

“Towards an Earth-Moon Economy – Developing Off-Planet Resources”

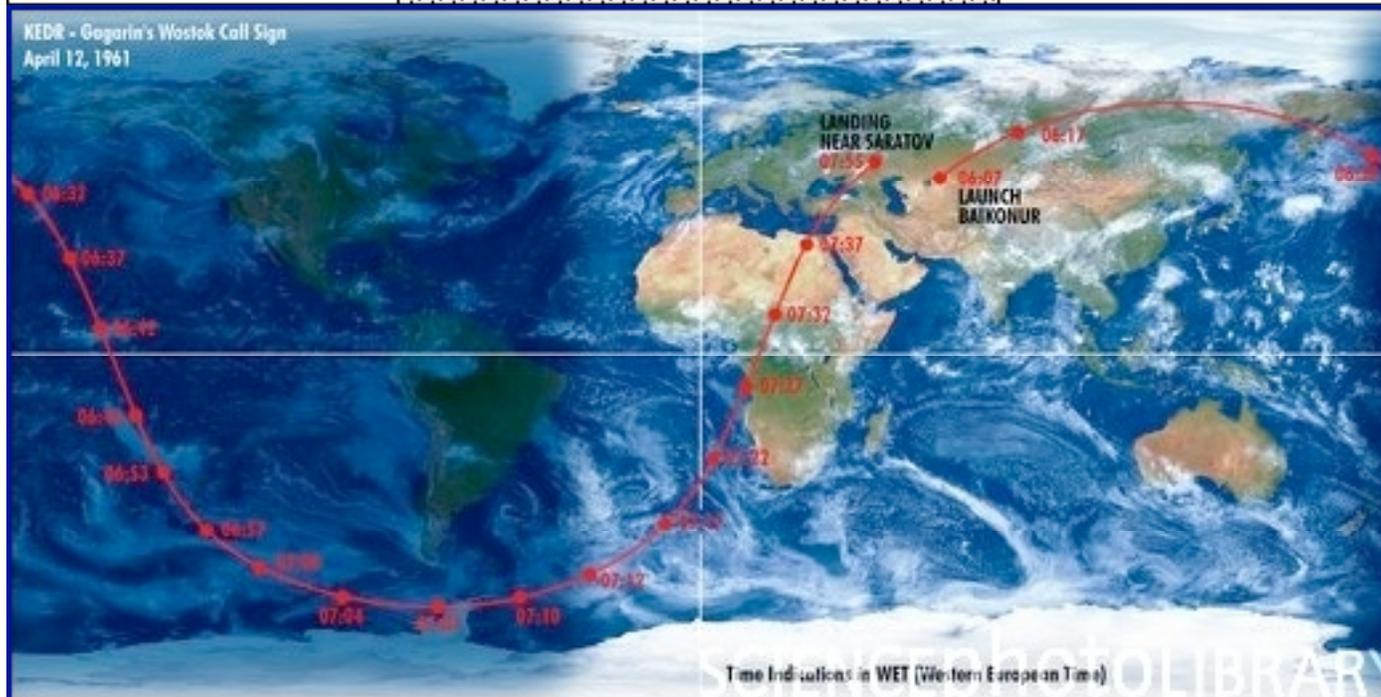
Moon Miners’ Manifesto

India Quarterly Edition

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

#10

APR-JUN 2011



“First Orbit” – The Path of Yuri Gagarin April 12, 1961 – See “First Orbit” page 9

Feature Articles This Issue

Chandrayaan-1 Data Reveals Intact Lava Tube Section	ISRO	p. 3
ISRO invited by NASA to Partner in Moonrise Sample Return Mission 2016		p. 6
On-Orbit Vehicle Assembly at ISS	Charles Powell ASTE 527	p. 22
NASA’s New Moon Mission Budget	D. Dunlop	p. 26
Two Analog Research “Sim” levels	P. Kokh	p. 29
Footsteps on the Moon & Other Leavings	P. Kokh	p. 32
Speculation: Could some Lunar Lava Tubes be Hiding Valuable Resources?	P. Kokh	p. 34
Complete article & feature index on the last page		

Welcome to Moon Miners’ Manifesto India Quarterly Issue #10

Our purpose in launching this unique publication two and a half years ago (already!) was to provide the enormous ground-swell of space enthusiasts in India with a vehicle that might help them organize “Moon Society India.” The reception this Quarterly has received throughout the country has been most gratifying,

But we are not there yet! Moon Society India, spearheaded by Jayashree Sridhar (Chennai) and Pradeep Mohandas (Mumbai) needs to recruit a few more persons to its Executive Committee and to begin growing the general membership. Please read our Call to Volunteer on page 12.

And by all means, spread the word by sending us email addresses of persons who might enjoy this free publication, whether they live within India or abroad.

Once MSI is firmly established on its own, it will take over this publication, giving it a new name and a new look. *That is how it should be!* We look forward to that development. *To the Moon!*

About The Moon Society

<http://www.moonsociety.org>

Our Vision says Who We Are

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

Moon Society Mission

Our Mission is to inspire and involve people everywhere, 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 young people and to people in general, contests & competitions, workshops, ground level research and technology experiments, private entrepreneurial ventures, moonbase simulation exercises, tourist centers, and other legitimate means.

About Moon Miners' Manifesto

<http://www.MoonMinersManifesto.com>

MMM is published 10 times a year (except January and July. The December 2009 issue began its 24th 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. These issues are freely accessible, no username or password needed, at:

www.moonsociety.org/publications/mmm_classics/

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About MMM-India Quarterly

<http://india.moonsociety.org/india/mmm-india/>

This publication was launched with the Fall 2008 issue. This issue completes our 2nd year. The Moon Society was founded as an International organization, but in fact has few members outside the United States, and these are for the most part solitary and unorganized.

Background

The Moon Society and The Planetary Society of Youth (TPSY) in India, <http://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. It is likely that English-fluent Indians outnumber English speakers in the United States. More books are published in English than in any other country.

And – India has now gone to the Moon!

In short, 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 his assertions and want to share that bold vision with the forward-looking people of India.

Free Access:

MMM-India Quarterly issues are available as a free access pdf file, downloadable from this address:

<http://www.moonsociety.org/india/mmm-india/>

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.

Chandrayaan-1 Report Discovery of intact lavatube section

February 25, 2011 - Today, ISRO, Indian Space Research Organization, released a paper detailing the discovery of a 1.72 kilometer long (5,733 ft.) intact lava tube section in the south western reaches of Oceanus Procellarum, Ocean of Storms.

<http://www.ias.ac.in/currsci/25feb2011/524.pdf>

The data was compiled by Chandrayaan-1's Terrain Mapping Camera (TMC), one of the eleven science instruments on board India's first lunar orbiter, launched October 22, 2008.

<http://www.isro.gov.in/chandrayaan/htmls/tmc.htm>

"The TMC image is in the panchromatic spectral range of 0.5–0.75 m with a stereo view in the fore, nadir and aft directions of the spacecraft movement and with a high spatial resolution of 5 m at an orbital height of 100 km (ref. 1), to enable three-dimensional viewing of the lunar surface with crisp and clear surface features and morphology.

"The Digital Elevation Model (DEM) generated from the three look angles enables morphometric study of various lunar features, thus furnishing topographic relief and dimensions of various morphological entities.

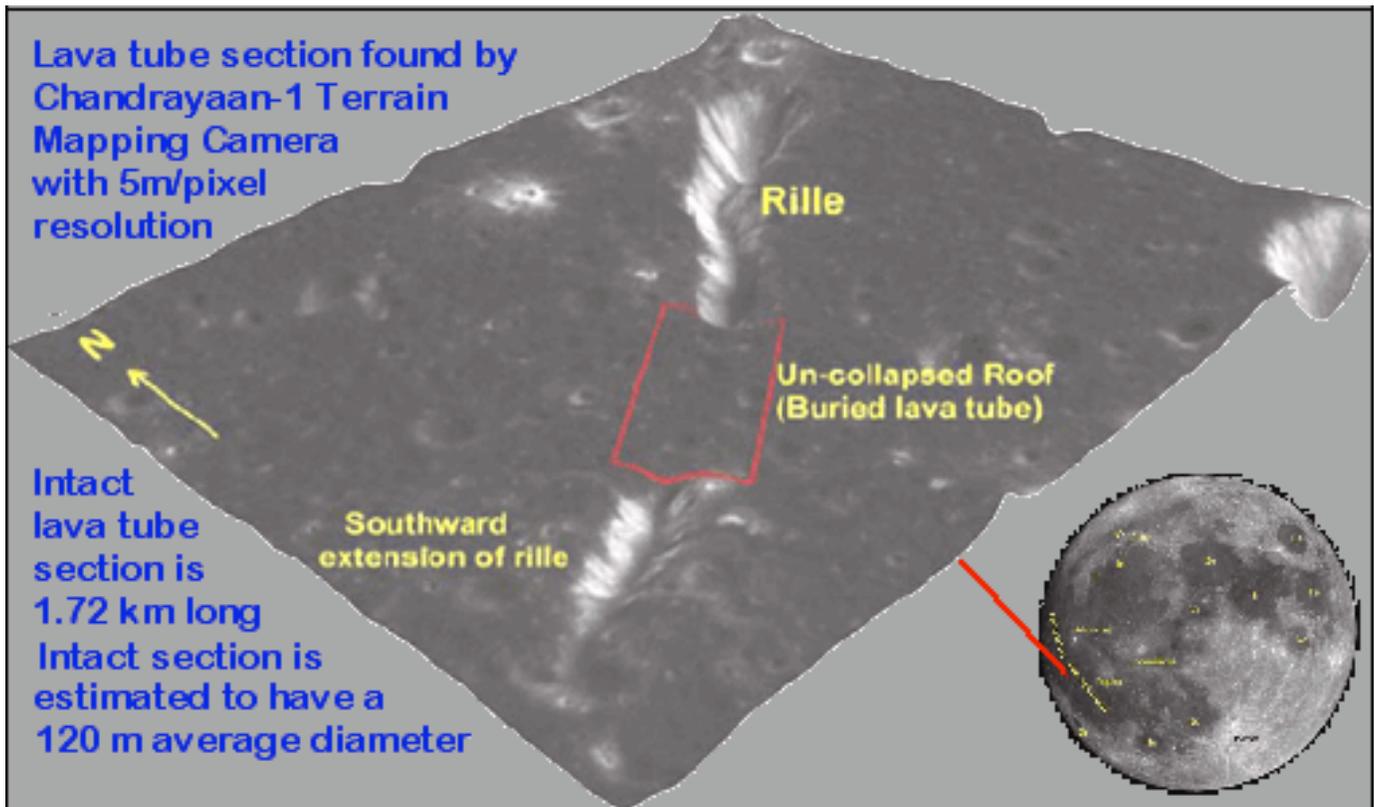
"Identifying sites for permanent base stations for possible human settlement on the Moon is important for long-term perspective of lunar exploration."

Japan's Kaguya probe had previously discovered the first of several lavatube "skylights" now known, the find announced in 2009. Lunar Reconnaissance Orbiter has discovered several more.

Chandrayaan-1's finding reinforces the prevailing assumption that the basaltic lava flow areas of the Moon (the maria, pronounced MAH-ria, Latin for seas) that occupy 39% of the Moon's nearside, and a lesser portion of the Farside. These are substantial and voluminous spaces well-shielded from the cosmic elements of radiation and micrometeorites, and as such provide ideal locations for area-intensive developments such as warehousing, industrial parks, agriculture, archiving, and settlements.

A discovery long predicted: More than 20 years ago, Cassandra Coombs and B. Ray Hawke had published a list of such "interruptions" in various lunar rilles, suggesting that they represented "uncollapsed" sections of an original long lava tube. It was the Apollo 15 mission, which, back in the summer of 1971, set down along the rim of Hadley Rille, that convinced lunar geologists that these features were the remains of collapsed lava tubes of gigantic proportions.

Perhaps the most familiar of these suspected "interrupted" rille sections are those along Hyginus Rille in central nearside. What has been needed is a very high-resolution view taken from just the right angle facing one/both "end(s)" of such an "interruption" or "bridge" and that is what Chandrayaan-1's high-resolution Terrain Mapping Camera has provided. We look forward to the release of similar findings elsewhere on the Moon.



Editorial Comment (Peter Kokh):

It is a top level priority of the Moon Society (International) to change public perception of the Moon from that of a "been there, done that rubble pile" to one of "a fascinating world of Hidden Valleys ideal for human settlement and begging to be explored."

We are encouraged that while NASA seems to have turned its back on the Moon, to go with the flow to Mars, the space agencies of other nations have not done so. The International approach, with or without NASA, is more likely to "go the course" and prepare the way for the establishment of a permanent human pioneer frontier on this "Eight Continent."

Another finding: Shortly after this report came out, NASA announced a similar find, in NW Mare Imbrium:

http://www.nasa.gov/mission_pages/LRO/multimedia/lroimages/lroc-20110217-chain.html

Relevant Reading:

- **Lavatube Skylight Explorer:** Building on the previous discovery of lavatube skylights on the Moon, the Moon Society (International) announced its intention to sponsor an engineering competition to design a probe that could lower itself down into one of these skylights and explore what it sees. You can download our Lavatube Explorer PowerPoint presentation ([SkylightExplorer.ppt](#)) from this directory:

www.moonsociety.org/competitions/engineering/

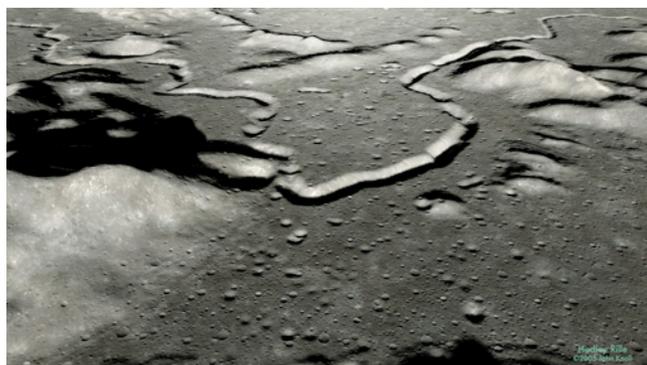
- **The Potential of Lunar Lavatubes:**

www.moonsociety.org/publications/mmm_papers/lavatubes_ccc.htm

- **How we might use a collapsed section of a lavatube: "Prinnton: a Rille-bottom Settlement for 3,000 people:**

www.moonsociety.org/publications/mmm_papers/rille_paper1.htm

Below: Hadley Rille, the only such feature visited by human a human crew:



More Views:

<http://facstaff.gpc.edu/~wlahaise/Hadley%20Rille%20Apollo%202015.jpg>

http://www.nasa.gov/centers/ames/images/content/368637main_hadley-rille.jpg

http://www.nasa.gov/centers/ames/images/content/368635main_hadley-rille-closeup.jpg

<http://www.lpi.usra.edu/publications/slidesets/hawaii/volcanoes/images/hawaii12.jpg>

PM: Space Programme can help realise Sustainable Development

<http://www.allvoices.com/s/event-5896012/aHR0cDovL3d3dy5uZXdrZXJhbGEuY29tL25ld3Mvd29ybGQvZnVsbG5ld3MtMTc2ODQ5Lmh0bWw=>

Ahmedabad, March 26: Prime Minister Manmohan Singh asked the **Indian** Space Research Organisation (ISRO) to give priority to tele-education, tele-medicine and village resource centre services.



Stressing space-based observation systems, a newer class of environment and monitoring sensors and study of weather-related phenomena, he said, "The space programme has a vital role to play in making the concept of sustainable development a reality."

He noted that space-based applications are a very

potent means of bridging the divides in society through reducing the cost of access to space.

"This requires expediting the development of heavy lift launchers, advanced propulsion systems, including the cryogenic stage, and recoverable and reusable launch systems. We should pay greater attention to the Geosynchronous Satellite Launch Vehicle Programme."

On the need to master newer technologies for more sophisticated communication satellites, the Prime Minister said that "Satellite-based broadband internet services could bring about a new technological revolution that directly benefits rural and remote areas,"

PSLV-C16 Mission a Triple Success India Puts Three Satellites into Orbit

By Pradeep Mohandas

<http://spacefellowship.com/news/art25564/india-puts-three-satellites-into-orbit.html>

The Indian space agency ISRO on Wednesday, April 20th, after eighteen nervous minutes, successfully launched three satellites. The mission, designated PSLV-C16, orbited India's remote sensing satellite, RESOURCE-SAT-2, an Indo-Russian collaborative space physics satellite, YOUTHSAT and Singapore's first satellite, XSat-1. All satellites are operating normally.

Resourcesat-2, an advanced remote sensing satellite to study natural resources. will provide information on biophysical and geophysical parameters on the Earth's surface. The biggest satellite aboard this launch, replaces Resourcesat-1, launched in 2003.

The **joint Indian-Russian satellite Youthsat** for stellar and atmospheric studies and **Singapore's first satellite, X-Sat**, a mini satellite for imaging applications, and the Singapore Nanyang Technological University 100kg X-sat micro satellite were also on board in this dramatic success for ISRO after a series of failed launches.

It has been a nervous build-up to this mission. The Indian Space Research Organisation (ISRO) has been faced with two mission failures of the Geosynchronous Satellite Launch Vehicle (GSLV) last year and was rocked by the Antrix-DEVAS S-band spectrum scandal. Following these, ISRO was extra cautious with this launch with its liquid stage engine going through additional testing in the build up to the launch.

On the morning of April 20, 2011 at 10.12 am (IST), the PSLV-C16 lifted off from the Satish Dhawan Space Center (SDSC), Sriharikota. Over the next eighteen minutes, the Mission Control was absorbed and tense. As the PSLV completed critical mission steps, there was nervous clapping. Finally, at 18 minutes after lift-off there were cheers as RESOURCESAT-2 separated from the fourth stage of the PSLV and then cheers again as YOUTHSAT and XSat-1 separated.

On April 25, 2011, ISRO reported that the launch had put all 3 satellites in precise orbits. Such was the precision that it saved RESOURCESAT-2 about 10 kg of fuel. It was also announced that the two Indian payloads on YOUTHSAT was also switched on.

On April 28, 2011, ISRO announced that the RESOURCESAT-2 satellite had relayed very good quality images. Also it was announced that the second Russian payload on YOUTHSAT was switched on. "The Moon Society's purpose is to encourage the development of a vigorous pro-space movement in India, in light of public enthusiasm over the successful launch and mission of Chandrayaan-I.

India is looking to emerge as a global player in the lucrative satellite launch market. With *16 consecutive successful flights*, including the launching of India's 1st lunar mission Chandrayaan-1, the PSLV has gained a reputation as a reliable and versatile launch vehicle.

More on PSLV -
http://en.wikipedia.org/wiki/Polar_Satellite_Launch_Vehicle

Space Tourism in India

Space tourism wows India's Kerala State

<http://www.ibtimes.com/articles/106231/20110128/space-tourism-wows-india-s-kerala-kerala-tourism-kerala-backwaters-god-s-own-country-india-tourism-a.htm>

January 28, 2011 The interest in Space tourism is spreading world. **Kerala Travels plans to send 30 children age 12 to 18 years, selected from across the country, to a "space camp at the Singapore Space Centre (SSC) April 27, 2011,** where they would be given a thorough understanding of space by experts from NASA." K.C. Chandrasan, managing director of Kerala Travels, told media.

Their visit to Singapore Space Centre **would be followed by "next stages being planned,"** IANS reported.

Five Indians have purchased 90 lakh tickets to experience Zero Gravity, earn astronaut wings

www.siliconindia.com/shownews/Now_take_a_trip_to_the_space_with_Rs90_lakh_worth_ticket-nid-78886-cid-1.html

By SiliconIndia 14 February 2011

In 2012, Virgin Galactic will launch the first ever commercial space flight for space enthusiasts all over the world, estimated to cost about \$200,000 (about Rs 90 lakh).

Five Indians are among the 500 enthusiasts who are ready to explore the space. The first 500 to sign up for flights come from 45 countries. The space travelers will rocket to 110 km above Earth's surface in a two-hour trip. Virgin Galactic's partner, Scaled Composites, is building the first privately funded manned spaceship, the first being christened "**Enterprise.**" The spacecraft is attached to a mother ship, which will take it to a height of 15,300 meters.

Then Enterprise's rocket motors will ignite, accelerating the ship to three times the speed of sound, taking it up over the Earth's atmosphere. Then, the engines will shut off, allowing the passengers to experience weightlessness, do somersaults, and gaze out the many round windows at the Earth below. By traveling to 100 kms above Earth's surface they will earn the title "astronaut." After 4 to 5 minutes, they will feel gravity again, As Enterprise reenters the atmosphere and glides back to Earth.

The space tourists must first prepare for the experience. will include medical tests, safety training and interactive sessions between space travelers and pilots .

Virgin foresees the ticket prices coming down up to about a quarter of the initial price, 22.5 lakh.



Above left: SpaceShip 2 ("Enterprise") rocketing free from its "mother ship" "White Knight 2" -Below: Enterprise's wings swivel upwards for controlled descent.



More Information: <http://www.virgingalactic.com/>
http://www.youtube.com/watch?v=FPJSH4XXhE&feature=player_embedded (Video)

ISRO invited by NASA to Partner in 2016 Sample Return Mission to the Lunar Farside

<http://www.parabolicarc.com/2011/02/12/isro-partners-jpl-proposed-moonrise-lunar-sample-return-mission/>



Above: top right **ISRO lunar Orbiter** that would maintain contact between Earth and the lander (bottom, on surface) and Sample Return vehicle (above surface, headed back)

Other Sources:

<http://moonrise.jpl.nasa.gov/> (Overview, Science, Technology, Team, News, Multimedia, Education)

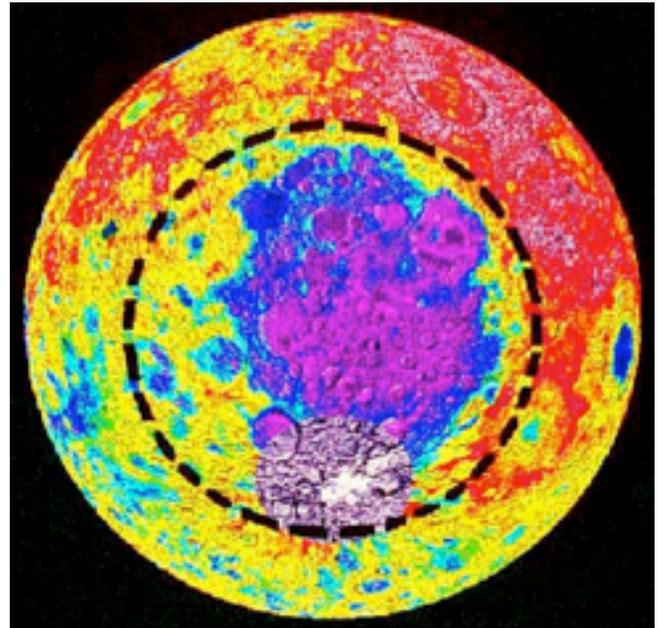
India agrees to Aid NASA Moonrise Mission

www.portaltotheuniverse.org/blogs/posts/view/108205/

By Peter Kokh

In an agreement which cuts costs, while combining the talents of two major space agencies in an effort that will allow both to pioneer potentially ground-breaking science in a mysterious unsampled area of the Moon's farside, forever hidden from direct view from Earth, this announcement is very encouraging. But there are some hurdles that must be overcome, notably the current budget crisis in the United States that could potentially force NASA to cancel or postpone this long-desired mission. Meanwhile scientists in both countries are proceeding with the design and planning stages in the hopes that Moonrise will fly as projected in 2016, five years from now.

The target area is the so-called "South Pole-Aitken Basin, the deepest impact basin on the Moon, some 8 km below the Moon's mean surface level at the basin's center. The basin except for its southernmost polar fringe lies entirely on the Moon's Farside, out of reach to the Apollo moon landing missions.



False colour image of lunar farside showing South Pole-Aitken Basin within dotted line. Blue and purple areas are the lowest in elevation and may contain previously unsampled material from the Moon's mantle forced to the surface by the tremendous impact.

India to provide Orbital Relay

But this area has also been out of reach to landers of any type for the simple reason that we cannot control from Earth anything not in line of sight of Earth or of relays in Earth orbit. And here is where India's contribution comes to the rescue. ISRO would provide the orbiter, which will receive reports from the lander and sample retriever, and store them until the orbiter passes around the limb and is again in line-of-sight with Earth. Without this orbiter, such a mission could not be attempted. Whether or not ISRO will also contribute instruments to the lander-sampler is not stated, but it seems eminently logical to extend the collaboration in this fashion.

It is heartening to this writer, that despite some real friction over the reporting of Chandrayaan-1, both agencies understand that it is in their benefit and long-term interest to continue to pursue opportunities to work together. There is much to gain, nothing to lose. ISRO can add another mission to its already ambitious lunar agenda.

On February 12th, The Space Commission, India's apex space policy body, gave ISRO the go-ahead to partner with JPL in developing the Moonrise Mission. JPL (Jet Propulsion Laboratories) is a world famous lab operated for NASA by the California Institute of Technology (Caltech).

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

Sample Return

This will be the first samples of lunar materials to be returned to Earth since the Soviet (Russian) Luna 24 in 1976, in other words, the first in forty years, unless China retrieves a sample first. That this is to be an International mission gives it an advantage when it comes to potential budget cutting by the US Congress, which tends to respect International commitments.

PK

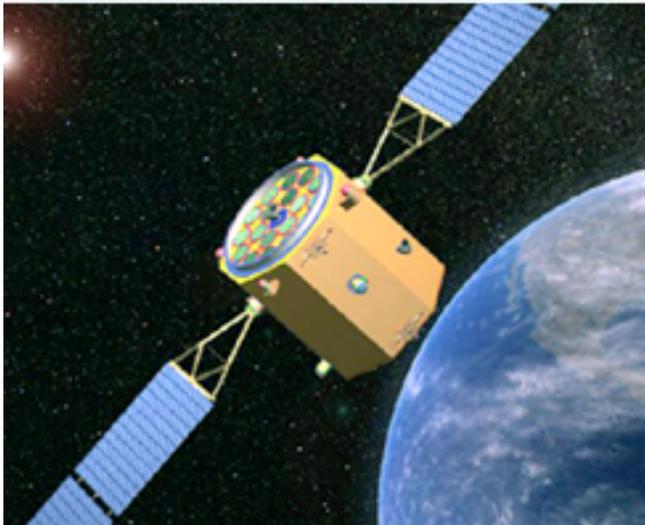


Elsewhere in Asia

Chinese
National
Space
Agency



China to launch 1st space telescope in 2012



<http://www.hxmt.cn/english/>
http://en.wikipedia.org/wiki/Hard_X-ray_Modulation_Telescope
<http://unified-communications.tmcnet.com/news/2009/07/23/4287484.htm> =

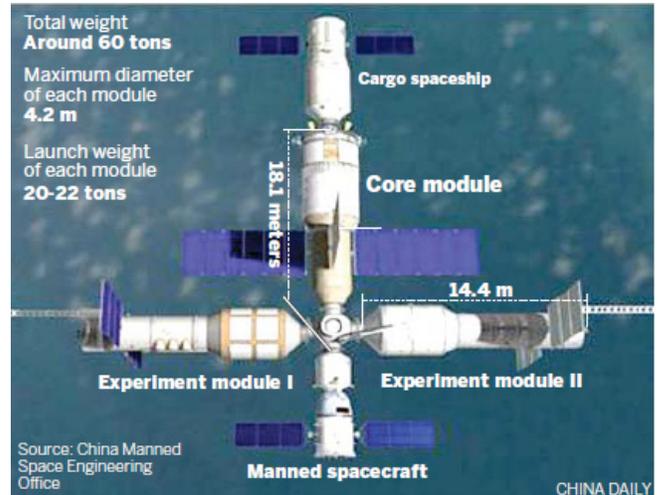
China's Hard X-ray modulation Telescope, that nation's first contribution to in-space astronomy, is designed to observe black holes, and comprises three to four single telescopes equipped with hard X-ray detectors, instead of optical lenses, according to Li Tipei, academician with the Chinese Academy of Sciences (CAS). These detectors are much more sensitive than optical lenses to black holes. The telescope and its carrier will weigh about one ton, and orbit Earth at an altitude of about 500 km. The life expectancy is four years.

The launch might cost 1 billion yuan (US\$146 million), had been scheduled for last year, but it was postponed for two years due to financial problems. The mission was initiated by China's Ministry of Science and Technology, Tsinghua University and the CAS in 2000.

The ground prototype of the HXMT has been completed, with all the key technical difficulties being overcome.

China Unveils Space Station Plans

Deployment Goal 2020



Reminiscent of MIR towards the end of its evolution

<http://www.businessinsider.com/china-space-station-2011-4>

<http://www.guardian.co.uk/world/2011/apr/26/china-space-station-tiangong>



The station as planned would weigh 60 tonnes (MIR's final weight was 137 tonnes: ISS weighs 419 tonnes)

The China Manned Space Engineering Office wants the public to get enthused by having the opportunity to suggest names and a standout symbol for the station. They had previously named the station "Tiangong" meaning heavenly palace.

First things first. A Tiangong-1 lab module is to be launched later this year. Then next year a manned Shenzhou capsule will attempt to dock with it. This process must be mastered if the final complex of several modules is to be successfully assembled.

There has been no sign of interest in China in inflatable modules such as those being developed by Bigelow Aerospace, a commercial firm headquartered in Las Vegas, Nevada, USA. These modules will be lighter, yet more spacious, as well as more puncture-resistant.

Meanwhile, the lifetime of ISS has been extended to 2020, and many of the International Partners would like to see it continue in service well beyond that date.

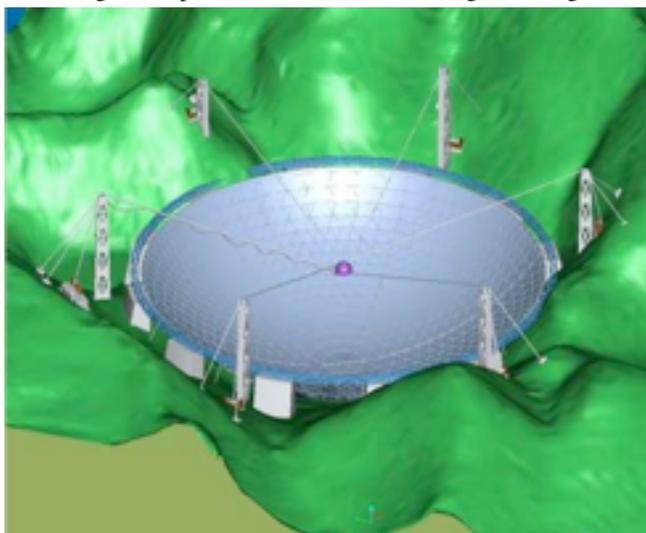
By 2020 a number of commercial space stations may be in orbit serving a variety of functions. Mastery of "coastal space" will have become widespread. **M3IQ**

World's largest Spherical Radio Telescope to be built in SW China, Guizhou Province

The Five-hundred-meter Aperture Spherical Telescope (FAST) will be built in a huge natural Karst depression, and at 500 m wide, have a total area 2.7 times that of the famed 305 m wide Arecibo telescope, and have a "capacity" of ten times as much.

<http://www.allvoices.com/news/8463534-official-huge-telescope-on-the-agenda-in-sw-china>

Construction will start soon, and the project is expected to take five years. Work was to have started in 2008, but has been delayed because of the need to get permission of the Forestry Authorities, which have jurisdiction over the area. Apparently bureaucracy is slow everywhere! But the delay has had advantages, with several technological improvements made to the original design.



Composed of 4,600 panels, the spherical instrument's highly sensitive passive radar will also be of service in monitoring satellites and space debris, which will be a benefit to China's ambitious space program.



Location of Pingtang county, Guizhou province about 400 km S of Chongqing, 500 km N of Hanoi

Earlier article (when project first announced):

http://www.spacedaily.com/reports/China_Starts_Work_On_Largest_Radio_Telescope_Ever_Built_999.html

Japan Aerospace Exploration Agency



NASA TOOK CONTROL OF JAXA ISS MODULES as JAXA control center sustains Earthquake damage

<http://news.discovery.com/space/japans-evacuates-space-station-control-center-1.html#mkcpgn=rssnws1>

NASA control centers in Houston, TX and in Huntsville, AL took charge of Japan's **Kibo** space complex, the station's largest laboratory, after the 9.0-magnitude earthquake hit Japan on March 11, 2011.



JAXA's Kibo complex

NASA is also began overseeing the Japanese cargo ship docked at the orbital outpost following the evacuation of the Japan Aerospace Exploration Agency (JAXA) center in Tsukuba in the wake of the earthquake.



JAXA robotic Cargo ship at ISS

JAXA's space station control center is located about 30 miles northeast of central Tokyo and has sustained significant damage. Experiments inside Kibo were shut down before the Tsukuba center was evacuated. Experiments and payloads attached outside the complex have not been impacted.

The Tsukuba center was reopened after two weeks, and control required from NASA. ▣

Now for an Encore! Hayabusa-2



<http://www.jspec.jaxa.jp/e/activity/hayabusa2.html>

Asteroid Itokawa, the 500 m long target of the troubled but eventually successful Hayabusa mission, is an “S-type” asteroid. These siliceous stony asteroids make up some 17% of the known asteroid population.

http://en.wikipedia.org/wiki/S-type_asteroid

Now JAXA is considering a C-type astrochunk. These are also stony, but also carbonaceous, including hydrated minerals and far more common, forming around 75% of known asteroids and an even higher percentage in the outer part of the belt beyond 2.7 AU. Is there any relation between carbonaceous asteroids and life on Earth? Hayabusa-2 may throw some light on that question.

http://en.wikipedia.org/wiki/C-type_asteroid

A tentative target has been identified: Asteroid 199_JUS, not yet named, in an orbit similar to Itokawa’s.

[http://en.wikipedia.org/wiki/\(162173\)_1999_JU3](http://en.wikipedia.org/wiki/(162173)_1999_JU3)

1999_JUS is an Apollo class asteroid – also known as “Earth-crossers” with perihelions within Earth’s orbit and aphelions beyond Earth’s orbit. They have periods close to a year but pass close to Earth very infrequently.

{The closer two objects are in period, the less frequent are their mutual passes and/or launch window opportunities – a Catch 22 of orbital mechanics.}

Apollo objects are the class of objects that could conceivably impact Earth.

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

Asteroid 1999_JUS is about twice the size of Itokawa with a similar elongated shape 980 +/- 29 meters in length, and a rotation period of 0.3178 days or 7 hours, 37.6 minutes.

Differences from Hayabusa-1

Hayabusa-2 will use ion engines as did Hayabusa and be similar in size. But “problematic points discovered in the Hayabusa mission will be corrected.” Hayabusa-2 will have a planar antenna in place of parabolic one of Hayabusa.

Hayabusa-2’s mission will be similar: first characterize the asteroid, then collect samples and return them to Earth. A small lander, Minerva-2 will be included. ■

Russian Space Agency



Russia, Israel to boost space cooperation

<http://english.ruvr.ru/2011/03/28/48091534.html>

Mar 28, 2011 – The space agencies of Russia and Israel have signed an agreement whereby they will collaborate on **Space Exploration and Uses of Outer Space**. The agreement was signed by **Roscosmos** head Anatoly Perminov and Dir. General of the Israeli space agency **Tsvi Kaplan**.

Russia has already been helping Israel in its space program. Russian carrier vehicles assisted Israel in putting five of its spacecraft into orbit. At present, our country is developing an Amos-5 communications satellite for Israel.

The new document facilitates the transition from purely commercial projects to a brand new level of interaction, opening up new fields as well. This cooperation is not aimed at giving Israel any military advantage over its neighbor countries. Rather, it is “Especially promising for the two countries’ space agencies are segments linked to space exploration, the discovery of new materials, navigation, medicine and space biology.”

About

Tsvi

Kaplan



www.most.gov.il/English/Units/Israel+Space+Agency/

ISA is a Unit of the Ministry of Science and Technology, and has signed cooperation agreements with the following bodies: CNES – France; NASA – USA; CSA – Canada; **ISRO – India**; DLR – Germany; NSAU – Ukraine; RKA – Russia; NLR – Holland

Agreements with the following bodies are yet to be signed: ACE – Chile; AER – Brazil; KARI – Korea

<http://www.most.gov.il/English/Units/Israel+Space+Agency/ISA+International+Relations.htm>

<http://www.most.gov.il/English/Units/Israel+Space+Agency/About+ISA.htm>

<http://www.most.gov.il/English/Units/Israel+Space+Agency/ISA+Activity/The+Israeli+Space+Industry.htm>

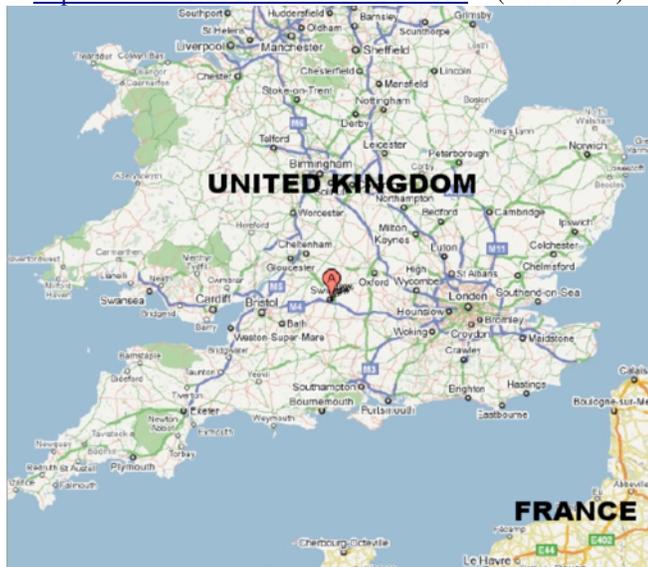
<http://www.most.gov.il/English/Units/Israel+Space+Agency/ISA+Activity/Satellites.htm>

Elsewhere in the Commonwealth



UK Space Agency launches in Swindon

<http://www.bbc.co.uk/news/uk-12879219> - (with video)



Location of Swindon east of Bristol, west of London

UK Space given boost from Budget

<http://www.bbc.co.uk/news/science-environment-12833654>

The government has promised regulatory change and some extra money to help boost the competitiveness of the UK space sector, which is growing at about 10% a year. £10m will go to fund new technologies used in spacecraft systems. There will also be changes to the Outer Space Act.

These reforms are designed to lower the sector's insurance costs and to make it easier for space tourism companies to operate out of the UK. {Virgin Galactic, currently at the head of the Space Tourism pack, is headquartered in the UK.)

The government recognizes the success that the British space sector has achieved in recent years and wants to offer it further support to maintain and grow its global market position. The best performing areas are in so-called downstream activities - services such as satellite broadcasting and telecommunications. But even the upstream sector - such as satellite manufacturing - has been doing well, with annual growth of 3% over the period 2006 -09.

The £10m on offer is part of a £100m injection of capital investment into science. The space money will be matched by industry to start a National Space Technology Programme, supporting development of new components and systems that companies can then sell around the world.

UK and Russia commit to Collaboration in Space Science

<http://www.govnet.co.uk/news/2011-02-22/uk-and-russia-commit-to-collaboration-in-space-science>

<http://www.4rfv.co.uk/nationalnews.asp?id=123234>

Tuesday, February 22, 2011 – Moscow: The UK and Russia will share expertise, knowledge and innovation in space science during “The UK-Russia Year of Space 2011.”

- University College London and the Institute of Medical and Biological Problems in Russia will work together on a psychological study of crew behaviour in space.
- Kingston University and the Russian Federal Space Agency Roscosmos will look at how fluids behave in microgravity, with experiments carried out simultaneously onboard the International Space Station and in schools in the UK and Russia,.
- A series of ‘Space Science Cafes’ will bring together leading UK and Russian senior space scientists to share knowledge, and look at priority areas for future research.

This program is part of an effort to promote greater cooperation on life sciences, physics, climate science, energy efficiency, nanotechnology and space science.

South African Space Resources Association (SASRA) Launched

<http://www.urban-astronomer.com/Urban-Astronomer-Updates/sasralaunched>

February 19, 2011 - Following fast on the creation of the South Africa National Space Agency (SANSA) last year, today, the founding members of the South African Space Resources Association (SASRA) signed the association's constitution, making its formation official. SASRA was founded by Michael Neale, a graduate of the Mining Engineering Department at the University of Pretoria, “to involve South Africa in the rapidly growing field of In-situ Space Resources Utilisation (ISRU).” [In Situ is Latin jargon for “on location” - “beyond Earth” being implied.]

“If humanity is ever to spread beyond planet Earth, our presence in space needs to be self-sustaining. Orbital stations, bases and colonies on Mars and the Moon need ready access to resources that are simply not feasible to lift up through Earth's gravity well in meaningful quantities. We must find basic resources and build mines to extract them.

“South Africa is one of the world's primary mining economies. We possess the technology and the expertise to build some of the world’s deepest mines in. We certainly have a great deal to offer the field, and if we could marry our mining giants to our space agency, SANSA, then we could rapidly become a world leader in space technology.

“SASRA's primary objectives are to improve the awareness of the global Space Resources industry and potential in South Africa, to encourage South Africans to contribute technically to the global Space Resources industry and to positively enhance the education attitude of the South African youth, through the use of Space Resources as a potential future involvement.’

Editor's Note: We expect that SASRA is aware of, and will be cooperating, with another Commonwealth hotbed of mining technology, **NORCAT, the Northern Centre for Advanced Technology** in Sudbury, Ontario, Canada, co-host with the Space Resources Roundtable (US) of the annual **Planetary & Terrestrial Mining Sciences Symposium**, PTMSS <http://www.ptmss.com/> - this year being held in Ottawa, Ontario, Canada June 19-22, 2011.

“FIRST ORBIT”

April 12th, We celebrate the 50th Anniversary of the first human spaceflight, Yuri Gagarin's solo one-orbit flight around the world

By Peter Kokh

Yuri was a Russian, a citizen of the former Soviet Union. But above all he was the first of humankind to soar above the atmosphere, and in an hour 48 minutes, he encircled the globe, shattering forever, the bonds that have held all of us to our home planet's surface.

“Yuri's Night” – launched exactly ten years ago , is now a world-wide observance. But this year is special. Our space machines have come a long way since Sputnik opened the space age to our machines in 1957.

But in what really counts, we humans, having spread out of Africa to fill the seven continents, through Yuri and the many astronauts of many countries who have followed, have signaled our intention to make the giant leap *“from an inter-continental species to an inter-planetary one.”* Where will be in 50 more years?

Yuri's flight, now a movie: “First Orbit”

Yuri did not have a camera to document for us all the splendid views outside his Vostok capsule window, only an audio recording. But now his experience has been recreated in a movie. The audio recording has now been matched to high-definition video shot from the International Space Station.

Gagarin's 108-minute journey around the globe took him across the Soviet republics, across the Pacific Ocean, over the Straits of Magellan in South America, above the Atlantic and Africa before re-entry and a bailout back to the ground near the city of Engels in southwest Russia.

The view down to Earth along this same path has now been filmed from the International Space Station (ISS). That was not as simple as it sounds!

Film director and space historian Dr Chris Riley noted, "My stipulation was that we had to film it at the same time of day that Gagarin had seen it, to get the Sun angles right. This only happen every six weeks,"

The movie is appropriately named **“First Orbit”** and will have debuted on You Tube in time for the grand 50th Anniversary .

I look forward to watching it – again and again and again. *May this film inspire us all!* **PK**

MMM-India Quarterly Editors:



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 University of Luna Project

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 Well-known space writer



Pradeep Mohandas
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 Formerly President of SEDS India

Moon Society India

From Pradeep Mohandas

The Moon Society's purpose is to encourage the development of a vigorous pro-space movement in India, in light of public enthusiasm over the successful launch and mission of Chandrayaan-I.

The Moon Society was started in India on **November 14, 2009** under the leadership of Jayashree Shridhar, Pradeep Mohandas and Avinash Siravuru.

The Moon Society is an international educational and scientific non-profit organisation founded in USA in 2000 by Gregory R. Bennett in the United States.

The Society seeks to overcome the social, technological, financial and business challenges to the establishment of a permanent, self-sustaining human presence on the Moon.

We would like you to be a part of this organisation.

These are the ways in which you can participate:

1. Be a member in the organisation.

You can apply for membership by emailing us at moonsocietyindia@gmail.com.

We don't have a membership fee right now although we might have it at a later date.

2. Be a part of the Executive Committee.

If you would like to be a part of the Executive Committee do email us with a Statement of Purpose on why you would like to be part of our Executive Committee at moonsocietyindia@gmail.com

3. Help us spread our free quarterly, the Moon Miners Manifesto India Quarterly.

If you know anyone who would like to receive this newsletter, please pass on their email addresses to us and we'll ensure that they get a copy of the newsletter when we put it out every quarter.

4. Help us spread the word throughout India and to Indian communities beyond India

You can help us promote India's future in Space, on the Moon and *beyond!*

Possible New Directions for The Indian Lunar Programme

By Pradeep Mohandas

India currently does not have any publicly stated statement on the status of its lunar programme beyond Chandrayaan-II lander-rover configuration slated for a launch in 2013-14. In addition, there was mention in the Indian media that the Indian space agency, Indian Space Research Organisation (ISRO) might consider helping the National Aeronautics and Space Administration (NASA)'s MoonRise mission to the Moon in 2016. [See page 6 above.] There is also a private Indian effort to go to the Moon by participating in the Google Lunar X Prize called Team Indus. This seems to be the sum total of technological missions to the Moon from India.

Russia and China have slated a multi-step lunar exploration and development programme. These are worth careful study and understanding but perhaps not worth following. I think India should approach lunar exploration and development through a multi-pronged approach. This aims at having a constant remote sensing observatory orbiting the Moon while also studying and improving Earth to Moon transportation architectures, developing and building human-rated Moon vehicles, improving in-situ resource utilisation (ISRU) through analog studies on Earth and improving lunar science sharing and collaboration. In short, Indian efforts at lunar exploration and development should be aimed at low cost transportation, aiding the growth of open and accessible lunar science and rapid and cost effective construction and development of the Moon. It is these aims that I hope to explore through this article.

Low Cost Transportation

ISRO has successfully developed PSLV, one of the most cost-effective carriers in its categories worldwide and hopes to do the same with the Reusable Launch Vehicle (RLV) and other programmes. It is also something that ISRO did well with Chandrayaan-I and is doing with Chandrayaan-II. This is something that ISRO does very well. By reducing cost and improving payload capabilities, ISRO has to work towards delivering payloads to the Moon in cheaper and cost effective ways. Making it easier for lunar remote sensing missions to travel to the Moon was a very good first step. Similarly reducing cost for delivering landers and rovers to various destinations on the Moon for sample return missions would greatly improve the volume of lunar science. This would also enable scouting for future human habitation sites.

Growth of open and accessible Lunar Science

The lack of infrastructure developed for high-end research pushes India to make novel innovations. An example of this is the Open Source Drug Discovery programme in India to find cures for diseases like tuberculosis which do not get the attention of the multi-million dollar drug discovery industry in the West. By crowd sourcing the drug discovery problem, India hopes to utilise the human capital already involved in individual efforts and concentrate their efforts for better result. Similar efforts at

working with lunar science data would enable global collaboration and improvement of lunar science. There are already small pilot programmes like MoonZoo which set a good precedent. India is also connected to research infrastructure through high speed under sea cables which could also be utilised for the purpose of lunar exploration.

Rapid and Cost Effective Development of the Moon

For the last several centuries, India has been building its villages and towns from locally accessible materials. Mahatma Gandhi also spoke about architecture practices that uses locally available material and energy. Extended to the realm of lunar exploration, this points to the practice of in-situ resource utilisation (ISRU). India's goal of cost effective development on the Moon would possibly enable the common man to live on the Moon earlier than imagined.

In conclusion, India needs a new roadmap of lunar exploration, one that enables it to deliver on its promise of "space exploration for human kind". Working on technologies that enable these to happen will certainly give India a new direction in its lunar exploration programme that will make it different from the ones pursued by the other spacefaring nations but I believe it is the best one that India can take.

PM



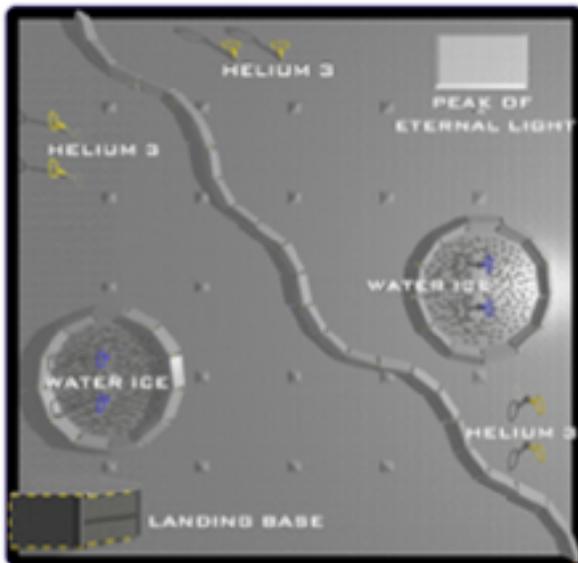
Moonbots Teams in India

A Google Lunar X-Prize LEGO Mindstorms Challenge

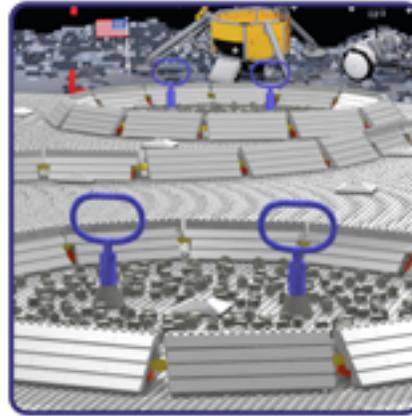
About the Game: Round Length: 3 minutes_

Maximum Score: 350 points

Playing Field: The MoonBots Challenge is played on a lunar surface made from 48" x 48" (1.2m x 1.2m) module large gray LEGO base plates and measuring 7.5 feet (2.2m) to a side. It is dominated by two large craters and a long ridge that bisects it.

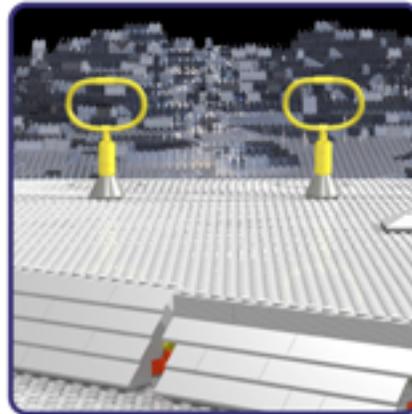


Objectives that represent simulated lunar mission tasks



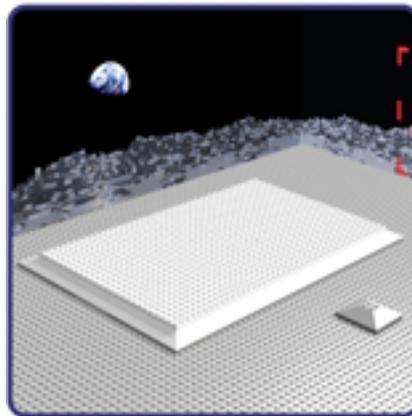
Discover Water Ice
15 points each

In each crater there are two Water Ice elements. Be careful not to lose traction in the regolith on the crater floor.



Discover Helium 3
10 points each

Spread across the lunar surface there are six Helium 3 elements, find them all and bring them back to base for analysis.



Survive the Lunar Night

30 points

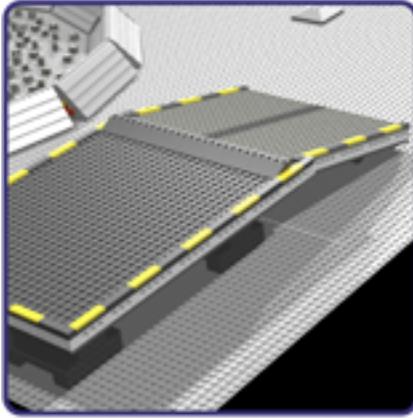
Your robot must visit the Peak of Eternal Light and rest in order to survive the lunar night.



Capture Mission Video

20 points

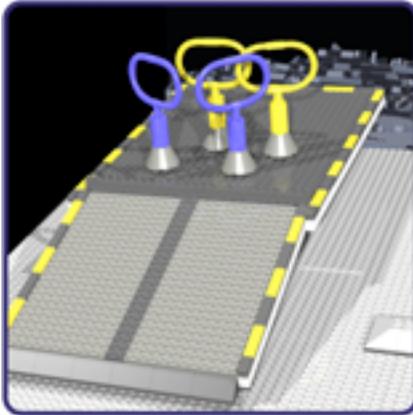
Capture video from your robot's perspective as it navigates the rough lunar surface during its mission.



Lander Dismount

20 points

Your robot starts here with the ramp up. It must successfully descend the lander onto the lunar surface.



Return the Elements to Base

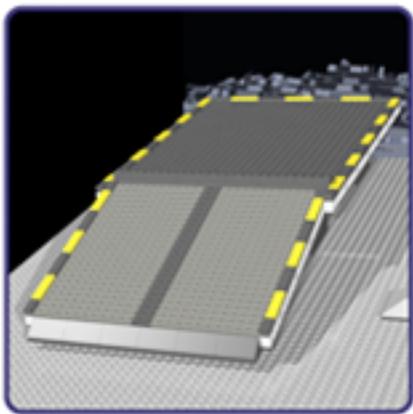
Each element x 2
Successfully returning the Water Ice and Helium 3 elements to base doubles their score. They can be on or off your robot to qualify.



Photograph the Heritage Artifacts

20 points

At some point in your mission your robot must stop and take a picture or video of the Heritage Artifacts.



Return to Base

20 points

Return to base at the end of your mission. Robot must touch the Landing Base to qualify but we will be really impressed if you go back to the top and bring the ramp up behind you.

Building Instructons:

<http://www.moonbots.org/about-game> (bottom of page)

Two Current Moonbot Teams in India

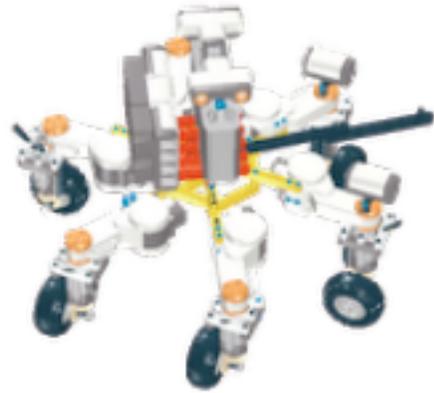
Noom the Conquerors

We are a group of students from **New Delhi**, India with an unhealthy liking for anything geeky. Our team is pretty weird -- four of us are sixteen with the fifth one being ten years old. Greetings from us all!

Team Website

<http://www.noomtheconquerors.blogspot.com/>

Robot Design Proposal



Team Captain: Ikshenya Sanghavi

Kalpana Club of Astronomy

<http://moonbots.org/teams/kalpana-club-astronomy>

Location: Between Chandrigharh and Delhi

Kalpana Club of Astronomy is engaged to popularise space science and astronomy among school students

Team Website <http://montsu.org> (server not responding)

Proposal Robot Design Proposal

Team Captain PUNIT shukla

India Student Team wins NASA Space Settlement Design Contest India teams capture 47 out of 84 prizes: 56%!

The Grand Prize for the 2011 NASA/NSS Space Settlement Contest went to a team of **seven high school students from Punjab**, India, for their double-torus space settlement design called **Hyperion**. The winning design was selected from 355 submissions from 14 countries.

<http://www.nss.org/settlement/nasa/Contest/Results/2011/index.html>

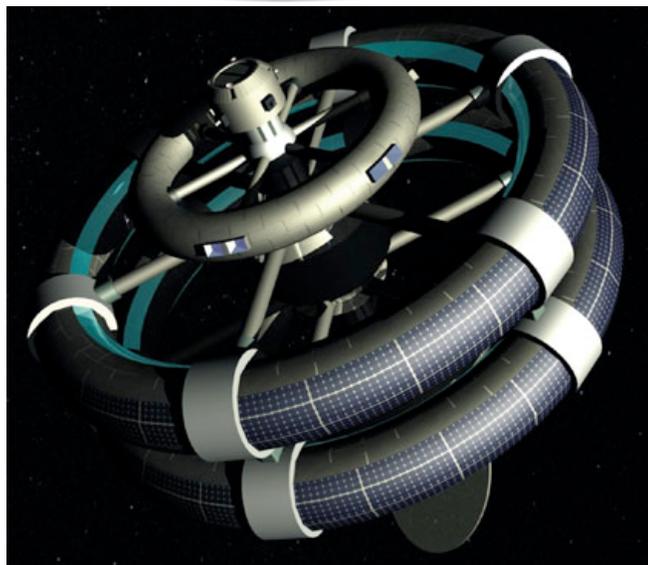
The Hyperion Space Settlement has a diameter of 1.8 kilometers and would provide a safe and pleasant living and working environment for 18,000 full time residents and an additional population (not to exceed 2,000) of business and official visitors, guests of residents, and vacationers. The settlement would be constructed primarily from lunar materials and located at the Earth-Moon L4 libration point.

<http://www.nss.org/settlement/nasa/Contest/Results/2011/HYPERION.pdf> - the team's entry

The seven 11-12 grade students are Gaurav Kumar, Deepak Talwar, Harman Jot Singh Walia, Mahiyal B. Singh, Kaenat Seth, Ishaan Mehta, and Navdeep Singh Makkar, from Punjab. *Continued* →

This year NASA received 355 submissions from 1078 students sponsored by 114 teachers. Entries came from 14 countries: Australia, Bulgaria, Canada, China, India, Ireland, Japan, Pakistan, Romania, Singapore, Turkey, Ukraine, United Arab Emirates, and the United States. U.S. entries were received from 14 states: Alabama, California, Colorado, Florida, Georgia, Kansas, Kentucky, Michigan, Nevada, New Jersey, New York, North Carolina, Virginia, and Washington.

Our of these 355 submissions, 84 were given some type of award, and that 47 of these 84 came from Indian student teams is rather overwhelming and says a lot about both the high degree of interest in space by Indian students and their teachers, and about their quality of work. This is a level of achievement that shouts at the whole world: “look at us!” In comparison, little Romania came in 2nd with 14 awards, followed by the USA with 9, and China with 6!



Above: Cover art of Hyperion entry

The other 46 teams from India receiving Recognition:

11-12 Grade First Prize

- Shangri-la, Odisha, India (Delhi Public School), Small Team.

9-10 Grade First Prize

- Adamas, Aditya Bathla, Punjab, India (Apeejay School), Individual.

Specialty First Prize

- S'ukhavati, Mrinal Chaudhury, Odisha, India (Delhi Public School), Artistic Merit.

11-12 Grade Second Prize

- Read-me: Re-Establishing and Defining Mother Earth, Ramesh Reddy Nidrabingi, Andhra Pradesh, India, Individual.

9-10 Grade Second Prize

- Avatar, Shubham Sharma, Rajasthan, India (St. Xavier's Senior Secondary School), Individual.
- ETHOS, Maharashtra, India (Somalwar High School, Nikalas Branch), Small Team.
- Ubiety, Karnataka, India (Delhi Public School), Large Team (tie).

6-8 Grade Second Prize

- Seven City Construction Project, Anmol Singh, Uttar Pradesh, India (Regency Public School), Individual.
- Project IRIS, Tamil Nadu, India (Bhavan's Rajaji Vidyashram), Small Team (tie).

Specialty Second Prize

- Saanjh, Delhi, India (Ryan International School), Literary Merit.

11-12 Grade Third Prize

- Mission NISSI, The World Abroad, Paul Sudhakar. Veerla, Andhra Pradesh, India, Individual (tie).
- Ashoka, Rajasthan, India, Small Team.

9-10 Grade Third Prize

- The Parallel World, G. Vikash, Andhra Pradesh, India (Narayana IIT Olympiad School), Individual (tie).
- Bhama Janaki (The First Artificial Space Plant), Akshay Sivadas, Delhi, India (Indirapuram Public School), Individual (tie).
- SWARG, Andhra Pradesh, India (Ravindra Bharathi School), Small Team (tie).
- Chrysalys, Maharashtra, India (Somalwar High School and Junior College, Nikalas Branch), Small Team (tie).

6-8 Grade Third Prize

- Comfortable Futuristic Living, Master Prashant Lonikar, Maharashtra, India (Ashoka Universal School, Wadala), Individual (tie).
- Controlled Environment City in Space, Sreejata Kishore Bhattacharya, West Bengal, India (Bandel Vidyamandir), Individual (tie).
- Swarajya, Maharashtra, India (Noel School), Small Team (tie).
- Space City, Maharashtra, India (Somalwar High School, Nikalas Branch) Small Team (tie).

Specialty Third Prize

- Saanjh, Delhi, India (Ryan International School), Artistic Merit (tie).
- Vrishin, Delhi, India (Ryan International School), Artistic Merit (tie).
- Alexandriat, Haryana, India (Ryan International School), Literary Merit (tie).
- Musings From a World Beyond..., Sonal J. Goyal, Punjab, India (Apeejay School), Literary Merit (tie).

11-12 Grade Honorable Mention

- Nanoseium, Sharadh Jois, Karnataka, India (Delhi Public School, Bangalore South), Individual.
- Supertramp, Salil Sunil Bhat, Maharashtra, India (Somalwar Nikalas Junior College), Individual.

- Dream Paradise, K.Kusuma Priya, Andhra Pradesh, India, Individual.
- Gagrot, Rupesh Aggarwal, Haryana, India, Individual.
- TAG, Krishna Ganesan, Tamil Nadu, India, Individual.
- Dhra Rakshak, Punjab, India, Small Team.
- Hawa Mahal, Union Territory, India (Vivek High School), Large Team.

9-10 Grade Honorable Mention

- Vaikuntha, Anushka Dasgupta, Assam, India (Army Public School Narangi), Individual.
- Quasar Space Settlement, Varun Sadaphl, Haryana, India (Delhi Public School), Individual.
- Miniature Space Colony, Dipjyoti Bisharad, Tripura, India (Holy Cross Convent School), Individual.
- Giant Gobbler, Andhra Pradesh, India (Ravindra Bharathi School), Small Team.
- AURSAE, Rajasthan, India (St. Xavier's Senior Secondary School), Small Team.
- STAR, Maharashtra, India (Somalwar High School), Small Team.
- HERTS, Rajasthan, India (St. Xavier's Senior Secondary School), Small Team.
- Momentos, Andhra Pradesh, India (Ravindra Bharathi School), Small Team.
- Assyria, Punjab, India (Spring Dale Senior School), Large Team.
- The Living Cell, Maharashtra, India (Oshin Coaching Classes), Large Team.

6-8 Grade Honorable Mention

- Noah's Arch 02, Hrushikesh Loya, Maharashtra, India (Ashoka Universal School), Individual.

Specialty Honorable Mention

- Vasishtha, Maharashtra, India, Life Sciences.
- Astro-Indus, Rajasthan, India (Rukmani Birla Modern High School), Life Sciences.
- Genesis, Haryana, India (DAV Sector-14 FBD), Life Sciences.
- Shatabdi - The Race Against Future, Uttarakhand, India (Campus School), Life Sciences.

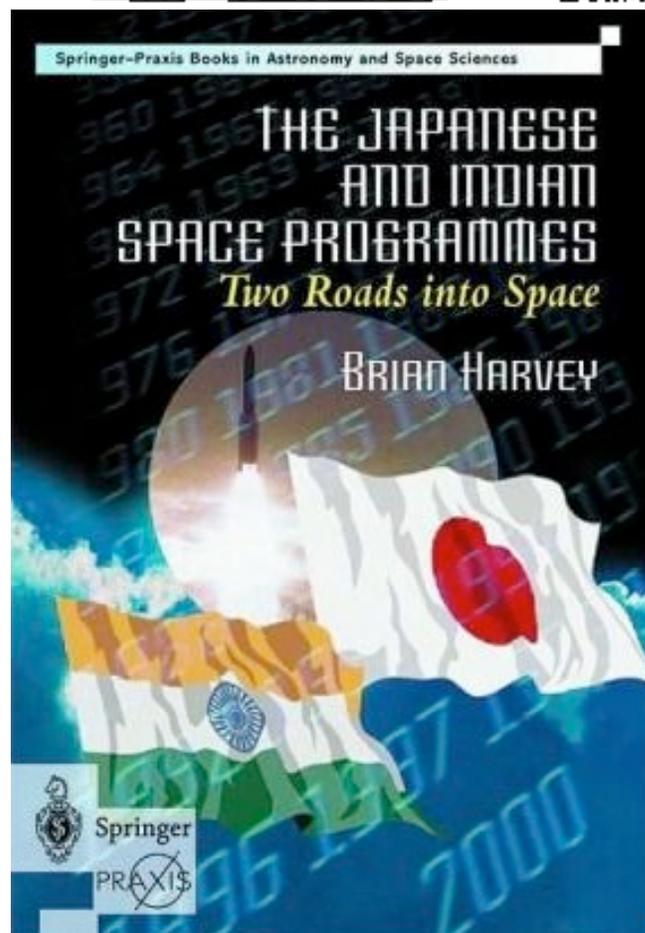
Posters of Winning Teams to be on display in the USA

Winning Entries have been invited to display their work at the International Space Development Conference (ISDC) held this year in Huntsville, Alabama, USA, May 18-22nd. The National Space Society is the principle sponsor of the ISDC. The Moon Society is one of several ISDC cosponsors.

Moon Society Director of Project Development, David Dunlop, one of M3IQ's editors, and incoming Moon Society President Ken Murphy will be on hand to greet the presenting teams.

This year, at ISDC, the Moon Society will also be giving a University of Luna Award to the Chadrayaan-1 team that found an intact lava tube section on the Moon.

Photos of Indian Student Teams at ISDC may be in the next issue of M3IQ – Moon Miners' Manifesto – India Quarterly. The editorial team of M3IQ is very delighted by this high quality participation in NASA_AMES annual contest. ■



(Hardcover - May 15, 2000)

Available from amazon.com, amazon.com.uk

<http://www.amazon.co.uk/exec/obidos/ASIN/1852331992/afrospaceguide>

<http://www.springer.com/astronomy/astronomy.+observations+and+techniques/book/978-1-85233-199-3>

Publisher's description: The development of the space industry in the Asian and Pacific Rim region provides the context for this book. The two major countries hoping for leadership in the area (apart from China) are Japan and India, both of whom have significant launcher capabilities.

There is a general introductory chapter which places the space programmes of the region in the comparative context of the other space-faring nations of the world. The author reviews the main space programmes of Japan and India in turn, concentrating on their origins, the development of launcher and space facilities, scientific and engineering programmes, and future prospects.

The book concludes with a chapter comparing how similarly/differently Japan and India are developing their space programmes, how they are likely to proceed in the future, and what impact the programmes have had in their own region and what they have contributed so far to global space research. ■



First in Space, First to Orbit
Yuri Gagarin in Vostok 1
April 12, 1961
50 years ago

50th Anniversary of First Human Space Flight April 12, 2011

By Srinivas Laxman

Was Gagarin's flight a result of Cold War rivalry?

Fifty minutes after lift off at 9.57 a.m. (Moscow time) from Baikonour on April 12, 1961, in a Vostok rocket, Yuri Gagarin a 27-year-old air force pilot remarked: "Thinking about America inevitably brought to my mind those lads there who also intended to fly into space. For some reason, I imagined that Alan Shepherd would be the one to do this," he said. Incidentally May 5, 2011, marks the 50th year of the first American in space. He *was* Shepherd.

Gagarin became the first human on April 12, 1961, to escape the earth's gravity after a 108-minute flight, and hastily Shepherd followed him on May 5, 1961 with a bare 15-minute mission. The Vostok rocket thundered off the launch pad at 9.07 a.m. (Moscow time).



Gagarin's remark during his flight assumes significance in the context of the former Soviet Union launching the mission during the Cold War between the US

and the former Soviet Union. According to space experts, the primary aim of the flight was more political rather than technological. It was to establish the superiority of communism over capitalism.

Twenty-three minutes after Gagarin took off, at sharp 1.30 a.m. (Washington time), the telephone rang at the residence of Jerome Wiesner, the scientific adviser to President John F. Kennedy. Wiesner was fast asleep at that moment! It was a call from an official at the Pentagon informing Wiesner that 23 minutes earlier the Soviet Union had rocketed a man into space. He was a 27-year-old air force pilot, Yuri Gagarin.

Fifteen minutes after the Soviet Vostok rocket took off from the Baikonour cosmodrome carrying Gagarin, the monitors at the US radar station in the Aleutian Islands picked up radio signals from the rocket.

Five minutes after receiving these signals, the radar station flashed the news about the historic flight in a coded form to the Pentagon in Washington. The Pentagon in turn alerted Wiesner--- a literal wake up call to American scientists and politicians who were dithering about the nation's manned space programme. Gagarin had opened space to humans for the first time.

This post-midnight telephone call on April 12, 1961, from the Pentagon hit Wiesner like a sledgehammer because once again the Soviets had beaten the US in the space race by becoming the first to send a man into space. The US for quite some time was planning to do something similar, but failed to implement the project.

This was a second major setback for the US because on October 4, 1957, the Soviet Union shocked the world, particularly the US by launching the world's first satellite, Sputnik, which inaugurated the global space era.

The rocket carrying Gagarin on April 12, 1961, was launched at 9.07 a.m. (Moscow time) and the entire flight lasted for 108 minutes. He landed at 10.55 a.m. (Moscow time) and the final descent was done by a parachute. Soon after touchdown, he was not greeted by Soviet space officials, but by a woman, her granddaughter and a cow triggering speculation whether the Soviets had miscalculated Gagarin's landing zone.

Gagarin's flight literally shook the US out of its slumber, forcing it to catch up with the Soviets as its reputation as a technological superpower had taken a serious beating. On May 5, 1961, the US, therefore, launched Alan Shepherd on a 15-minute flight. This year, therefore, as stated earlier also marks the 50th year of the first American in space. While recovering from the shocks inflicted by the Soviets repeatedly in the space arena, Kennedy on May 25, 1961, declared the US's plan to embark on a manned mission to the Moon. Again, 2011, marks the 50th year of this historic address by Kennedy at the Capitol.

It was for this reason that president of Pune chapter of National Space Society (NSS), Suresh Naik, told MMM3: "Though Gagarin's flight from the technology point of view was the greatest feat achieved by anyone and a breakthrough, one can definitely say at the same time that the whole achievement was politically motivated.

Former chairman of ISRO, U.R. Rao, said: "It was a very significant flight because it led to human space exploration and proved subsequently that humans can remain in space for a long time."

Another former ISRO chief, Krishnaswamy Kasturirangan, described Gagarin's flight 50 years ago as "a momentous event for humankind because man for the first time successfully tore away from earth's gravity."

"The mission called for the highest levels of courage of conviction, spirit of exploration and with the highest level of science and technology taking humankind to a new dimension all together," he said. Added Kasturirangan: "Man first explored sea, land and air and now it was space."

According to him, through Gagarin's flight, the Soviets also wanted to demonstrate the extraordinary levels of development of communism, which others cannot do. "It was a demonstration of existing political system. It showed that Gagarin's flight enjoyed political support," he stated.

Ron Garan, the NASA flight engineer, who flew in a Soyuz spacecraft named "Gagarin," to the International Space Station last week, remarked in a pre-flight interview to Nasa: "On April 12, 1961, humanity made a giant leap in our evolution as species. We instantly became a species that was no longer confined to the boundaries of our earth. On that day we were no longer a single planet species."

Garan said that Gagarin's flight led to a lot of international co-operation. "There is no doubt in my mind that the world is safer and more peaceful place than it would have been otherwise if we had not taken that first step into space," he stated.

As Rao explained Gagarin's flight eventually led to the first human landing on the Moon by Neil Armstrong and Buzz Aldrin on July 20, 1969. Armstrong in fact has acknowledged Gagarin's role in starting human space flights, and left a souvenir on the Moon in memory of the Soviet pioneer. The Apollo manned flights to the Moon took place between July 1969 and December 1972, and 12 men have walked on the lunar surface.

The flight by Gagarin's had a two-fold impact. One, it set off a race among nations to send humans into space and second, it has triggered a debate about the merits and demerits of manned space missions versus unmanned ones.

According to space experts, one school of opinion even within the US is strongly opposed to manned space missions calling it a drain on financial resources. They said that though manned space flights can be called great technological and engineering accomplishments, scientifically, however, they have had no value at all which even applies to the Apollo lunar flights.

They said that Gagarin's journey also led to NASA designing and developing the space shuttle which coincidentally commemorated 30 years of its first launch on April 12, 2011. The first flight was on April 12, 1981. According to them the shuttle has had a crippling effect on space sciences and planetary explorations.

They cite the examples of several unmanned planetary probes designed by NASA's Jet Propulsion Laboratory (JPL), which have produced excellent scientific results. This on going debate has pitched one NASA centre—the JPL against Johnson Space Centre in Houston, the centre for human space activities. NASA headquarters in Washington has always shown a strong bias in favour of manned space flights.

Information obtained from various sources suggest that to date more than 700 persons from nearly 40 nations flown to space including one from India—Rakesh Sharma. Two women of Indian origin have traveled to space—Sunita Williams and Kalpana Chawla. Two ISRO scientists, N.C. Bhatt and P. Radhakrishnan, were chosen to fly in the space shuttle "Challenger," in September 1986. But, the plan was scrapped following the "Challenger" disaster on January 28, 1986.

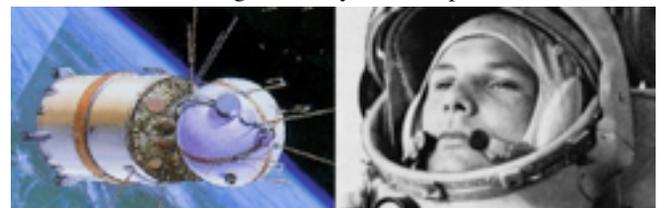
U.R. Rao said that in April 1984, he witnessed the launch of Rakesh Sharma's flight at Baikonour as a part of the Indo-Soviet Joint Space Odyssey. "The Indian ambassador to Moscow, Nurul Hasan, was also present. I had a chance of interacting with Gherman Titov, who was the backup for Gagarin and was even shown the house at Baikonour where Gagarin and Titov spent the final night before launch. "I also saw the bed where Gagarin and Titov slept," he said.

Though in the final pre launch evaluation, Titov was supposed to have scored slightly higher marks than Gagarin, Sergei Korolev, the well-known Soviet rocket genius, finally selected Gagarin for the first manned mission not only because of his skill and performance but also his temperament, attitude and his famous smile.

Some of the attributes which went in favour of Gagarin included his "modesty, high degree of intellectual development, fantastic memory, sense of attention to his surroundings, a well developed imagination, quick reactions and understanding life better than a lot of his friends."

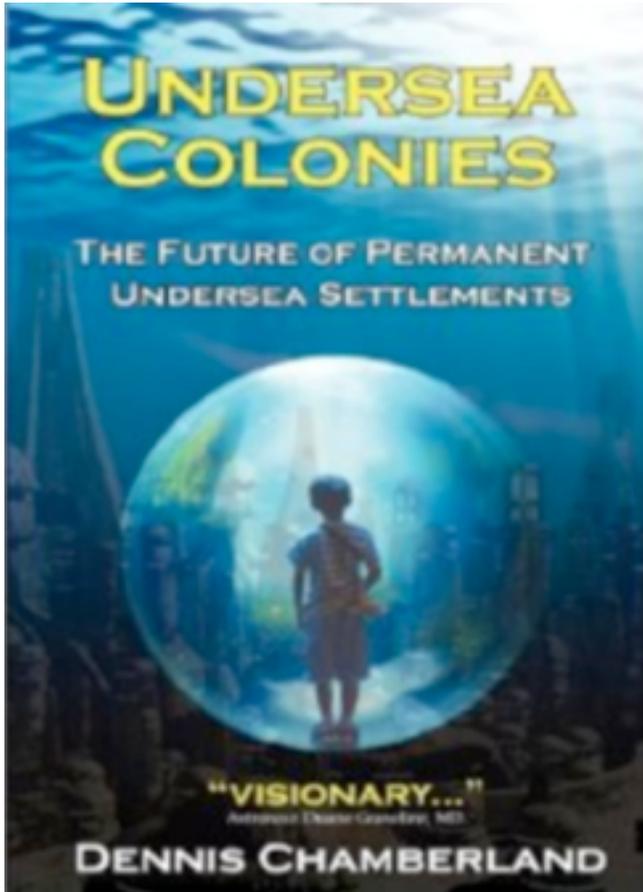
The record-breaking mission gave boost to the International Space Station project which apart from being a flying laboratory for carrying out scientific research was also intended to be a launch pad for future manned inter-planetary flights.

But these flights have yet to take place. **SL**



Yuri's Night Parties Held throughout India

According to <http://yurisnight.net/> there were a good number of Yuri's Night Parties and Events planned for throughout India: **Bangalore**, Karnataka, **Bhuj**, Gujarat, **Burdwan**, West Bengal, **Coimbatore**, Tamil Nadu, **Hyderabad**, Andhrapradesh, **Meerut**, Uttar Pradesh, **New Delhi**, Delhi, **Rewa**, Madhya Pradesh, and **Vellore**, Tamilnadu. A party announced for **Mumbai**, Maharashtra had to be cancelled because of the health of the host.



Undersea Colonies

(paperback) 376 page 6' x 9' soft cover book with 40 chapters, glossary and comprehensive index

By Dennis Chamberland

<http://underseacolony.com/core/book.html>

Amazon.com \$7.99 Kindle version

Online Review at address above

“The most surprising book of the new century speaks eloquently of a daring migration to an alien world that has been hidden in plain sight...”

“Of all one hundred billion humans who have ever lived, not a single one has gone to live permanently undersea. While we have had the technology to settle this vast, three-dimensional domain for over half a century, it remains empty of outposts, colonies or cities – or even of a single settler. While its immense territory covers nearly three quarters of the globe, no one has ever gone there to stay. In this book, Dennis Chamberland traces the history of the aquanaut from the first tentative 24-hour experiment in 1962 until today. Surprisingly, a careful reading of the record of humankind’s penetration of the oceans reveals misdirected starts, misunderstandings of the human’s capacity to adapt and, even-tually, a great abandonment of the quest. But now, Chamberland unveils a visionary strategy and a fresh, new look at previous challenges that

will soon open up the expansive undersea regions called Aquatica*. Here will arrive 21st century pioneers, colonists and families who will become the first Aquaticans* in what may yet prove to be the greatest human adventure in all of history.”

* “**Aquatica**” is his name for *all Earth’s oceans as one*

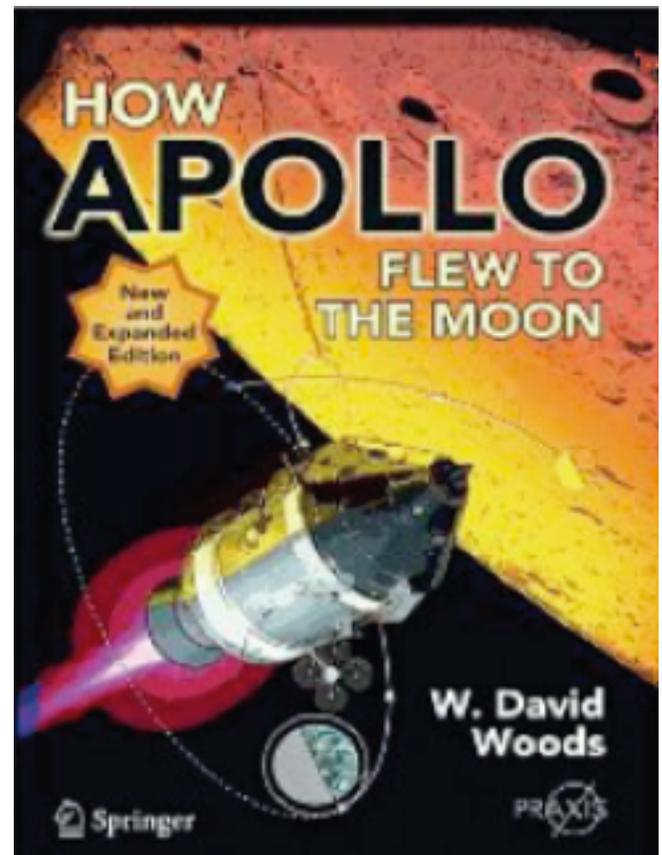
Follow their efforts at: www.underseacolony.com/

There is a lot to explore on this site, including Videos. This effort has long been past the paper concept stage, and the current seafloor habitat now nearing occupancy stage is only the latest of several such efforts of increasing ambition and elaboration.

There are many parallels between creating livable colonies on the seafloor and on The Moon and Mars, and the experiences of these pioneers can guide us space settlement enthusiasts to design and build more livable outposts beyond Earth.

And there are real analogies between the water ocean and the vacuum of the seas of space. This parallel effort is not only worth following closely, it is worth our support. The Moon Society is looking at the suggestion of our sponsoring a “readers corner” in the Leviathan seafloor habitat.

PK



(Springer Praxis Books / Space Exploration) 2008

Paperback - Kindle edition \$16.95 from Amazon.com

Review below by Jason Rihan

<http://www.examiner.com/space-program-in-orlando/how-apollo-flew-to-the-moon-second-edition-set-for-summer-release>

GREAT BROWSTING

SPACE TRANSPORTATION - ISS

<http://www.colonyworlds.com/2011/03/cheap-interplanetary-travel-via-water-powered-rockets.html>

Robot to become tourguide at Kennedy Space Center

<http://www.epdonthenet.net/article/38353/Robot-performance-moves-NASA.aspx>

RESOURCES

<http://mwcnews.net/focus/analysis/9477-the-race-for-space-solar-energy.html>

Where to go first for accessing space resources.

<http://www.thespacereview.com/article/1729/1>

EARTH

http://www.spacedaily.com/reports/The_Importance_Of_Being_Magnetized_999.html

THE MOON

http://www.space-travel.com/reports/B_999.html

<http://www.colonyworlds.com/2011/03/raising-radiation-resistant-planets-off-world.html>

<http://nssdc.gsfc.nasa.gov/planetary/lunar/lunartimeline.html>

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

<http://www.mapaplanet.org/explorer/moon.html>

Flight Opportunities to Low Lunar Orbit

<http://www.spaceflightservices.com/MHome.php>

10 km long intact lavatube section found

http://www.nasa.gov/images/content/521681main_021711_b.jpg (photo)

http://www.nasa.gov/mission_pages/LRO/multimedia/lromages/lroc-20110217-chain.html (article)

MARS

http://www.spacedaily.com/reports/Are_You_A_Martian_999.html

http://www.marsdaily.com/reports/Alternatives_Have_Begun_In_Bid_To_Hear_From_Spirit_999.html

http://www.marsdaily.com/reports/Oddly_shaped_Mars_crater_is_studied_999.html

<http://spacefellowship.com/news/art25132/some-of-mars-missing-carbon-dioxide-may-be-buried.html>

Imagining silicon based life forms on Mars (1976)

<http://www.spaceref.com/news/viewsr.html?pid=36549>

Curiosity's 3D camera nixed: won't be ready

http://www.msnbc.msn.com/id/42275969/ns/technology_and_science-space/

<http://www.mapaplanet.org/explorer/mars.html>

http://www.marsdaily.com/reports/Time_Is_Now_For_Human_Mission_To_Mars_999.html

<http://www.colonyworlds.com/2011/03/conquering-mars-via-bouncing-rolling-robots.html>

ASTEROIDS & COMETS

Research finds asteroid Itokawa an ancient rock

<http://spaceflightnow.com/news/n1103/13hayabusa/>

<http://www.dailymail.co.uk/sciencetech/article-1368732/Test-version-Nasa-Orion-craft-built-given-new-lease-life-Space-Station-docking-vehicle.html>

OTHER PLANETS

<http://spacefellowship.com/news/art25128/voyager-seeks-the-answer-blowin-in-the-wind.html>

<http://www.universetoday.com/83740/nasa-mission-to-europa-may-fall-to-budget-cuts/>

The Grand Tour: Uranus

<http://www.thespacereview.com/article/1766/1>

ASTRONOMY – OTHER SOLAR SYSTEMS

SETI search is worth the effort.

<http://www.thespacereview.com/article/1727/1>

<http://www.physorg.com/news/2011-02-scientists-protocol-messaging-aliens.html>

SPACE TOURISM

Space Adventures lunar flyby, 1st of 2 seats sold

http://www.youtube.com/watch?v=xB97UMLJN4w&feature=player_embedded

OTHER SPACE AGENCIES

<http://www.vector1media.com/news/headlines/19373-israel-russia-to-boost-co-operation-on-space-research.html>

<http://www.vector1media.com/news/headlines/19373-israel-russia-to-boost-co-operation-on-space-research.html>

UK Space Agency launches in Swindon

<http://www.bbc.co.uk/news/uk-12879219> (with video)

UK space given boost from Budget

<http://www.bbc.co.uk/news/science-environment-12833654>

World's largest rocket production base in north China

http://news.xinhuanet.com/english/2011-03/03/c_13759813.htm

FICTION

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

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

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

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

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

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

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

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

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

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

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

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

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

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

<http://www.avclub.com/articles/spaceracism-is-bad-and-17-other-notso-subtle-lessons,27462/>

<http://io9.com/#!5781358/are-we-ever-going-to-use-antimatter-to-drive-a-starship>

GREAT SPACE VIDEOS

Turtle-Back Spacesuits (in new lunar rover video)

<http://www.wimp.com/lunarover/>

Space Based Solar Power Alternative

<http://www.youtube.com/nationalspacesociety#p/c/17121734C7C43BE7/1/YiU9MibyBJQ>

Ways to save the planet – orbital power

<http://www.youtube.com/nationalspacesociety#p/c/17121734C7C43BE7/13/oor-ZNFyWSc>

“Sky-Crane” Drop test for Mars Curiosity Rover

http://www.youtube.com/watch?feature=player_embedded&v=YasCORAWRwU

M3IQ PHOTO GALLERY



The Soviet Mir Space Station was launched 25 years ago. NASA (USA) forced its deorbiting when it could have been reused as a commercial station, or boosted into a higher decay-proof orbit as the 1st International Space Monument.



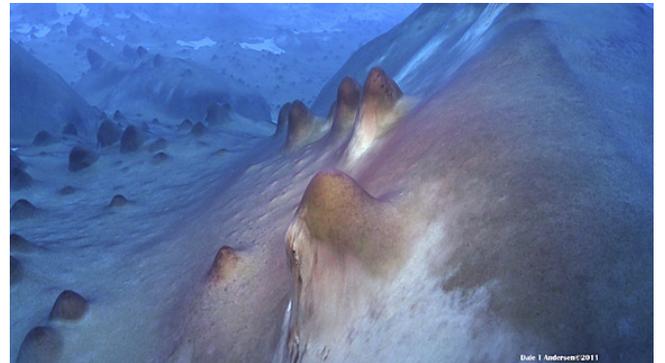
50 years ago, on April 12, 1961, Yuri Gagarin (white helmet above) walked towards the waiting capsule for his historic first manned spaceflight. How much further will human spaceflight have advanced in another 50 years?



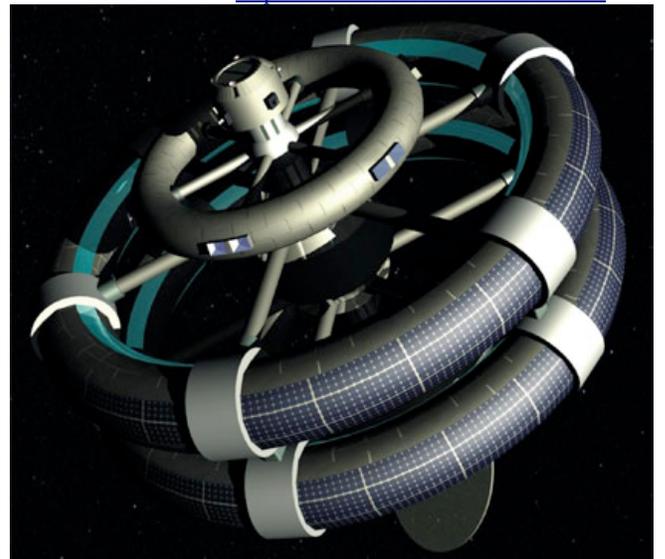
Have you ever thought of the Apollo astronaut bootprints in the moon dust as the very first human art pieces made from moon dust to be carefully scooped out and preserved?



NASA concept Study for a Non-Atmospheric Universal Transport Intended for Lengthy US space eXploration, **Nautilus-X** shows several inflatable modules and a rotating torus providing artificial gravity. The dream vehicle could make round-trips to many solar system destinations
http://www.space-travel.com/reports/A_Reusable_Manned_Deep_Space_Craft_999.html



Astrobiologists Discover Strange Benthic Microbial Mats in Lake Untersee 142 km SSE of India's Antarctic Station Mahtri
<http://www.onorbit.com/node/3221>



India Team wins NASA 2011 Space Settlement Award
www.nss.org/settlement/nasa/Contest/Results/2011/HYPERION.pdf

On-Orbit Vehicle Assembly at the International Space Station

Charles Powell Univ. of Southern California ASTE 527

M3IQ co-editor Madhu Thangavelu conducts the ASTE 527 graduate Space Exploration Architectures Concept Synthesis Studio in the Astronautical Engineering Department within the Viterbi School of Engineering at the University of Southern California. For consideration in this issue, he sent us a number of student presentations related to making use of the International Space Station. We have selected the following paper.



BACKGROUND

On-orbit “assembly” is nothing new

- Apollo mission components were “assembled” before moving to lunar orbit
- Apollo-Soyuz Test Project docked two distinct and separately launched vehicles – 1975 (below)



- Docking and berthing can be considered a basic “assembly”

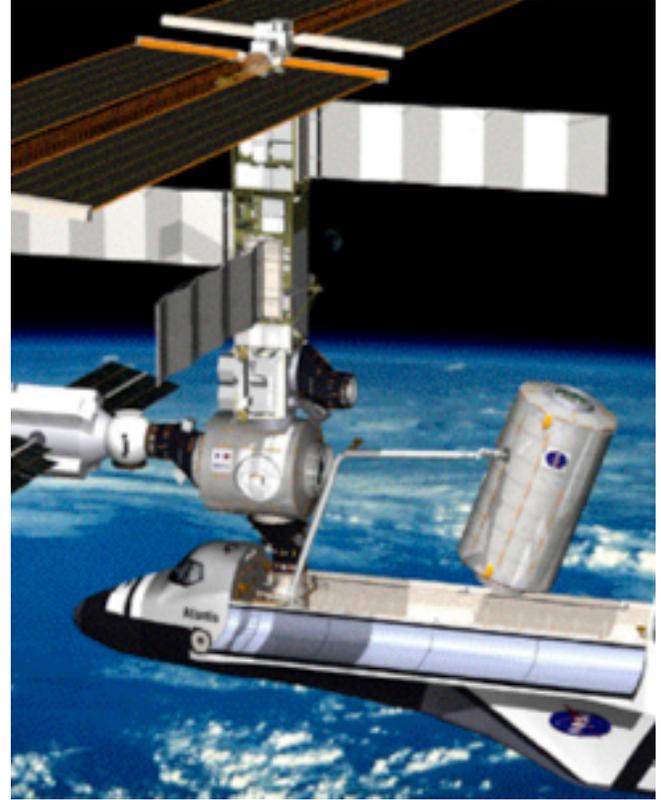
INTERNATIONAL SPACE STATION

- 14 pressurized modules with expansive Integrated Truss Structure
- Assembled over 12 years (and counting)
- A large number of components were never assembled on Earth

WHY ON-ORBIT ASSEMBLY?

- On-orbit assembly offers several benefits over Earth-based assembly
- Enables spaceflight with large vehicles
- Larger than ISS (~1,000,000 lbs)
- Shifts total mass across many smaller launches

- Unlikely for modular vehicle to outgrow available launch platforms
- Reduces program risks
- Enables spares
- Enables different (lighter) design methodologies
- Can support a longer timeframe for component readiness
- Experience of ISS, Mir, Skylab directly applies



Robotics at ISS

WHY USE ISS FOR ASSEMBLY

- Completely autonomous assembly is difficult
- Orbits need to be accurately planned and timed
- Propulsion and control systems for assembly must be budgeted
- Requires significant quality assurance and testing on the ground
- Even cutting edge systems have trouble

ISS AS A STEPPING STONE

- Larger vehicles are the future of human spaceflight, beyond LEO
- ISS provides an excellent platform to begin expansion

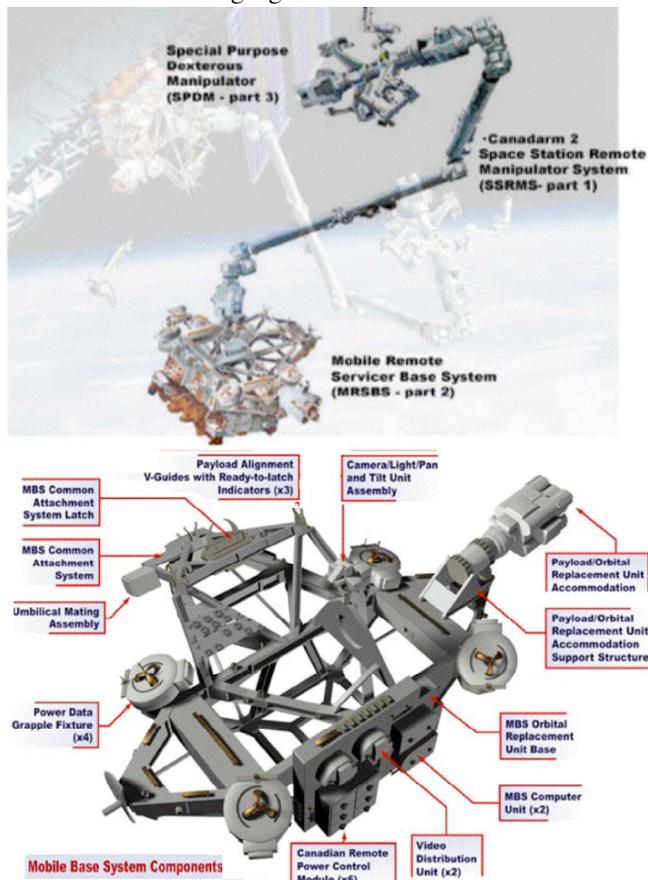
HUMANS + ROBOTS

- Humans are supervisory to assembly process
- Humans can fix any show-stopping problems

CONCEPT

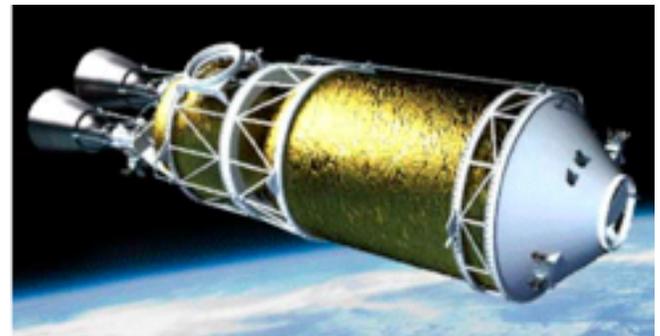
- Orbital Assembly Module
- Low mass, truss-based open frame
- Mounted on Node 2, PMA 2/MPLM

- Mount points for storage
- Scalable and reconfigurable
- Semi-autonomous remote manipulators
- Based on Canadarm design
- Mounted on Mobile Base Systems
- Modular tool tips (i.e. Dextre)
- Provides six-axis mobility for assembly
- Common command language
- Allows primarily autonomous assembly
- Similar to CAM language



CONCEPT

- ISS-based space tug fleet
- 2-3 space tugs to retrieve and position incoming components
- Refueled at ISS
- Possibility for modular fuel systems
- Autonomous or human-controlled
- Emphasis on standardization
- Assembly processes and systems
- Connection locations
- Standard positions allow easy assembly and even reconfiguration
- NASA's LIDS system
- Connection types
- Connecting hardware
- Distributed (i.e. redundant) architectures
- Power; fluids; data
- Standard data bus using high bandwidth proven protocols



MERITS

- Human attended assembly and deployment
- Reduces risk of failure due to design/quality escapements
- ISS provides habitation for passengers
- ISS provides an existing assembly fixture and location
- Rendezvous with ISS eliminates need for individual component docking/berthing
- Existing technology for tooling and power systems
- Space tug eliminates need for specialized docking maneuver, propulsion, and control systems
- Reduces cost, weight, complexity
- Increased degree of standardization benefits compatibility with future missions
- System could be used for on-orbit servicing during assembly downtime
- Limitations
- Possible higher overhead costs
- Resulting torque and vibration of assembly activities
- Tugs require energy and propulsion; danger of tugs in ISS proximity
- Standardization can be difficult
- ISS orbit

ASSUMPTIONS

- Future-state ISS can support additional crew and power requirements

- Extended habitation: living quarters, work stations, etc.
- ISS improvements proposed in this project (Earth Station, methane reuse)
- Decreasing cost to launch
- Even in medium/light lift vehicles
- Commercial providers – SpaceX
- Higher frequency of support missions
- Advancements in space-specific propulsion
- VASIMR and other electric propulsion

FUTURE STUDIES

- Standardization
- Best practices for connectors, structural points
- Most efficient designs and assembly order
- Robotic manipulator advancements
- Accuracy
- Feedback for controllers and systems
- Extension and flexibility
- Space tug framework
- Propulsion system selection (Monopropellant, Liquid • rockets, etc)
- Docking and refueling
- Maneuver methods for positioning

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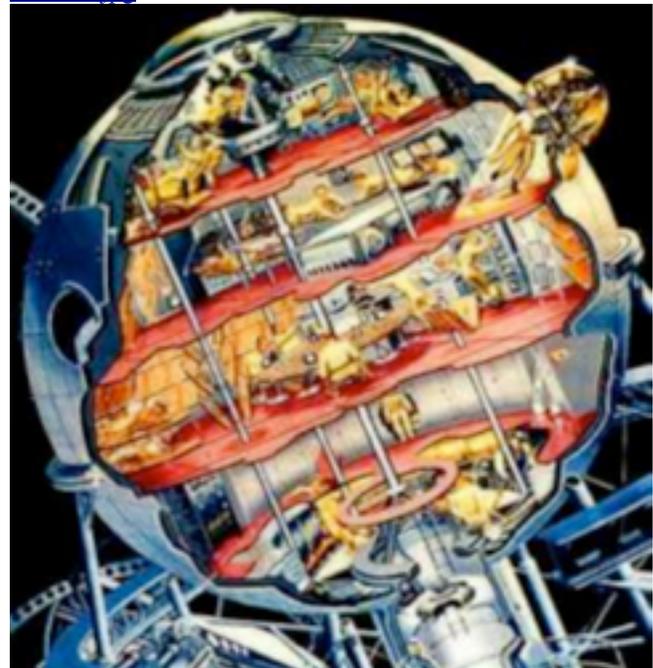
Editor's Comments: The History of "On Orbit Assembly" of Large Spacecraft

By Peter Kokh

On-orbit assembly was the way Wernher Von Braun planned to send 3 giant moon ships with a combined crew of 50, to the Moon.



<http://www.fabiofeminofantascience.org/COLLIERS/arriveonmoon.jpg>



www.projectrho.com/rocket/images/deckplans/habitat.jpg

But “Doing it Right” was the least of John F. Kennedy’s concerns in his famous 1961 speech “We shall go to the Moon *in this decade*”. JFK’s goal was to beat the Russians, not to explore the Moon, and in demanding something quick, he made the “Flags and Footprints” dead-end effort a certain conclusion. That we did some serious science while our 6 2-man crews were on the Moon’s surface, was to satisfy the critics, and irrelevant to Kennedy’s motives.

Given the Kennedy mandate, Von Braun could not take the time to build an orbital station at which major in-space assembly could be done. To be fair, we did not then have the technology we do today, when automated, teleoperated, and robotic assembly methods can be directed by crews on the ground, rather than in space.

Thanks to Kennedy, we “did the Moon” much sooner, but in an unsustainable dead end way. And that is why we have never gone back. The public saw through the charade, and lost interest. It was too early. Worse, it set a very bad precedent and when NASA was given a fresh mandate by President George W. Bush to return to the Moon, the only way the agency could imagine this goal being accomplished was the low-flight rate, no in-orbit assembly manner in which we did it the first time. Apollo on Steroids” as then NASA Director Mike Griffin called it, could only have led to “Flags and Footprints on Steroids,” another, but more expensive dead end with an empty “shanty” left on behind on the Moon, nor at all ready for “permanent occupation.” Rather it would be a “permanent ruin” for future tourists to visit.

In our view, an International effort, to establish an International Lunar Research Park, along with corporations, contractors, and enterprise part of the team, has any hope of establishing something poised to grow and gradually “morph” into the first human pioneer lunar settlement. Where such an I.L.R.P. should be located is another issue. The poles are tempting, but likely to be a dead end, in our minority opinion. That ISS is an International Partnership is the only reason it has survived to this point. Nations are hesitant to unilaterally break international commitments. Decisions about the growth direction of such an I.L.R.P. must be made outside political considerations if possible.

So on von Braun’s approved route to the Moon, the Space Station was bypassed altogether, and when we finally did build one, it was not in an equatorial orbit favorable for launching expeditions to the Moon, but in a highly inclined orbit favorable for Earth studies. This was necessary because in the end, the space station program was only narrowly approved by the US Congress after President Bill Clinton convinced Congress that this was the only way to keep Russian rocket scientists, former employees of the Soviet Union, “out-of-mischief” and away from would-be employers of other nations who meant America no good. What did this have to do with the station’s orbit? As Russia would be the key partner and co-anchor tenant of ISS with NASA, we needed the high inclination orbit so that Russia could launch components from its main Baikonur space port in the former Soviet Republic of Kazakhstan. Baikonur is at 46° North Latitude.

So now you know why there is a high stress on Earth-sensing and Earth studies at ISS.

We can’t undo history or unravel any of its strange twists. But what we need to do, if we want to assemble larger ships, ships that make more sense, is to build a second, dedicated Space Depot (not Station) in equatorial orbit. Using Bigelow Aerospace inflatable modules, this second station need not be nearly as expensive as has been the ISS. For a new, equatorial depot, using robotics and automation, we can assemble larger ships at modest expense.

Will it be done? Probably not by the current ISS partners, but by a consortium of space agencies that want to send humans to the Moon and beyond – a consortium including major space contractors. Unfortunately, the way most decisions about space are made is by political compromise, which bears no necessary relationship to what is rational. It is very seldom that anything rational comes of the political process, the principal reason this editor refuses to take space enthusiast “political action” seriously.

A Lost Opportunity to set ourselves up

Now we must say that NASA, having launched over a hundred shuttle flights, could have set the stage by not jettisoning each External Tank to a fiery death in the ocean when it had achieved 98 % of the velocity needed to go into orbit, with 3% of the fuel remaining inside. The agency could have instead directed them into a high altitude minimal decay parking orbit where they would remain ready to be put to constructive use at some time in the future.

Listening to the common sense of space advocates who promoted such a policy, the US Congress mandated NASA to deliver External Tanks to orbit. But the agency tweaked this mandate to read, “if there was a customer ready to use it.” Someday, this “wasting” of 100-some massive structures with tons of aluminum and copper, will be seen as a crime by those who do settle the space frontier; a crime against the pioneers; against the future lunar frontier and its settlers.

That one is a rocket scientist does not guarantee that one has vision or wisdom. To this day, NASA is flight-oriented, not destination or goal-oriented. Is it any wonder that we have so little to show for the past 50 years?



von Braun’s station would have room for a hundred people, and provide artificial gravity. Arthur C. Clarke’s station in Space Odyssey 2001 depicted this concept in considerable detail. It remains a promise unrealized.

Courage! - The Commercial Space Era begins! PK

NASA's New Moon Mission Budget

By David A. Dunlop

April 20,-2011

The Fiscal Year 2012 NASA budget contains a mix of both good news and bad news for advocates of Lunar Exploration and Development.

http://www.nasa.gov/pdf/516674main_FY12Budget_Estimates_Overview.pdf

The Good News: 2 Lunar missions still in the pipeline:

LADEE: (Lunar Atmosphere & Dust Environment Explorer) Launch Date: May 2 2013)

<http://science.nasa.gov/missions/ladee/>

Under the Lunar Quest Budget

GRAIL: (Gravity Recovery and Interior Recovery)

Launch Date: September 08, 2011

<http://science.nasa.gov/missions/grail/>

Under the Discovery Program

These two missions are still funded and will be launched (Congress willing) later this year and in early 2013.

The Bad News: After the GRAIL LADEE missions NASA's budget largely walks away from the Moon.

ILN: International Lunar Network Missions: These missions are off the NASA FY2012 budget and what has been an active program in development over the last several years is effectively put on hold. These had \$14.9M in actual FY2010 funding is cut to \$0.03M for FY 2012. After that the outlier years reflect zip, nada, 0. Correct me if I'm wrong but a short-term conclusion might be that the ILN is dead. The ILN web site is described at:

<http://science.nasa.gov/missions/iln/>

There has been excitement at the prospect of a **South Pole-Aitken Basin Sample Return** as one of the finalist candidate for a New Frontier mission. Funding in the New Frontier line item might yet reflect another lunar mission if it wins the New Frontier selection.

Lunar Science:

What tells the story are NASA's projected budget cutbacks as a result of efforts in the Congress to reduce the Federal Deficit. The Lunar Quest budget line item is almost eliminated in outlying years. Note that the figures above are from NASA's FY12 Budget Estimates Overview document. The SMD [NASA's Science Mission Directorate] decadal priorities reflect decadal white papers and other reports highlight the central strategic value of lunar science and recent discoveries have only underscored and validated these perceptions

Annual Continuing Resolution (NASA Budget)

Fiscal Year	2010	2011	2012	2013	2014	2015
Lunar Quest	94.5	114.	81.2	48.9	28.1	19.5
Lunar Science	31.4	50.9	48.1	48.9	28.1	19.5
LADEE	48.2	83.2	33.1	0.0	0.0	0.0
ILN	14.9	0.3	0.0	0.0	0.0	0.0
GRAIL	124.1	40.5	4.4	0.0	0/0	0.0
Other	60.4	135.	200	246	265	242

Figures in millions US Dollars

NASA's New Emphasis on Mars

The Science Mission Directorate is continuing to support the Discovery Program and Mars Exploration. Let look at NASA's Mars Exploration line item numbers:

MSL **Mars Science Lab**

Launch Date November 25, 2011

www.nasa.gov/mission_pages/msl/index.html

MAVEN **Mars Atmosphere and Volatile Evolution**

Launch Date: November 18, 2013

<http://science.nasa.gov/missions/maven/>

Fiscal Year	2010	2011	2012	2013	2014	2015
Mars Exploration	438	594	433	408	309	245
MSL	258	138	40.5	37	0.0	0.0
MAVEN	48.1	240	140	34	15.4	4.7
Other	132	218	252	338	293	241

Figures in millions of US Dollars

From the comparison of the line items for Lunar Quest, Discovery, and Mars Exploration we can clearly and simply see that NASA projected budget is reducing the Moon line item as a strategic priority in the Science Mission Directorate. While the overall Science budget is essentially flat the Moon's budget virtually disappears from the numbers into the noise level if we look to FY2015. But let's look further into this budgetary picture to see what good nor bad news remains and if hopes for further progress in lunar exploration and science can be kept alive.

The Obama/Bolden Budget Rationale

The strategy of lunar exploration, utilization, development, and ultimate settlement is not just a story or strategy of funded lunar science missions. Science Missions are the province of the Science Mission Directorate and what I have focused on is the Science Budget of about \$5B. It is also a story of building capabilities for the long term. It aims at changing a paradigm of human space activities and expenditures that have remained in LEO for 30 years to one, which is capable of moving beyond LEO to a variety of destinations. For lunar advocates that a good thing even if not specifically tagged as lunar. **NASA's overall budget request is \$18.7B.** When the Congressional dust settles NASA may have a budget that reflects 2010 levels of funding.

Under the Bush administration "**Vision of Space Exploration**" we have had a strategy progression of orbital robotic precursors to be followed by and International Lunar Network and then a Human Return to the Moon. This was principally an American initiative with some parallel international cooperation contemplated but not part of the mainstream effort, as had been the case with the ISS. Now with the Obama/Bolden administration the lunar manifest seems to stop, but the devil is in the details.

In defense of NASA's budget, there is a long overdue emphasis on technology development.

Consolidation of Exploration and Operations Directorates

This budget has been drafted in draconian economic times and reflects a necessary retrenchment with

consolidation of the Operation Missions Directorate with the Exploration System Mission Directorate. The Space Exploration item is budgeted at \$3.95B with a *commercial spaceflight budget of \$612M in FY2011 and this rising to a frozen level of \$850M in 2012 and beyond*. Exploration Research and Development is also at \$288M. Lunar advocates in the Moon Society and NSS, and Space Frontier Foundation have long advocated for a more commercial model of operations as the key to actually getting back to the Moon. We are now seeing this commercial space model developing.

The Space Operations budget is \$4.37B, which continues the last Shuttle flights (\$665M) and closeout, the ISS (\$2,841B), and Space and Flight Support (\$840M). As opposed to dumping the ISS in the ocean which the former administration contemplated the ISS now has an upward trending budget line going forward to \$3.174.8 in FY2016 much to the relief of our 15 ISS international partners.

Under Space Flight and Support the Space Communications and Navigation (**ScaN**) is another area where technology development and capability development may offer some hope for lunar advocates. This research and infrastructure development is needed for the realization of lunar exploration and human return. So while expenditures are not tagged as lunar related such expenditures move a lunar agenda forward.

The Moon Society's interest in competitions involving a Solar Sail and Communication Cube Sat. and a Lunar Lava Tube Skylight Explorer, for example, would both require enhanced ScaN capabilities. The Solar Sail Communication Cube Sat is a proposal, which might provide a lower cost way of implementing a lunar communications and lunar positioning system (LPS) network. ScaN related research is therefore a plus and the FY2012 438M and rising to the \$470M's and \$480M in outlying years is a commitment that is also positive.

The further development of commercial operations to supply the ISS should see a first flight by Space X's Falcon /Dragon systems in late 2011 and another first flight for Orbital Science's Taurus/Cygnus System in 2012. Commercial Crew and Cargo are also strategic initiatives, which should result in commercial manned access.

Of additional significance is the development of the **Innovative Lunar Data Demonstration** program, which has already awarded a number of contracts. This contracting program can be the start of a commercial market for lunar transportation providers. The positive pioneering contracting approach of ESMD is also under consideration by SMD. If this model is followed it will build momentum from the recent positive and highly successful venture of NASA collaboration with ISRO. On Chandrayaan-I two NASA instruments flew and were highly successful in their yield of scientific information.

We need more of the same not less! *The Moon Society* should advocate the implementation of a "data-purchase" contracting model similar in nature to the Innovative Lunar Data Demonstration of ESMD. The Combined budget for Explorations and Operations line items is \$8.32B.

Technology

NASA's current rationale is to push the envelope and develop technologies and capabilities that will permit moving beyond LEO. So far so good. The Technology line item has increase to \$1.02B although about \$300M of this apparent jump is due to a shift in line items. Another \$200M for Research and Development is located in the Exploration Budget under Exploration Research & Development. So the administration's FY 2012 request "puts their money where their mouth is." Exploration Technology Development is increasing from \$151M in FY 2010 to \$261M in FY2012.

The Moon is now understood to be the closest place on the CryoFrontier. Low Temperature microelectronics and instrumentation as well as larger mechanical systems, which can function in the lunar cold traps, are another pioneering area for NASA technology development. This research and infrastructure development is needed for the exploration and exploitation of lunar ice deposits needed to sustain both a human return and cislunar space operations. So while such expenditures are not tagged as lunar related such expenditures move a lunar agenda forward.

We see almost a doubling of the SBIR and TTR line items from \$96M in FY 2010 to \$177 in FY 2012, which support further commercialization and that is a positive thing. So far we have \$5B for Science, \$8.2B for Exploration and Operations, and \$ 1B in Technology Development for a NASA subtotal of approximately \$14.2B

Education

The Obama/Bolton administration has cut its education budget from \$180M in FY 2010 to \$138M for FY2012 and forward. It is hard to see this translating into transforming education or the better preparation of our young people for the jobs of the future.

The Space Grant Support and Experimental Program to Stimulate Competitive Research program have been reduced from \$45.6M and \$25M in FY2010 respectively to \$26.5M and \$9.1M respectively in FY2012 and forward. STEM expenditures have been kept relatively flat and lumped into one large category where it is less clear how the money is actually targeted. An educated and informed electorate is necessary of we are to advance as a society. If we are not educated then as a species to we will not have the understanding and knowledge explore and claim the resources of the Moon, Mars and outer space or perhaps even to understand what those things are important. Our responsibility as the Moon Society and with our affiliate the National Space Society is to address this educational responsibility.

Summary

In these turbulent economic times NASA's FY2012 budget proposal has both strengths and weaknesses. There is much to be applauded in the area of building capabilities to move beyond LEO. This comes at a time when it could and should use its resources to work collaboratively with other nations to push forward in building a global lunar exploration and development initiative and planning an Earth-Moon economy. This would be the most creative use of rather constrained US resources, and in the historic US tradition of building win/win international coalitions.

We would prefer the Obama Administration in hard times to hand the baton with regard to the Moon to a collaborative international Moon policy. The NASA leadership itself has shown itself to be very proactive and foresighted behind the scenes over the years in this regard with its international partners and peers. The problems here are well beyond NASA's pay grade in the US Congress and at the White House level of policy.

NASA has been working hard behind the scenes to make such coalitions possible with meeting of NASA with other space agency heads, collaborative inter-agency lunar architecture studies, and the ILN agreements, and collaborative missions. Freezing the ILN missions is part of the financial cutback that the US Government is making but the New Frontier budget area may be one where these missions may be restored in the future. The Discovery Mission area is another where lunar mission ambitions may yet find fulfillment.

Google Lunar X-Prize International Teams

Now against this backdrop of NASA budget woes we should take time to recognize the entry of a number of new teams to the GLXP competition and to a final roster of 29 teams.

<http://www.googlelunarxprize.org/lunar/featured-article/final-team-roster-announced>

There are two teams now centered in South American. A new team is Angelicum Chile from Chile, where the Moon Society has been working to plan and support the Moon Mars Atacama Research Station initiative.

We also note a new team from Brazil SpaceMeta. Plan B from Canada is another new entrant. Of special note is **Team Indus**, a new team *and the first from India*.



<http://www.googlelunarxprize.org/lunar/teams/indus>

Space IL of Israel is the first team from the Middle East. Everything has its season and the GLXP teams should be mentioned on a positive note because to focus only on the adventures of NASA relative to the Moon is to miss the bigger international picture. Even here we hope and advocate that the NASA SMD can add to the potential of purchase contracts for GLXP teams.

To learn more about the registered teams, visit:

<http://www.googlelunarxprize.org/lunar/teams> **DD**

Supplemental Information for preceding article:

This following message on the Lunar list serve is from Clive Neal <neal.1@nd.edu>, past chair of LEAG, the Lunar Exploration Analysis Group

The full "lunar" summary of the Inner Planets Chapter of the Decadal Survey is now available on the Lunar-L web page at: <http://www.nd.edu/~cneal/Lunar-L/>
Subject: **NASA's Planetary Sciences Decadal Survey and the Moon**

Fellow Lunar enthusiasts:

“As I am sure everyone is aware, NASA unveiled it's 2013-2022 decadal survey for Planetary Sciences at the recent Lunar & Planetary Science conference in Houston on March 7, 2011. The document (which can be downloaded as a PDF file from www.lpi.usra.edu/decadal/2013_2022/ is very detailed! The Moon was dealt with as part of the Inner Planets Panel and is documented in Chapter 5 of the report. I have gone through Chapter 5 in detail and I believe that the Lunar Community could not have wished for a better showing, especially given the current fiscal and political climate. Let me explain by quoting directly from Page 5-24 of the Decadal Survey, with some formatting for clarity:

Priority [Lunar] mission goals include:

- Sample return from the South Pole-Aitken Basin region;
- A lunar geophysical network, as identified in this chapter. Other important science to be addressed by future missions include:
 - The nature of polar volatiles (e.g., Lunar Polar Volatiles concept described in Appendices D and G);
 - The significance of recent lunar activity at potential surface vent sites;
 - The reconstruction of both the thermal-tectonic-magmatic evolution of the Moon;
 - The impact history of the inner solar system through the exploration of better characterized and newly revealed lunar terrains.
- Such missions may include orbiters, landers and sample return.

“The first two missions in this list are specified as New Frontiers candidates, whereas the remainder could be proposed in future Discovery calls.

“There is, of course, much more detail in Chapter 5 and the rest of the Decadal Survey. I have prepared a Chapter 5 "lunar" summary (7.5 pages instead of 24!) that will be available next week on the Lunar-L website (www.nd.edu/~cneal/Lunar-L). Note that this summary represents details directly extracted from Chapter 5 and contains only four words of commentary ("Minor for the Moon").

“I, for one, am very happy with how the Moon has fared in this Decadal Survey, and this is due to the incredible response by the lunar community to the request for white papers (see www.lpi.usra.edu/decadal/leag/)

“To the Moon!”

Clive Neal

2 Models for Analog Station Research “In Sim” vs. “Out of Sim” Procedures

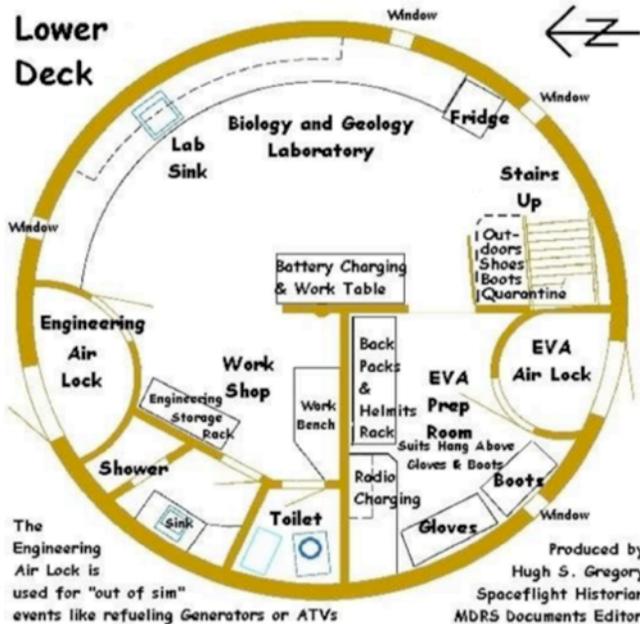
By Peter Kokh

I: simulating Mars/Moon) Exploration Environment:

In 1999, Robert Zubrin announced that the Mars Society would erect a Mars Analog Research Station – M.A.R.S. [later rendered Mars Arctic Research Station] on Devon Island in the Canadian north, just 15° from Earth’s North Pole. From the very beginning, the idea was to demonstrate how humans could do a better job of geological exploration than unmanned probes and rovers.

An important research goal was to develop equipment and techniques that could be used efficiently by humans wearing cumbersome, heavy “space suits.” Thus the two Mars’ Society stations – another in the American desert southwest (Utah) that would soon follow, were designed and equipped to support this requirement.

Mars Arctic and Mars Desert Station Equipment: Airlock, EVA room (Extra Vehicular/Hab Activity), jumpsuit spacesuits simulators, helmets, gloves, gator boots. breathing equipment, radios, backpack chargers, water pack, capcom equipment in the hab, etc,



“Hab” Lower floor – EVA airlock/space suit” area lower right

Except when performing maintenance work on the outdoor utilities and/or All Terrain Vehicles (ATVs) any one exiting the station was to go through the process of donning the suit, checking all the equipment including radios, and then going through a pretend air-lock cycle before opening the outer air-lock door. The purpose of this tedious exercise went beyond wearing equipment that would simulate the clumsy spacesuits of future explorers of Mars. It was also intended to set a strong mental mood of actually being on Mars. Such an attitude would promote greater dedication and concentration on what they would be doing.

Having served on two 2-week long crews at the Mars Desert Research Station (one in 2005, one in 2006) I strongly defend these requirements. Those who would dismiss it as spurious “play acting” are missing the point.

II: Concentrating on simulated research without simulating research conditions

All other Analog Research Programs with which I am familiar, if they have considered the matter at all, have chosen not to encumber researchers with having to simulate the conditions under which actual research would be done. This frees exo-geologists and exo-biologists to test tools and techniques without having to consider the conditions under which they would eventually be used. Someone could figure that out later, Professional scientists at the Houghton-Mars, Hawaii-PISCES, and NASA-Antarctic “stations” did not want to bother with spacesuit and airlocks “paraphernalia”.

Pro “sim” and con “sim” considerations



Above: An EVA at the Mars Desert Research Station

Suitability of analog spacesuits

There are many problems with the Mars Society suits. They do create the mood, but that they accurately create the degree and types of clumsiness and inconvenience that will be experienced by real astronauts in the field is doubtful. For the Mars Society, this has been a matter of “picking its battles,” and putting its crew field workers “in the mood” has been given much more attention than accurately modeling the inconvenience of wearing such a suit. A more realistic suit would surely cost more money, perhaps considerably more, but if the goal is to design tools and instruments to be used by astronauts in spacesuits, then *at least the gloves* should be considerably more realistic. However, mobility of shoulder, arm, hip, knee joints etc. are certainly worth modeling as well.



Left: “skinsuit” research at MDRS crew 45.

Again, without NASA funding, the Mars Society has had to pick its battles with cost as the deciding factor. The lesson is that Space Agency support, if successfully sought, could have made research conclusions much more valuable and convincing. We recommend that space suit research should be a “first order direction” of any worthwhile Moon/Mars analog research station. In fact, NASA itself has short-changed and under-funded its own spacesuit research program. But that is all the more reason to include serious spacesuit research in analog programs.

Research Breadth: Science only or architecture too?

- If the goals of the station research program only extend to fieldwork in the areas of geology and biology, other considerations seem spurious.
- But if the research program is comprehensive enough to include the design and function of the Moon/Mars base itself, then if there are multiple structures, inter-connection through “pressurized” air-locks and/or hallways is essential. In short advancing “modular architecture” should be a research direction of any comprehensive analog program.
- Both Mars Houghton and Pisces Stations consist of clusters of temporary modules not physically inter-connected as they must be on Moon or Mars.
- MDRS has an external GreenHab (greenhouse), but a simulated connecting “tunnel” was not built until the 2-week Moon Society crew simulation exercise in 2006.



The simulated open frame R. A. Heinlein Tunnel at left

- If you are going to simulate pressurized connectivity between modules, it is consistent to simulate egress in space suit simulators

Access to Tourists: pros & cons

- **Tourists can be a major source of income to support research.** A nearby off-site motel, exhibits area and souvenir shop would maximize income, as would guided tours. On the other hand, uncontrolled access to the Station vicinity can interfere with research either directly or indirectly by disturbing the concentration of researchers on their work. Web-cams are one solution.
- **Allowing tourists at special times.** If tourists are permitted on location only when researchers are not present, interference will be minimized. If researchers are present but not at work, interference will be less, but could still affect concentration
- **A “duck-blind” trail.** Careful site planning could provide tourists with vantage points from which they could watch ongoing research without the researchers being able to see them, and thus lose concentration.
- **If tourists saw researchers wearing simulated space suits,** they would get a more realistic idea of what manned exploration on Moon or Mars would be like.

Conclusion:

Despite real personal inconvenience to personnel, observance of a “simulation” routine offers real benefits in public appreciation as well as, and more importantly, improved research simulation quality.

“If it’s worth doing, it’s worth doing well!” PK

Mars Desert Research Station Sim Suit Gallery



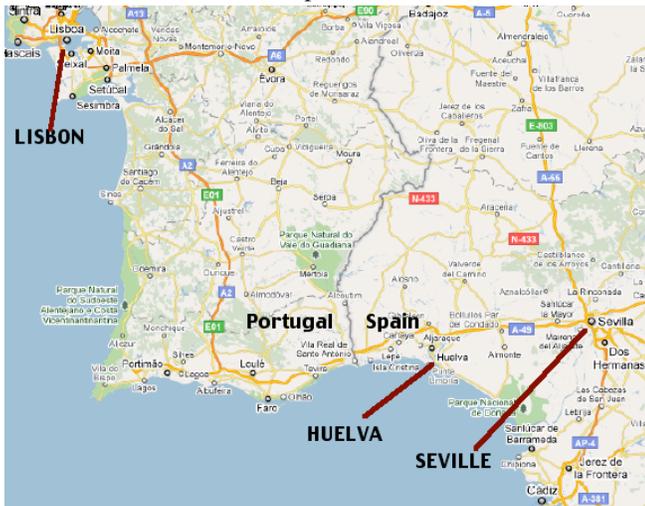
ANALOG RESEARCH NEWS

ESO tests Equipment for Mars in Mars-like Terrain in Spain

<http://www.sify.com/news/mars-spacesuits-unmanned-rover-tested-in-spanish-mining-desert-news-international-lfepughgd.html>

May 5, 2011 – The European Space Agency has found a very Mars-like setting in southwest Spain that seems ideal for testing spacesuits, rovers, and other equipment that could one day be used on Mars. The site is an ancient mining area along the Rio Tinto (tinted “blood-red” near the town of Huelva, in the Andalusia region of southern Spain.

The site is about 30 km east of the Portugal border and 80 km west of Seville, Spain.



Above: Lunar Landscapes at the Rio Tinto Mines
Reputed to be the oldest mines in the World

www.andalucia.com/province/huelva/riotinto/home.htm

Do visit the above page for more about this area!

This terrain contains a mineral called **jarosite**, just like Mars, according to experts. This landscape offers a chemical and geological make-up that comes closest to conditions on the Red Planet in Europe.

As if the striking appearance and Mars-like beauty were not enough, according to age-old myths, this area is the birthplace of the legend of King Solomon’s Mines. “It was tales of the Iberian Peninsula’s mineral wealth that drew Phoenician merchants to its shores, laying the foundations for a succession of Greek, Carthaginian and Roman invasions.” [andalucia.com link above]

“The predominant ores, however, are the ferrous ones, which oxidize when they come into contact with the air and colour land and river alike in shades of reddish brown.” [Loc. Cit.] ESO scientists have tested the spacesuit simulator **Aouda X** and a prototype, unmanned rover **Eurobot** here.



Above: **Eurobot** rover and **Aouda-X** Spacesuit simulator

The Eurobot is “a human-like robot. It has stereo vision, and two arms that can operate little pieces of payload,” according to Phillippe Schoonejans, head of the robotics project office at ESA. It is designed to do that is “too difficult, too dangerous or too boring for astronauts to do.” This frees astronauts to do what they do best.

The prototype Aouda-X spacesuit has onboard life-support systems and hi-tech computers that have been specially created to help astronauts withstand the hostile conditions on Mars. Below: an astronaut testing the suit.

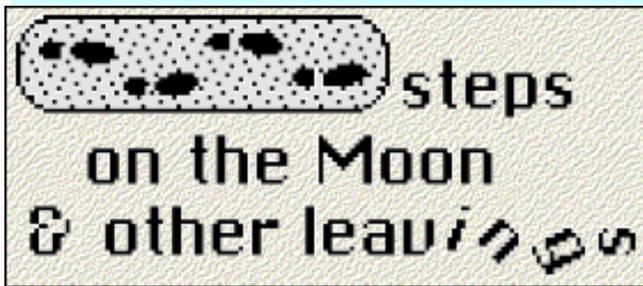


Whether ESA will continue to test space-bound equipment in this area is not stated. But clearly, this is Europe’s answer to the famed Atacama Desert in northern Chile, a favorite testing ground for NASA equipment and proposed location for the Moon Mars Atacama Research Station now budgeted for phase I construction by the University of Antofagasta, in the northern Chilean port city of that name.

Analog activities are also proposed for Spain’s Canary Islands. There is no shortage of equipment and systems to be tested to keep any number of analog research stations busy for some time, preparing for Moon and Mars.

PK

**The 1st Moon Settlement may still be a dream
But its Museum is already under construction
As are the first Lunar National Monuments**



[Footsteps on the Moon & Other Leavings]

By Peter Kokh

Proud, yet Humble Beginnings

While a physical museum building is not now under construction in a settlement site yet to be picked, the first things to be exhibited in it are already on the Moon.

There are already some 22 man-made objects on the Moon, from Soviet Lunas and Lunakhods to American Surveyors, Apollo lander descent stages, and Apollo moon rovers, plus sundry scientific instruments and paraphernalia left behind by returning Apollo Astronauts. All of these artifacts were delivered between 1966 and 1978. To today's young people, these relics are rather "prehistoric!" But they are a "down payment" future lunar permanent settlement.

http://www.moonsociety.org/info/manmade_objects_on_moon.html

On site or Museum preservation?

What to leave on site to be preserved in Lunar "National Monuments" and what to relocate and preserve in Settlement Museums? For the Apollo sites, my call would be to preserve as fully as possible the first (Apollo 11), the most scenic (Apollo 15, plus 1st rover), and the last (Apollo 17) sites. Leavings from the Apollo 12, 14, and 16 sites could be put in lunar settlement museums, and to major museums on Earth at major international tourist destination cities (or to highest bidder, money collected going to purchase *terrestrial artifacts* for Lunar museums, so future Lunans can get some feel for what life was like on Earth for the. Pioneers who bravely left it behind.

As for NASA Surveyors, #3 at could be preserved at the A16 leavings site, that site deliberately chosen for the Apollo 16 mission. Other surveyors could go to museums. Some of the Soviet craft could also be left on location: the first Luna lander, the first Lunakhod rover. There should be a balance between on site and museum preservation.

First human artifacts made of lunar materials

Among the "leavings" are Apollo moonwalker bootprints, the first human artifacts made of lunar materials. The first footprint at the foot of the Apollo 11 lander ladder must have been stepped over several times. Any solitary pristine footprint would be museum quality, carefully set in a preserving box tray. There are enough for many local settlement museums, and for some major museums on Earth, as well as for preservation on site. By restraining visitors to fenced and elevated pathways.

Some of these items will one day be proudly showcased in frontier Museums in Lunar Settlements yet to be built: Luna City? Selenopolis? Let's leave the naming of future settlements to the brave and hardy pioneers who build them. They represent the first humble beginnings of mankind's efforts to add the Moon to the Greater Human Domain, as Earth's 8th, offshore continent.

In addition to the various Soviet era landers and rovers – Lunas and Lunakhods, and US surveyors and rangers, there are the 6 Apollo sites, with the descent module, flags, and various scientific equipment still on location in addition to those "footprints." There of the Apollo sites, A15, A16, and A17 also boast "moon buggies" – the first manned vehicles on the Moon, waiting for future drivers, not that that would be allowed!

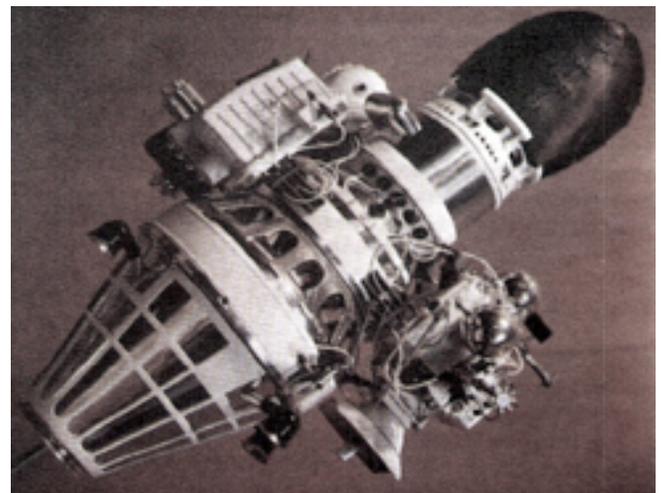
From Trash to Treasure

Some people, who accept leaving behind the Apollo lander descent stages and moon buggies, look on the various pieces of scientific equipment, wrappings, and other sundry items left Out on the surface (instead of inside the descent module storage lockers) at the Apollo sites as trash, "defacing the Moon." Yet they represent some of mankind's highest technological achievements, of enormous value. Left in place, they chronicle our scientific activities.

**A Gallery of Settlement Museum-worthy Leavings
From the Soviet and American Moon Programs**

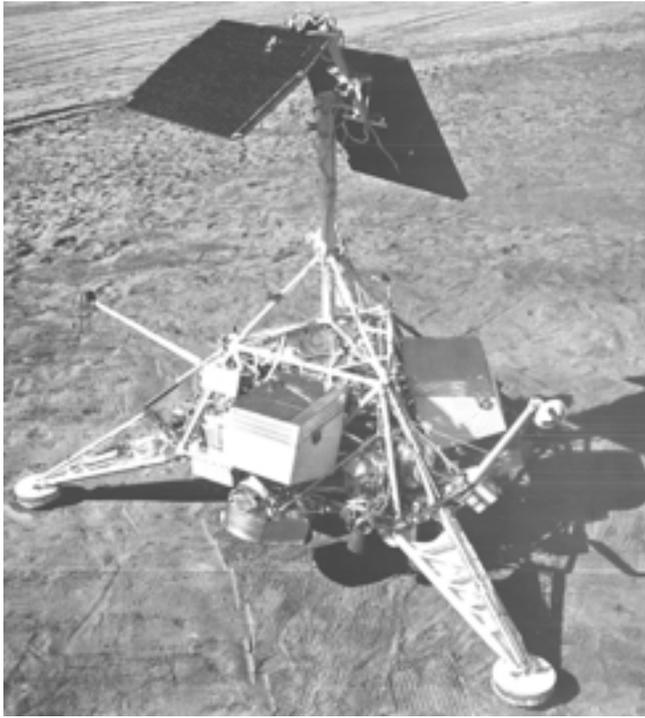


These impressions are the first "pieces" of human art made on the Moon of lunar materials!

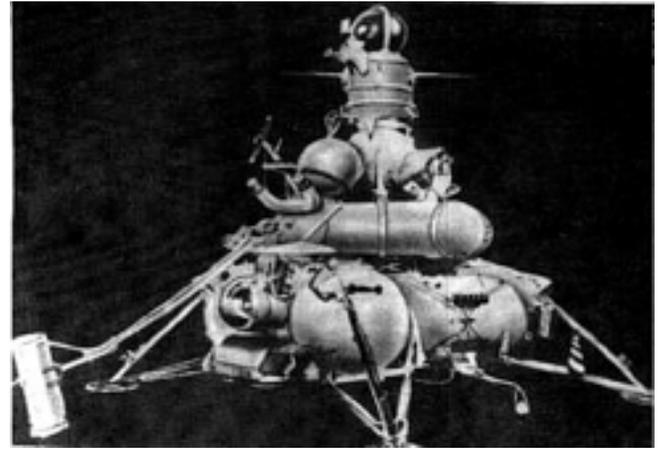


Luna 9, 1966, 1580 kg

The first manmade object to soft-land on the Moon!



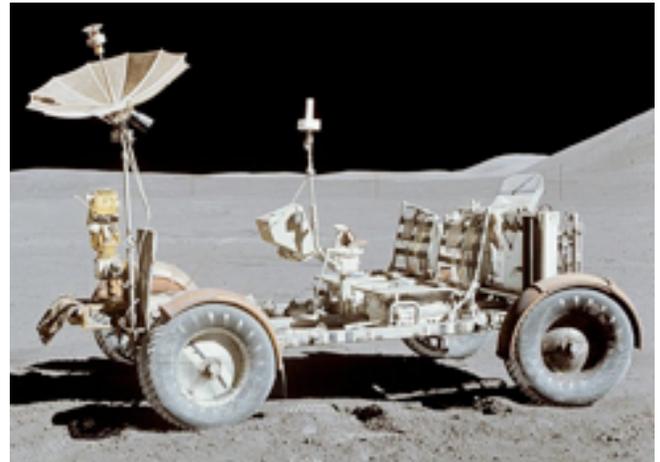
Surveyor 1, first US soft landing, 1966 270 kg



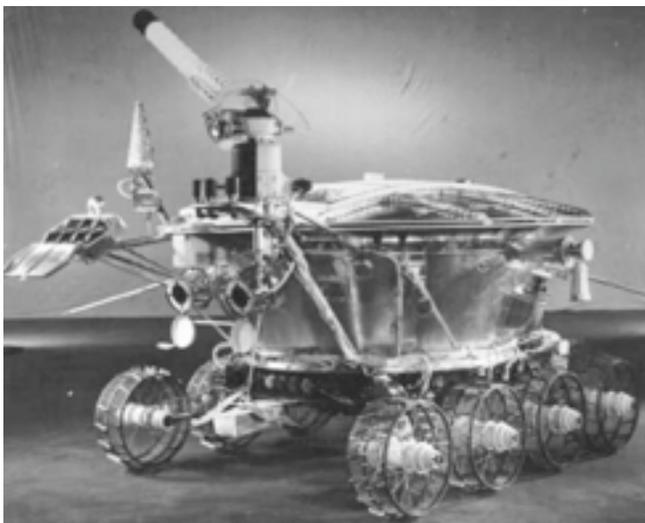
Soviet Luna 16 lander, 1970, 5727 kg



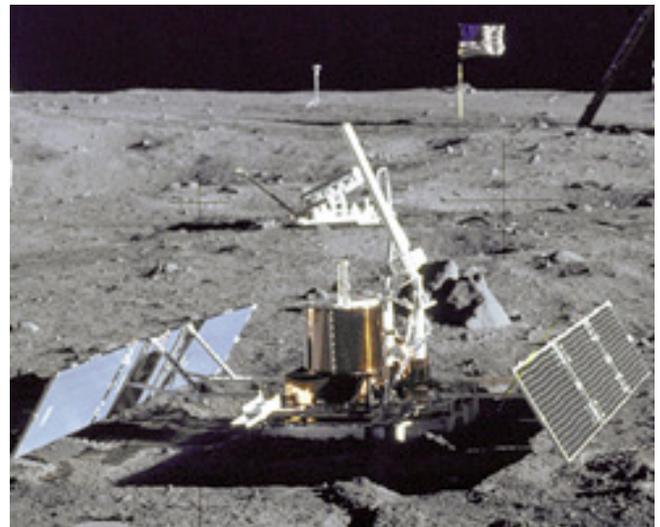
Photo of one of the Apollo Descent Stages, taken remotely by a camera left behind after the Ascent Stage had left with its two astronauts



One of the three Apollo moon buggies left behind.



Lunakhod 1, first Soviet rover



Apollo science experiment equipment left behind

http://en.wikipedia.org/wiki/List_of_man-made_objects_on_the_Moon

Impacted equipment; Besides 21 intact soft-landed objects, 50-some objects have crash landed on the Moon at high speed. We don't know if any of these objects will be recognizable, although the artwork on Chandrayaan-1's Moon Impact Probe was designed to survive. If so, that too will be a treasure, and an object of real pride for India and for the ISRO space program. **PK**

Could Some Lunar Lavatubes Be Hiding Valuable Resources? *Let's Speculate!*

By Peter Kokh with input from David Dunlop

Forward [Reprint of an article in MMM #44, April 1991]

For centuries we've realized that the Moon's surface was desert-dry. The first good telescopes had shown the great dark areas hopefully called "Seas" to be really dry low-lying plains (filled with a dry quicksand of dust, many wrongfully supposed). We took it for granted that the Moon had formed wet, as had Earth, and that its low gravity was insufficient to hold on to its aboriginal atmosphere so that its waters had been lost to evaporation and ultraviolet disassociation.

The findings of the Apollo missions and follow-up studies of their precious hoard of Lunar Samples told another story. The maria seas were really great sheets of frozen lava with the upper few meters pulverized and gardened into a dust blanket (the regolith, a feature shared with highland areas). Moreover, nowhere was there to be found any relics or clues of a past wetter epoch. There is no rusted iron. In fact, even with a gross composition of 42-45% oxygen, the Moon seems under-oxidized. For what iron there is, is either FeO, ferrous oxide (a less oxidized state than our commonplace Fe₂O₃), or pure iron fines. Nor are there any hydrated minerals or clays, so common on Earth. The Moon had apparently formed hot and dry, quite unlike the Earth, perhaps from vaporized material cast off (but retained in orbit) following a major collision between the forming proto-Earth and a smaller but rival body forming at roughly the same distance from the Sun. One day we may know the 'rest of the story' but this is our current best solution to the puzzle.

What we have found instead, quite by surprise, is a non-negligible endowment of hydrogen atoms (1 ton in a football field sized area 1 yard deep - far less than in Earth's driest desert sands) adsorbed to the fine particles of the regolith 'top soil', apparently a gift of the Solar Wind which has been softly buffeting the Moon's surface for billions of years.

[skipped paragraphs irrelevant to argument]

Yet it has occurred to the writers that there is some possibility, indeed an appreciable chance that *vaporized cometary materials have been cold-trapped in places not exposed to the loss mechanisms of cosmic radiation and solar wind gusts. The greatest wave of comet bombardment of the Moon may have been in the formative era. But even in the past 3 plus billion years since the great impact basins were filled with runny lava, an appreciable number of comets (in episodic waves or not) may have impacted the Moon.*

The maria are not totally flat, but have a slow gradient, stepped by lava flow fronts, with highest elevations near the source(s) of the magma upwellings. *It is in these relatively higher regions of the mare seas that we expect to find lava tubes.* Very near-surface [and especially large] lava tubes would have collapsed, and it is probably

their relics we see in the many sinuous rilles (like Hadley, visited by Apollo 15). *And we see winding 'rows' of rimless sinkholes, which would seem to indicate partially intact tubes a bit deeper below the surface. Here and there, a stray comet might have hit the jackpot, crashing through the roof of a lava tube and vaporizing. While perhaps most of the vaporized material would have escaped out of the impact crater, it is possible some fraction fleetingly pressurized the adjacent segments of the lava tube (too much pressure would only blow out the roof) long enough to freeze out as frost on its floor, ceiling, and walls, at a distance where they wouldn't have been heated by the thermal shock of the impact. Down here, there is no exposure to cosmic rays or errant wisps of solar wind. We may have won the Solar 'Lottery'!*

[skipped paragraphs irrelevant to argument]

The technical feasibility of deep-looking radar is quite real. Improvements on the radar that have revealed ancient river bottoms beneath dry Sahara sands, may someday reveal the existence and whereabouts of many near surface lava tubes in the lunar basalt seas. In our earlier article "Lava Tubes" in MMM # 25 APR 1988, we stated our belief that deeper lava tubes may lie in subsequently buried early lava sheets. Many of these may have been later filled and plugged, but some few could remain void. But whatever the case, only near surface tubes could have been entrusted with this gift of the comets. Will such improved deep-looking radar find a few unmistakably ice-walled lava tubes as well as the more common bone-dry ones?

If so, will the frost layers be so diffused and thinned out on the inner surfaces of these voluminous hollow sanctuaries that, scientific treasure trove or not, they won't be economically recoverable? That's a possibility. The history of space development scenarios and speculations has been heavy on overly romantic expectations. Despite the dashing of many naive hopes, from hydrated minerals on the Moon, to lichen covered fields on Mars, the promise of a human-settled inner solar system rooted in the use of extraterrestrial materials, spring-boarding from Earth's ever growing energy thirst, is still concrete enough to keep us planning and scheming ways to work with the grain of nature off planet.

Ice encrusted cavernous tubes on the Moon may or may not be found. But if we don't find any, it will be a matter of bad breaks only. Until we've checked our ticket stub, we can't dismiss the not-so-unfavorable odds that we've won this Solar Lottery! < MMM >

Twenty Years Later – Revisiting the Question Lavatube Ice Reserves?

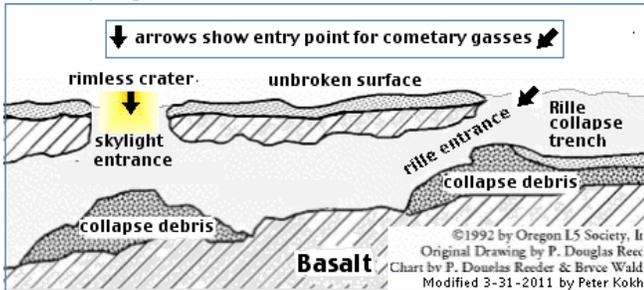
Most of us, I suspect, imagine these underground lairs to be nothing but barren, and somewhat boring caverns whose main value is their capacity to shelter extensive human settlements and all the activities that go with it.

Two decades ago, I wondered aloud (in MMM #44 bulk of text reprinted above) if it might just be possible, however low the odds, that a comet small enough not to obliterate a tube, but large enough to penetrate its ceiling with a precise hit, against very high odds, and vaporize with

the cometary ices freezing out on the tube's inner surfaces, waiting hundreds of millions of years for some intelligent explorer-settler to discover this treasure. I dubbed such a comet strike "winning the cosmic jackpot."

But now we know that objects, probably small astrochunks rather than comets (but who can be sure?) have penetrated lavatube ceilings in several places on the Moon. And it occurred to me, that even if none of these penetrators was cometary in nature, the very presence of an opening might invite cometary vapors from a nearby strike to wander in, and take up abode. After all, this is how much if not most of the ice deposits in permanently polar craters slowly built up. Comets can strike anywhere at anytime, The sun and the solar wind will work to blow those gases away from the Moon. But if a comet strikes on a part of the Moon experiencing nightspan, and some of the vapors spread to the polar regions before the Sun rises, they are sequestered in these polar cold traps.

Now Chandrayaan-1 and Lunar Reconnaissance Orbiter data both show intact lava tube sections that open onto rilles, the collapsed remnants of once extensive tube sections. These entrances could also be penetrated by cometary vapours.



NOTE: The age of skylight collapse pits could be considerably younger than most rille collapses, thus skylight cometary volatile sequestration should be much less rich on the average than rilleside tube entrances. The former are easier to find at low-res, the latter requiring high-res for confirmation and even for original notice.

But there is a catch to this idea. When it first occurred to me, 20-some years ago the "word" was that we expected the temperatures inside intact lunar lavatubes to be on the order of 80° K, -193° C, -315° F. **But that may not be the case.** There is good reason to believe that lavatubes should be of a temperature that we would expect at that depth below the lunar surface.

Now during the Apollo missions. We probed the surface to a depth of 2 meters, not far, but far enough to suggest that at that depth, the temperature was fairly stable no matter whether the surface above was experiencing full dayspan heat or bone-cracking nightspan cold. While we did not really probe deeper, other evidence suggests that as we go down deeper, we should reach a point at which residual heat from the lunar interior balances any neat heat loss to space over the dayspan-nightspan cycle.

Polar craters are different. *They are permanently exposed to the heat sink of cosmic space at a few degrees above absolute zero.* Lavatubes are not so exposed, so they will not have cooled down below the temperature prevailing in the surrounding rock

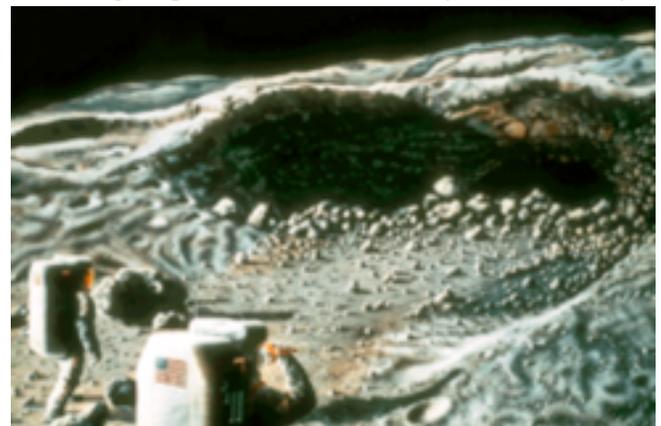
I put the question to *Dr. Alan Binder*, Principal Investigator for the **Lunar Prospector** mission 1998-9, and received the following prompt reply:

"As I state in [my novel] MOONQUAKE (p 170), the temp at 1 meter depth in the regolith is (in the equatorial regions - it will be somewhat colder at high latitudes) -20° C, is essentially constant, and the gradient in the regolith is 1 to 1.5° C/meter via Apollo measurements. Thus at the bottom of a typical 3-5 m deep mare regolith layer the temp is about -15° C.

"Now, the Apollo conductivity measure-ments were made in the outer couple of meters of the regolith, i.e., not even to the bottom of the regolith, but, we know from the passive seismic measurements that show that the P-wave velocity of success-ively deeper layer increases dramatically as a result of the decrease in brecciation of the mare basalts with depth. Thus, the thermal conductivity must increase and the thermal gradient will decrease with increasing depth.

"But right now, we do not know how much. Clearly, the deeper a lava tube is, the hotter it will be --- but right now we have no good data to tell us the gradient. Lets say a tube were 100 meters deep and the gradient is 0.1° C/meter, the tube temp would be say +5° C. But as you can see, until we know the latitudes' depths and the temperature gradients as a function of depth, this is just a game of rough estimates."

This argument explodes the previously heard expectation that Lavatubes would be cryo-environments, cold enough to preserve refrozen cometary ices indefinitely.



The classic Pat Rawlings painting above shows astronauts gazing at such an entrance, which as collapsed rubble or talus, will be challenging to traverse in order to get inside. Now we know that they won't need icepicks or iceskates!

Oh how reality has a way of dashing one's favorite expectations. If cometary ice were available at lavatubes far from the Moon's poles, the prospects for early settlement in those areas would have been much brighter.

As usual, simpler understandings give rise to expectations that are dashed by more complete knowledge.

What about volcanic gasses?

We now know, or suspect, that lunar volcanism may have been far wetter than previously expected, that the Moon did *not form "bone dry."* So in lavatubes that remained plugged at both ends, could there be trapped volcanic gasses of economic value? Sulfur, carbon, nitrogen, and hydrogen oxides? In a world where the key elements of organic chemistry are extremely scarce, such underground reservoirs or gastraps could be game changers.

Now to be fair, we can't yet pinpoint the location of lavatubes that are wholly intact, only those that have been compromised by skylight collapse pits or rille collapses. But even in these tubes open to the outside vacuum, if there had been some volcanic gasses, there might be residual traces left that could be detected and analyzed by sophisticated equipment.

This is certainly more than just an interesting question, it is one of potential great economic significance. On the downside, the surrounding basalt is likely fractured, allowing some slow seepage of such volcanic gasses to the surface to be blown away by the solar wind. But in cases where seepage has been at a minimum, what kind of pressure (and desitiy) might we expect? Could some such deposits be of economic significance? We will never know if we never probe further.

Volcanic gasses on Earth:

The principal components of volcanic gasses are water vapor (H_2O), carbon dioxide (CO_2), sulfur either as sulfur dioxide (SO_2) (high-temperature volcanic gases) or hydrogen sulfide (H_2S) (low-temperature volcanic gases), nitrogen, argon, helium, neon, methane, carbon monoxide and hydrogen. Other compounds detected in volcanic gasses are oxygen (meteoric), hydrogen chloride, hydrogen fluoride, hydrogen bromide, nitrogen oxide (NO_x), sulfur hexafluoride, carbonyl sulfide, and organic compounds. Exotic trace compounds include methylmercury, halocarbons (including CFCs), and halogen oxide radicals.

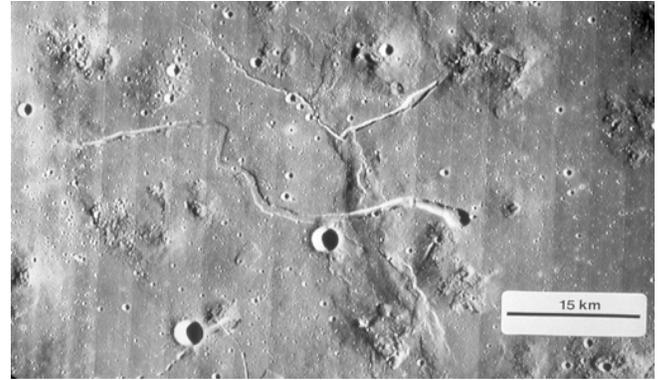
The abundance of gases varies considerably from volcano to volcano. However, water vapor is consistently the most common volcanic gas, normally comprising more than 60% of total emissions. Carbon dioxide typically accounts for 10 to 40% of emissions.

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

Now until recently, the prevailing dry-Moon hypothesis strongly suggested that there would be no water, water vapor, or hydrogen in lunar volcanic gas. But given the findings of Chandrayaan-1 and other recent probes, this expectation has turned on its head. But without any experimental evidence we have no idea how "humid" lunar volcanic gasses may be.

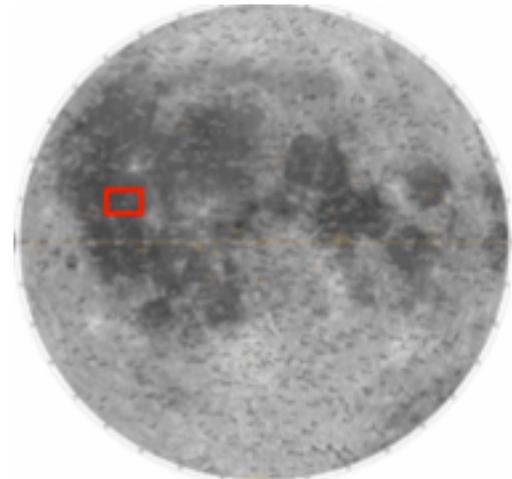
Instead of turning its back on the Moon, one would think that the agency would be working diligently on a mission to probe the Marius Hills area of Oceanus Procellarum, the "Ocean of Storms" where there is much evidence

of past volcanic activity, a number of suspiciously volcanic "domes", and a confirmed lavatube skylight!

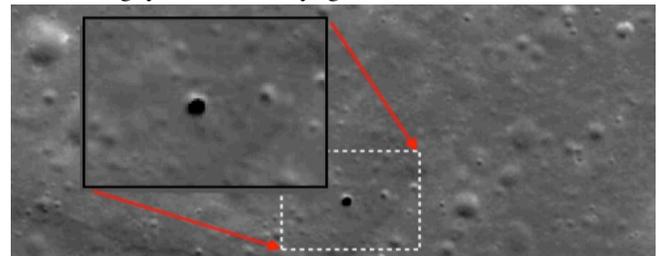


A section of the Marius Hills: rilles, domes, etc.

Location of the Marius Hills, below



Kaguya lavatube Skylight, Marius Hills below



What are people in Washington thinking? But we already know that the political process is rarely moved by reason. Rather by "how many jobs will it bring to my district?" or "How will this help my re-election chances?"

What's at Stake

At present, these are just interesting questions, and it is frustrating, that even if the Obama Administration had not altered NASA's course, that the agency had no specific plans, at least none announced or even proposed in the public domain, to begin any kind of lavatube exploration. Why? NASA is driven by scientists rather than by potential settlers, and a determination of resources of economic value to settlers is of little interest to many if not most of them. This is a case of impatient shortsightedness, as there will be far more science done on the Moon if it is settled, by the settler population, than will ever be done by scientists from Earth, returning to Earth, laying no foundations., only interested in publishing arcane papers. **PK**

Upcoming Conferences & Events

<http://www.spacecalendar.com/downrange/>

INDIA

May 20 — Committee on Space Research, Indian Space Research Organization, *Online*: Deadline for Main Scientific Organizers to upload event descriptions for Call for Papers for the '39th Scientific Assembly of Committee on Space Research (COSPAR)

Aug 19 — Committee on Space Research, Indian Space Research Organization, *Online*: Webpage open for abstract submission for the '39th Scientific Assembly of Committee on Space Research (COSPAR)

ELSEWHERE – a selection by the editor

May 10-13 International Academy of Astronautics, *Bucharest, Romania*: '2nd IAA Planetary Defense Conf'

May 18-22 International Space Development Conf, *Huntsville, AB., US*: – National Space Soc., Moon Soc

May 30-Jun 1 — International Academy of Astronautics, *Arcachon, France*: '2nd Symposium On Private Human Access to Space.'

Jun 13-15 — Lunar and Planetary Institute, *Houston TX*: 'A Wet Vs. Dry Moon: Exploring Volatile Reservoirs for the Evolution of the Moon and Future Exploration.'

June 19-22 - Planetary & Terrestrial Mining Sciences Symposium/Space Resource Roundtable, *Ottawa, Ontario, Canada*

Jun 27-30 — International Academy of Astronautics, *St. Petersburg, Russia*: '3rd IAA Symposium on Searching for Life Signatures.'

Jul 2 — International Lunar Observatory Association, Space Age Publishing Company, *Silicon Valley CA*: 'Galaxy Forum 2011: Galaxy Education and Galaxy Enterprise in the 21st Century.'

Jul 3-8 — International Astrobiology Society, International Astronomical Union, *Montpellier, France*: 'IAS / IAU c51 (Bioastronomy) Joint International Conf'

Jul 11-14 — International Academy of Astronautics, *Aosta, Italy*: '7th Symposium on Realistic Advanced Scientific Space Missions: Missions to the Outer Solar System and Beyond.'

July 21-24 – New Space Conference, Mountain View, CA

Jul 14-22 — Lunar and Planetary Institute, *Niigata, Japan*: 'Asteroids, Comets Meteors 2011.'

Jul 26-29 — International Astronomical Union, *Chiang Mai, Thailand*: '11th Asia-Pacific IAU Regional Meeting.'

Aug 4-7 — The Mars Society, *Dallas TX*: '14 Annual International Mars Society Convention

Sep 12-16 — Lunar and Planetary Institute, *Fairbanks AK*: '5th International Conference on Mars Polar Science and Exploration.'

Sep 24-28 — International Academy of Astronautics, *Baia Chia, Sardinia*: '4th IAA Symposium on Searching for Life Signatures.'

Oct 3-7 International Astronautical Federation, *Cape Town, South Africa*: '62nd Intern'l Astronautical Congress.'

Moon Miners' Manifesto Resources

<http://www.MoonMinersManifesto.com>

MMM is published 10 times a year (except January and July). The December 2010 issue will begin its 25th 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 2010, the first twenty-one years of MMM, 200 issues, are preserved in this directory**, These issues are freely accessible to all, no username or password needed, at:

www.moonsociety.org/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 of MMM-India Quarterly

NSS-Kalam Space Solar Power Initiative UPDATE

April 4, 2011 Peter Garretson, Raghavan Gopaldaswami, and John Strickland of the National Space Society have opened a relationship for NSS with The Observer Research Foundation in India. The Observer Research Foundation's Senior Fellow Dr. Rajeswari Pillai Rajagopalan has written an article calling for joint US-Indian development of space solar power. Below is the NSS press release on her call.

<http://www.nss.org/news/releases/pr20110405.html>

Dr. Rajagopalan has suggested a joint workshop on space solar power to be held in either India or the United States, sponsored by The Observer Research Foundation and NSS.

Student Space Organizations in India

Astronautical Soc. of India Student Chapter (ASISC) <http://www.indianspace.in/>

175 Bussy St, Pondicherry 605 001 175, India.

Phone: +91 0413 3246999,

email: mail@indianspace.in

Fax: +91 0413 3000222.

Head Office: ISRO Satellite centre, Airport Road,

Vimanapura, Bangalore - 560 017. India.

Phone: +91 080 25205257. Fax: +91 080 25082122.

SEDS-India - <http://india.seds.org/>

(Students for the Exploration & Development of Space)

National Headquarter - SEDS VIT,

C/O , Dr. Geetha Manivasagam,

Room No. 403 , CDMM Building ,

VIT University,

VELLORE-632014, Tamil Nadu

Phone No. : +91-9952281231

Anmol Sharma (Director, Chapter Affairs)

Current President: Pranay Puchakayala

SEDS-India Chapters:

<http://india.seds.org/CHAPTERS.HTML>

SEDS VIT (Vellore) (473 members)

SEDS Veltech (Chennai) (419 members)

SEDS Savitha (Chennai)

SEDS NITW (Warangal) (100 members)

SEDS GGITM (Bhopal) (89 members)

SEDS KCT (Coimbatore) (27 members)

SEDS ISM (Dhanbad)

SEDS NIT Trichy (Trichy) (17 members)

SEDS NIT (Nehru Institute of Tech, Coimbatore)

See map on last page of this issue

SEDS-India Projects

<http://india.seds.org/projects.html>

Help Wanted !

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

If this publication is going to help spread the word about Space in India, among the public at large, and especially among the students and younger generation, 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

This publication is intended for wide public distribution to encourage support for space research and exploration and development.

It is not intended to be 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 moon dust, 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 is 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. We will set up an online subscription service so that each issue is emailed to your email box directly, if you wish.

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

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

MMM-India Quarterly #10 – April-June 2011 Index - Table of Contents

- p. 2 About The Moon Society
About “Moon Miners’ Manifesto”
About “MMM-India Quarterly”
- p. 3 Chandrayaan-1 Data reveals intact lavatube
- p. 4 PM: Space Programme helps realize Sustainable Development;
PSLV-C116 launches 3 satellites
- p. 5 Space Tourism in India
- p. 6 ISRO invited by NASA to collaborate on Moonrise Sample Return Mission
- p. 7 China to launch Space Telescope in 2012;
China Unveils Space Station Plans
- p. 8 China to build world’s largest spherical Radio Telescope in SW China;
Japan’s Mission Control Operations taken over by NASA in earthquake aftermath
- p. 9 Hayabusa-2 mission plans;
Russia to collaborate with Israel on Space
- p. 10 Swindon gets UK Space Center HQ;
UK-Russia collaboration:
South African Space Resources Association
- p. 11 “First Orbit” film on Gagarin’s Flight
M3IQ Editors
- p. 12 MSI Call to Volunteers; Possible New Directions for Indian Space Programme
- p. 13 Moonbots Teams in India
- p. 14 Indian Student Team wins NASA Space Settlement Design Competition
- p. 16 Book: Japanese & Indian Space Programmes
- p. 17 50th Anniversary of 1st Human in Space
- p. 19 Books: Undersea Colonies; How Apollo flew to the Moon
- p. 20 Great Browsing Links; Videos
- p. 21 M3IQ Photo Gallery
- p. 22 On Orbit Vehicle Assembly at ISS
- p. 26 NASA’s New Moon Missions Budget
- p. 29 2 Models’s for Analog Station Research
- p. 31 ESO tests Mars Equipment in SW Spain
- p. 32 Footsteps on the Moon & Other “Leavings”
- p. 34 Speculation: Could some Lunar Lava Tubes be hiding Valuable Resources?
- p. 38 Kalam-NSS Space Power Initiative Update

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

Leonardo da Vinci

Is the Moon a wasteland?

“There is no such thing as waste.

There are only resources we are too stupid to know how to use.”

Arthur C. Clarke to Walter Cronkite during launch of Apollo 13

“The cure for boredom is curiosity.

There is no cure for curiosity.”

- Ellen Parr



Key: ■ ISRO Centres; ■ Moon Society; ■ SEDS; ■ NSS



Engage! And Enjoy!