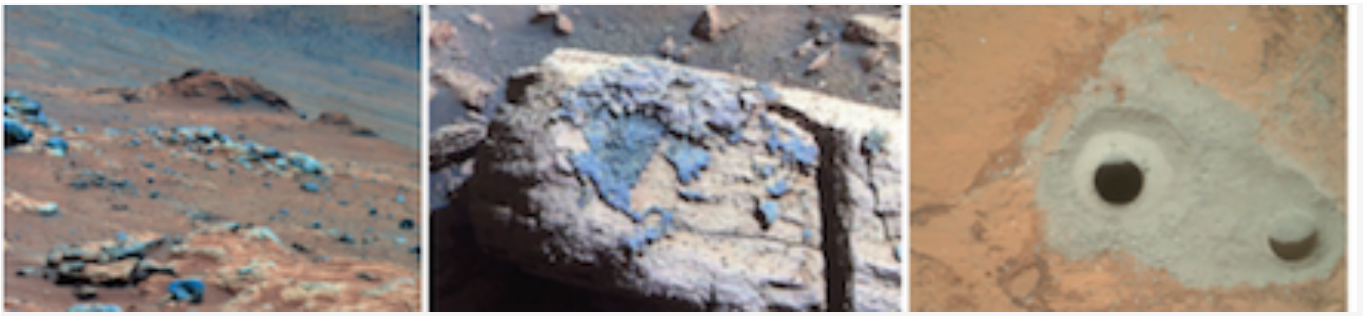
GREAT SPACE BLOGS

http://lightyears.blogs.cnn.com/201
http://hobbyspace.com
http://moonandback.com
http://selenianboondocks.com
http://blogs.airspacemag.com/moon/
http://spudislunarresources.blogspot.com
http://www.blogs.com/topten/top-10-space-blogs/ e e
http://dsc.discovery.com/space/top-10/best-space-science-blogs.html
http://space.about.com/od/computerresources/tp/blogsastrospace.htm

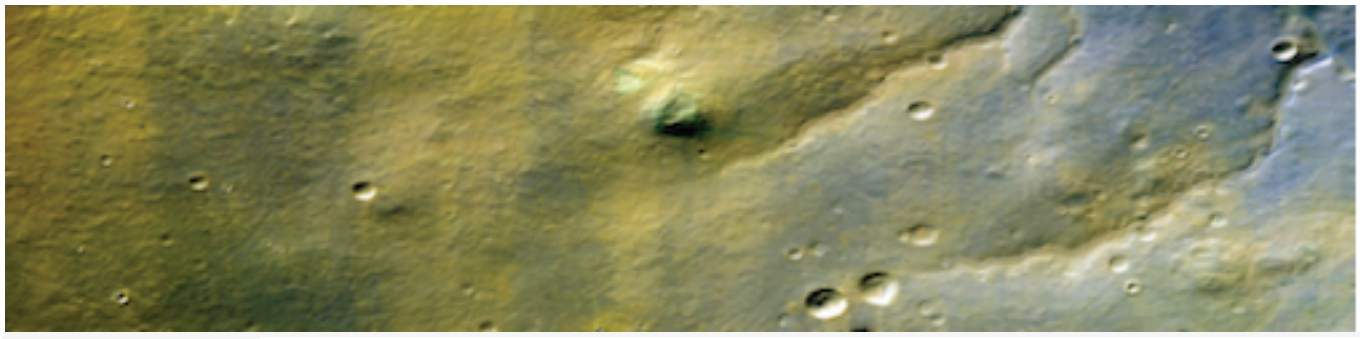
If you know of a good space-related blog to add to this list, please send it to the editor: kokhmmm@aol.com

MZTQ PHOTO GALLERY

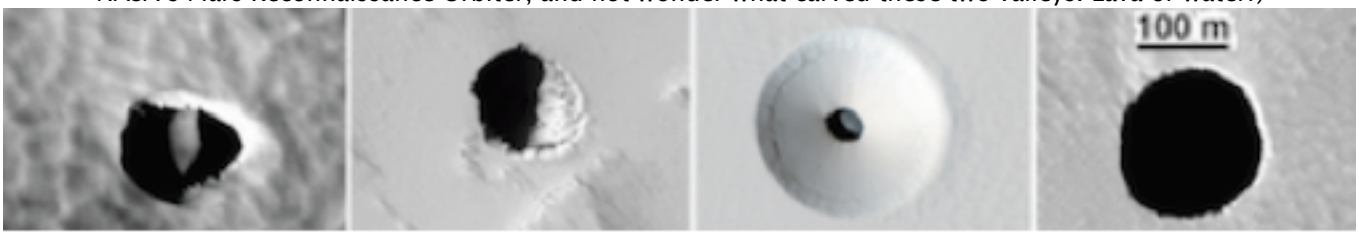
First Meteorite found that came from Mercury? Two opinions:
http://www.space.com/20426-**mercury-meteorite-discovery-messenger**.html
http://science.nbcnews.com/_news/2013/04/08/17661391-**green-meteorites-age-casts-doubt-on-claims-that-it-came-from-mercury**



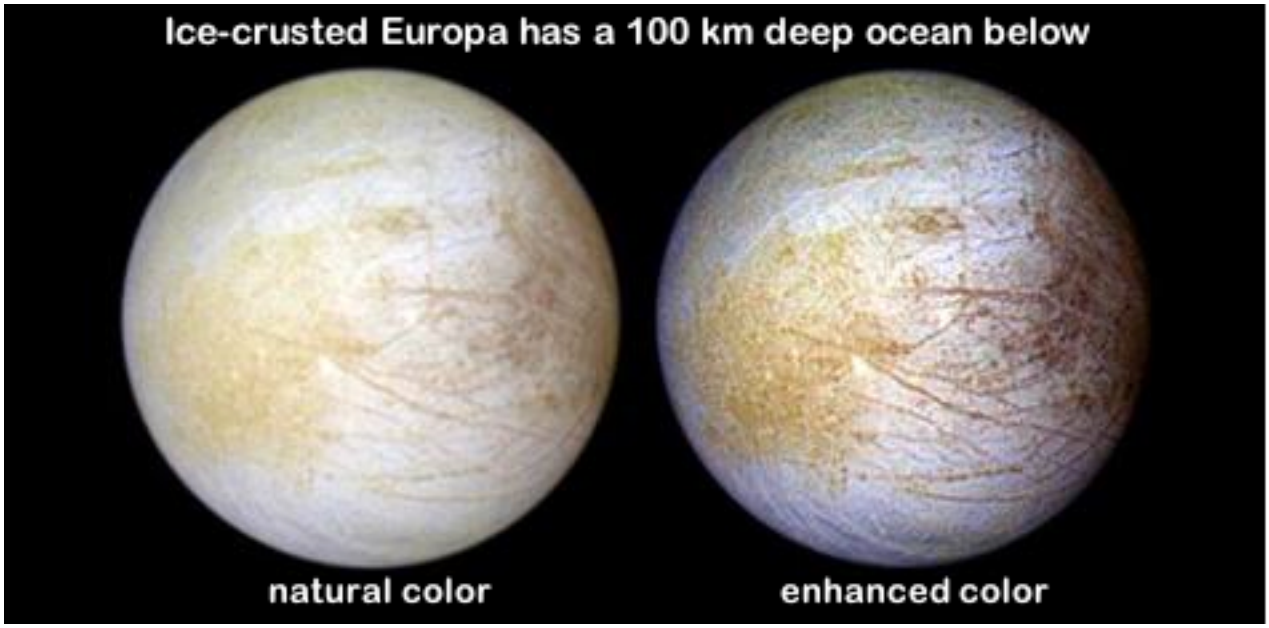
Will Mars' Pioneers collect "blue rocks" for color relief in rock gardens outside their homestead airlocks?
R: Curiosity's drill found gray below: www.space.com/19932-**mars-color-gray-curiosity-rover**.html



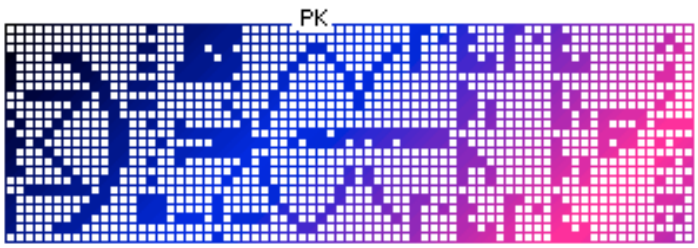
It is hard to look at this first false color image of Mars from the High Resolution Imaging Science Experiment (HiRISE) on NASA's Mars Reconnaissance Orbiter, and not wonder what carved these two valleys. Lava or water?)



http://www.space.com/18519-**mars-caves-lava-tubes-photos**.html - **not all to the same scale**



This color composite view combines violet, green, and infrared images of Jupiter's intriguing moon, **Europa**, for a view of the moon in natural color (left) and in enhanced color designed to bring out subtle color differences in the surface (right). The bright white and bluish part of Europa's surface is composed mostly of water ice, with very few non-ice materials. In contrast, the brownish mottled regions on the right side of the image may be covered by hydrated salts and an unknown red component. The yellowish mottled terrain on the left side of the image is caused by some other unknown component. Long, dark lines are fractures in the crust, some of which are more than 3,000 kilometers (1,850 miles) long. Credit: NASA/JPL/University of Arizona - http://phys.org/news/2013-04-**chemistry-life-europa**.html



Left: The pictorial "telegram" sent out "to anyone who might be listening" in 1974 by the Arecibo Radio Telescope in Puerto Rico. (coloration by the editor, hence the "PK"

Moon Miners' Manifesto Resources

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

MMM is published 10 times a year (except January and July. 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. 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 2011, the first twenty-two years of MMM, 200 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, and Analog Programs** have been added. New Theme Issues will be coming: Lunar Building Materials, The Lunar Economy, The Lunar Homestead, Modular Architecture, Modular Biospherics, Frontier Arts & Crafts, Frontier Sports, Other Solar System Destinations, and so on.

www.moonsociety.org/publications/mmm_themes/

MMM Glossary: The publishers of MMM, the 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(es) 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 2013 Conferences & Events – www.spacecalendar.com/downrange/

Editor's Selection ------2013 -----

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

Apr 22-26 — **International Space University**, Strasbourg, France: Executive Space Course.

May 5-8 — **Planetary & Terrestrial Mining Sciences Symposium, Space Resources Roundtable, Canadian Inst of Mining**, Toronto, Ontario, Canada: 4th Annual PTMSS/SRR Symposium; in conjunction with CIM 2013 Convention.

May 20-24 — **NASA, Kennedy Space Center**, Titusville FL: NASA 4th Annual Lunabotics Mining Competition; for university-level students to design / build innovative excavators (Lunabots) able to mine and deposit at least 10 kg of lunar simulant within 10 minutes.

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

Jun — **CNSA, Launch Long March 2F / Shenzhou 10**, Jiuquan, China: Long March 2F to launch Shenzhou 10 spacecraft for crewed mission to dock with Tiangong 1 laboratory; China 5th human space mission.

Jun 17 – Aug 16 — **International Space University, National Institute for Space Research,** Sao Jose dos Campos, Brazil: The International Space University's 26th Annual Space Studies Program; held at the National Institute for Space Research (INPE) campus

Jul — **CNSA, Launch Long March 5 / Chang'e-3**, China: 3rd robotic Moon Mission with 1st lunar rover; to be 1st soft landing on Moon since 1976 if successful; anticipating 3 months of lunar work; sample return in 2017.

Jul 25-27 — **Space Frontier Foundation**, Silicon Valley CA: NewSpace 2013 Conference.

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.

Nov — **NASA, Launch Atlas V 401 / MAVEN**, Cape Canaveral AFS FL: Mars Atmosphere and Volatile EvolutioN (MAVEN) to determine Martian upper atmosphere, role of atmospheric gas loss in changing Martian climate over time; mission to last 1 year; launch window Nov 18 – Dec 7; Nov 18 launch expected to reach Mars Sep 16, 2014.

------2014 -----

NET 2014— **NASA, Launch Ares 1 CLV / Orion CEV**, Cape Canaveral AFS FL: Unpiloted orbital Exploration Flight Test-1 of Orion Crew Exploration Vehicle.

NET 2014 — **ISRO, Launch GSLV / Chandrayaan-2**, India's 2nd Moon Mission with Russian lander/rover.

NET 2014 — **SpaceX, Launch Falcon 9 / Flight 6,** Cape Canaveral AFS FL: Powered for the first time by Merlin 1D engines, which will enable a full range of payloads to orbit, the SpaceX Falcon 9 rocket set to launch flight 6 to ISS for resupply. **Note:** If you know of a scheduled space conference or other space-relevant event in India that is not listed at the address above, please inform us in advance – mmm-india@moonsociety.org

Help Wanted!

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

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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(es) so that they receive notice when a new issue if published. Readers are encouraged to share and distribute these issues widely, as email attachments, or via the direct download address **www.moonsociety.org/india/mmm-india/**

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

If you wish 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 o our new-issue-ready announcement list, write mmm-iindia@moonsociety.org

MMM-India Quarterly #18: April 2013 Index - Table of Contents

Moon Miners' Manifesto - India Quarterly #18

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Publication Schedule: **JANUARY - APRIL - JULY - OCTOBER**
To add your email address to the distribution list, write mmm@moonsociety.org

Engage! and Enjoy!