

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

Moon Miners’ Manifesto

India Quarterly Edition

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

#2

WINTER 2009



Astronaut **Sunita L. Williams**, STS-116 mission specialist, smiles for the camera while in the hatch which connects the flight deck and middeck of Space Shuttle Discovery.

Highlights This Issue

- Chandrayaan-1 and other Lunar Mission News**
Pages 3- 9
- The Sunita Williams Story**
Page 11
- What will India name its “Astronauts?”**
Page 12
- SEDS-India, SINC 09, & Rover Competition**
Page 18
- An International Lunar Research Park**
Pages 20-25
- Complete article & feature index** on last page.

Welcome to Moon Miners’ Manifesto India Quarterly Edition #2

Our first edition released last November was well received and we are grateful for the many gracious comments we have received. It is a delight to see and feel all the new enthusiasm for space exploration in India. But we were not surprised. India’s leap into the 21st Century has been confident and well-grounded. What’s more, it has a powerful momentum of its own. *World take notice!*

We have had as much fun putting this issue together as we did with our first. And this time we take on the first, we hope of many, Indian contributors, Jayashree Sridhar.

Nothing could please us more than to see space enthusiasts in India take over this publication in time.

The Editors

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 2008 issue will begin its 23rd 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 to all, no username or password needed, at:

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

Editors of MMM-India Quarterly:

Peter Kokh kokhmmm@aol.com

Madhu Thangavelu thangavelu-girardey@cox.net

David A. Dunlop dunlop712@yahoo.com

About MMM-India Quarterly

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

This publication is being launched with this Fall 2008 issue. 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.

http://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 in India than in any other country.

And – *India is going to the Moon!*

In short, we'd like 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 will be available as a free access pdf file, downloadable from the Internet. We encourage readers to share these files with others freely, and to use this publication to grow and cultivate widespread 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.

तस्मिन् चंद्रयान-1

Science Mission Progress Report

Sources: <http://www.isro.org/chandrayaan1.htm>
<http://www.spaceref.com/news/mission.html?mid=277>

Dec 18, 2008

NASA Instrument starts 3-D Moon Imaging

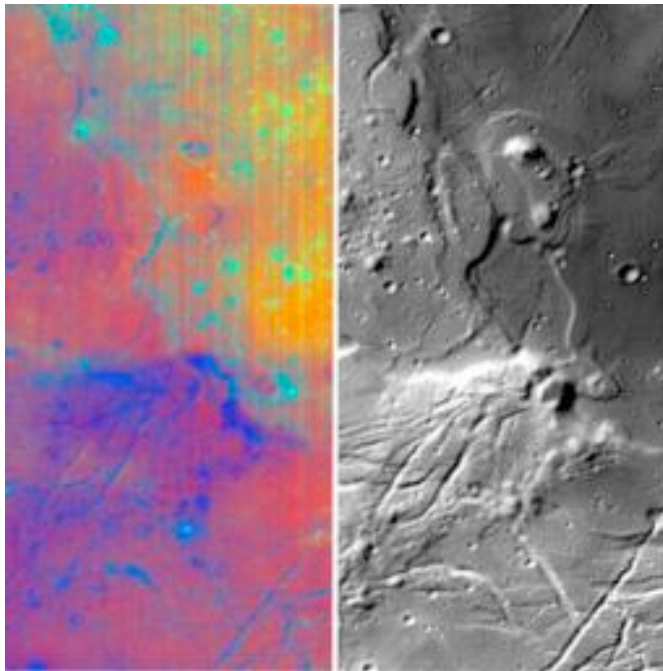
<http://www.spaceref.com/news/viewpr.html?pid=27222>

PASADENA, Calif. - Different wavelengths of light provide new information about the Orientale Basin region of the moon in a new composite image taken by NASA's Moon Mineralogy Mapper, a guest instrument aboard the Indian Space Research Organization's **Chandrayaan-1** spacecraft.

The **Moon Mineralogy Mapper** is the first instrument to provide highly uniform imaging of the lunar surface. Along with the length and width dimensions across a typical image, the instrument analyzes a third dimension - color.

This two-image figure, and other data from NASA's Moon Mineralogy Mapper Instrument can be found at:

<http://photojournal.jpl.nasa.gov/catalog/PIA11727>



Full Size image:

<http://photojournal.jpl.nasa.gov/tiff/PIA11727.tif>

The composite image is a subset of Moon Mineralogy Mapper data for the **Oriente** region. The image strip on the left is a color emission, providing a new level of detail on the form and structure of the surface. The Moon Mineralogy Mapper provides scientists their first opportunity to examine lunar mineralogy at high spatial and spectral resolution.

"The Moon Mineralogy Mapper provides us with compositional information across the moon that we have never had access to before," said Carle Pieters, the instrument's principal investigator, from Brown University in Providence, R.I. "Our ability to now identify and map the composition of the surface in geologic context provides a new level of detail needed to understand the moon."

The Orientale Basin is on the moon's western limb. The data for this composite was captured during the commissioning phase of Chandrayaan-1 as the spacecraft orbited the moon at an altitude of 100 kilometers (62 miles).

Jan 24, 2009

C1XS catches 1st glimpse of X-ray from the Moon

<http://www.spaceref.com/news/viewpr.html?pid=27420>

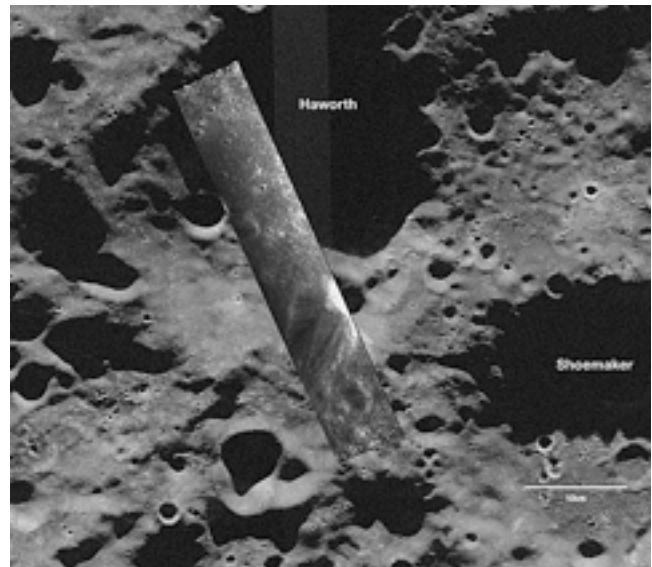
The **C1XS X-ray camera** was jointly developed by the UK's STFC Rutherford Appleton Laboratory and ISRO. It has now successfully detected its first X-ray signature from the Moon - a first step in its mission to reveal the origin and evolution of our Moon by mapping its surface composition.

The signal is from a region near the Apollo landing. The solar flare that caused the X-ray fluorescence was very weak, approximately 20 times smaller than the minimum C1XS was designed to detect. This means that the camera has exceeded sensitivity expectations and is the most sensitive X-ray spectrometer of its kind in history," said Ms. Shyama Narendranath, Instrument Operations Scientist at ISRO.

The camera collected 3 minutes of data just as the flare started, revealing the X-ray fingerprint of part of the lunar surface. As the mission continues, C1XS will build up a detailed picture of the ingredients that make up the Moon's surface, identifying its chemistry.

Chandrayaan-1 Radar Provides First Look Inside Moon's Shadowed Craters

<http://www.spaceref.com/news/viewpr.html?pid=27389>



http://www.nasa.gov/images/content/301602main_2009_0108_south_polar.jpg

January 19, 2009 - Scientists got their first look inside the moon's coldest, darkest craters. The Mini-SAR instrument, a lightweight, synthetic aperture radar, passed initial in-flight tests and sent back its first data. The image shows a portion of Haworth crater that is permanently shadowed. Over the coming year of Chandrayaan-1 operations, Mini-RF (Mini-SAR) will map both polar regions to look for water ice from a 100-km (62-m) polar orbit, revealing features as small as 150 m (490 ft) across. Bright areas represent surface roughness or slopes pointing toward the spacecraft. The area shown is about 50 km (31 mi) by 18 km (11 mi) ###

Looking Forward चंद्रयान-2

From Various Sources

[1] ISRO & Roskosmos Agreement on joint lunar efforts
http://www.isro.org/pressrelease/Nov14_2007.htm

[2] India, Russia giving final shape to Chandrayaan-2
<http://www.hindustantimes.com/StoryPage/StoryPage.aspx?sectionName=&id=7d024b18-bd9c-4011-96ba-111c19bebd24&MatchID1=4815&TeamID1=6&TeamID2=1&MatchType1=1&SeriesID1=1212&PrimaryID=4815&Headline=Final+shape+given+to+Chandrayaan-2>

[3] Chandrayaan-2

<http://en.wikipedia.org/wiki/Chandrayaan-2>

[4] Blogs about: Chandrayaan 2

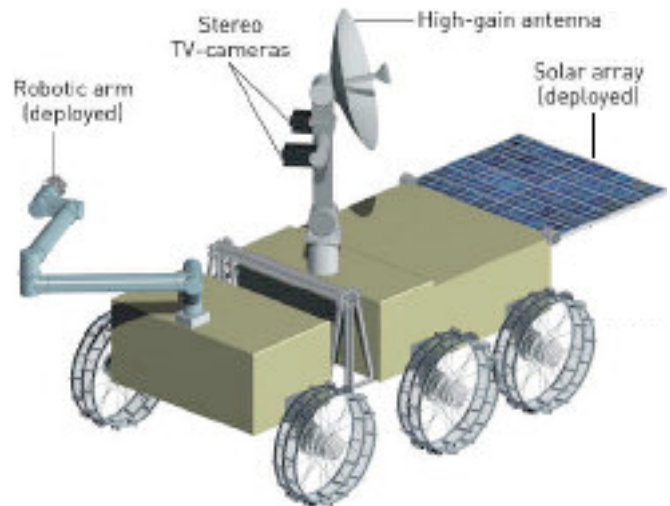
<http://en.wordpress.com/tag/chandrayaan-2/>

[5] Indo-Us Cooperation in Civil Space – Slide 13

http://www.nasa.gov/pdf/164274main_2nd_exp_conf_14_InternationalExplorationPerspective_MrVKumar.pdf

[6] India starts work on Chandrayaan-2 news-29 Oct. 08

www.domain-b.com/aero/space/spacemissions/20081029_chandrayaan_2.html



Artist concept of lunar lander-rover on board Chandrayaan-2
www.hinduonnet.com/fline/fl2501/stories/20080118509510900.htm

The rover, designed to move on wheels on the moon's surface, will pick up samples of soil or rocks, do in situ analyses of them, and send the data to the spacecraft orbiting overhead, which, in turn, will beam the information to the ground station at Byalalu, 40 km from Bangalore. The huge dish antenna there will receive the information.

[4] ISRO Chairman G Madhavan Nair told reporters that the composition of the instruments for Chandrayaan-2 would be decided after studying data received from the first mission.

[5] Lander includes robotics, rovers, penetrators. Preferred landing sites, specific scientific problems and instruments need to be finalised. Possible instruments on the orbiter: Terrain mapping camera, 400-4000nm hyper spectral Imager, Low energy X-ray spectrometer (CCD-array), Gamma ray, neutron, alpha spectrometer

[6] The Chandrayaan-2 launch vehicle provided by ISRO will be a three-stage Geosynchronous Satellite Launch Vehicle (GSLV), with a cryogenic upper stage. The Russian rover will deploy a robotic arm to collect samples and conduct an in situ analysis of the moon's soil.

[1] "Mr G Madhavan Nair, Chairman, ISRO, and Mr A Perminov, Director, Roskosmos, sign Agreement in Moscow on November 12, 2007 during the visit of the Prime Minister of India to Russia. This cooperation envisages Chandrayaan-2, a joint lunar mission involving a lunar orbiting spacecraft and a Lander/Rover on the Moon's surface. ISRO will have the prime responsibility for the Orbiter and Roskosmos will be responsible for the Lander/ Rover. A few scientific instruments from other space agencies may also be accommodated on these systems. Chandrayaan-2 will be launched on India's Geosynchronous Satellite Launch Vehicle (GSLV) around 2011-12 time frame."

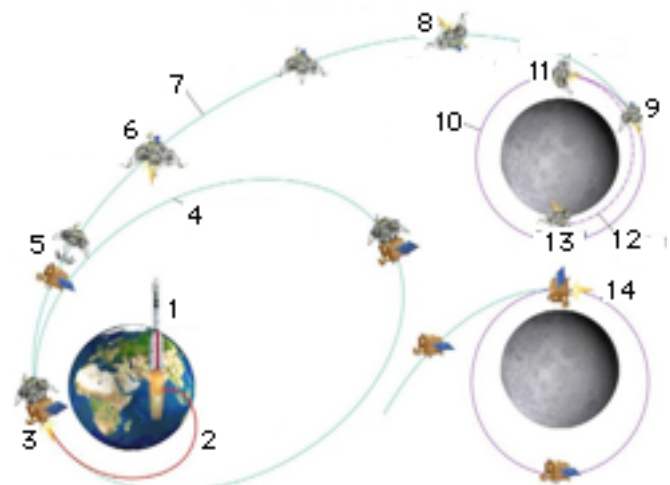
[2] Unlike Chandrayaan-1, which orbits the moon at an altitude of 100 km mapping topography and the mineralogical content of the lunar soil, the Chandrayaan-2 mission involves a lunar orbiting spacecraft and both a lander and a rover on the moon's surface.

The Government has approved a Rs 425 crore budget for the Chandrayaan-2 venture, with seed money of Rs 50 crore already in place.

Conceptual studies are in place. Overall configuration may take through April 2009 to finalise.

The rover will be a joint Russian-Indian development but with the contribution of Indian expertise. Many of the scientific instruments on board Chandrayaan-2 will be from India. Work-sharing discussions on the mission (who will do what) are in progress with the Russian space agency.

[3] The wheeled rover will move on the lunar surface, to pick up soil or rock samples for on site chemical analysis. The team headed by Myswamy Annadurai that was behind the success of the first mission would work on Chandrayaan-2



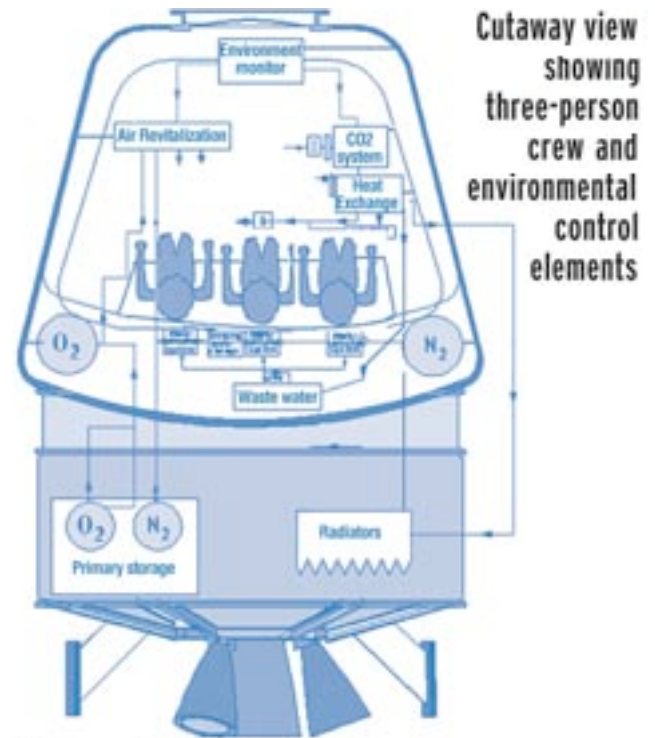
1. launch - 2. Injection into (3) Earth Parking Orbit - 4. Injection into (5) Lunar Transfer Trajectory - 6 Orbiter Separation - 7 Mid-Course Corrections - 8 Injection into (9) Lunar Orbit - 10 Injection into (11) Pre-Landing Orbit - 12 Braking and Landing ###



Design for India's 3-Person Space Capsule

M3IQ Special Report

Shillong January 3, 2009 – At the Indian Science Congress, Indian Space Research Organization chairman G. Madhavan Nair broke the news that by 2015, there will be a 2-man test flight of a manned capsule built for 3, in a 400 km high orbit. The launch rocket would be a variant of the Geosynchronous Satellite Launch Vehicle Mark 2 which will feature India's home-developed cryogenic fuelled second stage, burning liquid hydrogen and liquid oxygen. The first test flight of this vehicle is expected later this year.



The design above is not dissimilar to the 3-man Apollo craft
Credit for illustrations on this page: Space News Graphic

This craft would provide India with its own access to the Space Station as well as to any other similar facilities constructed in Earth orbit. If India were to become a full ISS partner, having such access would give India priority status. Currently, only the US and Russia are able to ferry personnel to the International Space Station.

Manned spacecraft capacity is under development in both Europe and Japan, among ISS partners. This is a goal already realized by China, which, however, is not at this time involved in the ISS program.

Manned access would also allow India to contribute to the manned exploration of the Moon and potential development of its resources for building solar power satellites or other large-scale facilities in Earth orbit.

India already has produced two astronauts. Rakesh Sharma was trained in Russia's Cosmonaut program and served on Mir. Kalpana Chawla was trained in the NASA astronaut program and served on several shuttle missions before her death on the disintegrating shuttle Columbia on its return to Earth in early 2003. Sunita Williams, of Indian parentage, was born in the United States.

These three are more than enough to have already begun a proud tradition for the future Indian Astronaut Corp and they are sure to be regarded as India's first pioneers in space. However, the launching of the first two Indian test pilots in an Indian built capsule aboard an Indian built rocket from an Indian launch pad will truly mark India's coming of age as a full partner in manned space exploration, joining the US, Russia, and China.

These developments are made possible by the cooperative agreement signed December 15, 2008 by ISRO and the Russian Federal Space Agency, Roskosmos during a state visit to India by Russian President Dmitri Medvedev. ###

I Preliminary work has begun. Several needed technologies remain to be developed. These include life-support systems, rescue and recovery systems, and a robotic remote manipulator arm.

The overall program cost spread over a period from 2007-2015 is an estimated 100 billion Rs or about \$2 billion US. That India should develop its own manned-space capacity was proposed to the government in 2006. An initial 950 million RS, about 2.3% of ISRO's 40.7 billion Rs budget for 2007-08 has been allotted for the start of this program.

In addition to the hardware itself, the program will require a new launch pad at the Satish Dhawan Space Centre in Sriharikota as well as an astronaut training center to be located in Bangalore. s releasing the first conceptual sketches of the manned capsule it hopes to build with Russian help.

ISRO Mission Director M. Annadurai Addresses Indian Students

By Jayashree Sridhar - February 2009

(About Jayashree Sridhar – see page 10. bottom column 2)



Mr. Annadurai is the older gentleman on the left, the young man on the right with a notebook of some sort must be a reporter or student.

Jayashree Sridhar, new M3IQ reporter, is the young woman in between the two. One can only see her face.

Dr. Mylswamy Annadurai, Project Director of the Chandrayaan-I, India's Rs 386 crore unmanned lunar mission spoke to students in Chennai about the mission at the 100 day mark, and also gave them a glimpse of forthcoming lunar missions. **Chandryaan -1** India's first lunar orbiter had a spectacular launch October 22, of 2008 and was brought into a lunar orbit several days later. It has been functioning flawlessly in the subsequent 100 days (and counting) since.

The Chandrayaan-I orbiter carries aboard a suite of 11 payloads. Five of these were developed by India's ISRO, and six by international partners on the mission. Two are from the United States- NASA, three are from the European Space Agency, and 1 is from Bulgaria.

Dr. Annadurai is emphasizing an integrated approach towards Chandrayaan Lunar Science. He indicated that all the instruments were functioning perfectly and that everyone shares the excitement as something new is discovered. During the beginning of the mission the data beamed from the Moon has been handled independently by the various teams but the Director indicated he wanted an integrated effort and a collective package of results to increase beneficial results. He is convening a meeting of all the scientists of the 11 instrument teams for this purpose.

One major benefit expected from Chandrayaan-I data is to help scientists and engineers narrow down future landing sites on the moon. The Director said that in just the 100 days since the launch that India's journey to the Moon had come a long way and thrown new light in its quest to trace the origin and evolution of the Moon and quantifying the mineral resources that exist.

One example is the breakthrough made by successfully detecting the first x-ray signature from the Moon with the Imaging X-ray Spectrometer (CIXS, one of the 11 payloads. This instrument was jointly developed by the Indian Space Research Organization and the Rutherford-Appleton Laboratory of the UK. X-Ray images will help to map the

surface composition and thereby help to reveal the origin and evolution of the Moon.

In orbit on December 12, 2008 the CIXS detected an X-ray signal from a region near the Apollo landing sites just as a solar flare began. A weak solar flare, approximately 20 times smaller than the instrument was designed to detect, produced 3 minutes of data from the X-ray camera. The CIXS camera depends on radiation from the sun and the level of solar radiation was expected to increase from the solar minimum phase of the solar cycle in early 2008 but has yet to increase (toward the maximum phase of the solar cycle). ISRO Administrator Madhavan Nair said the operation of the highly sensitive instrument was a major achievement and highly encouraging.

Award! One of India's highest award, the prestigious Padma Vibhushan award was announced to Dr. G. Madhavan Nair. He dedicated this award to all the members of the Chandrayaan-I team on the occasion of the 60th Republic Day of India. A special ceremony in Rashtrapati Bhavan for the presentation of the award will be made at a later date.

Chandrayaan-2 A major result of the first mission is to zero in on selecting the landing zone for the next joint Indo/Russian mission Chandrayaan II. This mission is scheduled to launch in 2012 from Sriharikota on the PSLV. The Head Administrator of ISRO has indicated that India's second lunar mission would consist of a Lander and a Rover. (Editor's note India will also design and build the lunar lander while Russian will contribute the rover. This will be India's first landing on the lunar surface and the first Russian surface mission since the Lunakhod mission in 1976.)

Chandrayaan-3

Director Annadurai also said yet another new mission Chandrayaan-3. was in the cards. This lunar sample return mission is also expected to launch around 2012. This will involve not only a surface landing but returning lunar samples to Earth for laboratory analysis. This will lead to a deeper understanding of the Moon's characteristics.

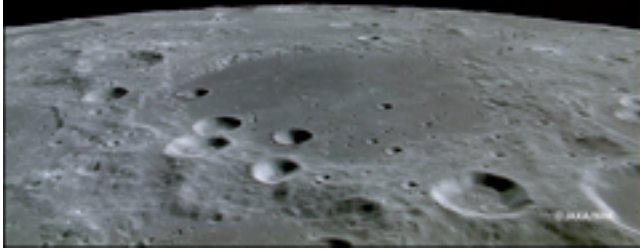
Student Interaction

Dr. Mylswamy Annadurai, following in the footsteps of India's former President A. P. J. Abdul Kalam, interacted with students and scientists. He predicted that an Indian would be on the Moon by 2020. He noted, "There was a Pre- Chandrayaan India and subsequent to Chandrayaan-I, there is a Post-Chandrayaan India in the change in the attitudes of both parents and children alike.

Students today are well equipped to handle technology. The Indian Space Research Organization will consider permitting high school students to carry out project work in their laboratories. A good transition is happening. As the success of the ISRO has come at a time of the slump of the IT industry, many bright young minds will start to think of a career in space research. The country could achieve the long term goals of research in a shorter period if more school students came forward to contribute to research in the field." He mentioned the importance of tapping the potential of the Moon in meeting the energy needs of the country. "India is keen on energy. One of the benefits of sending a man to the Moon would be the possibility of an alternative fuel." he told the students.

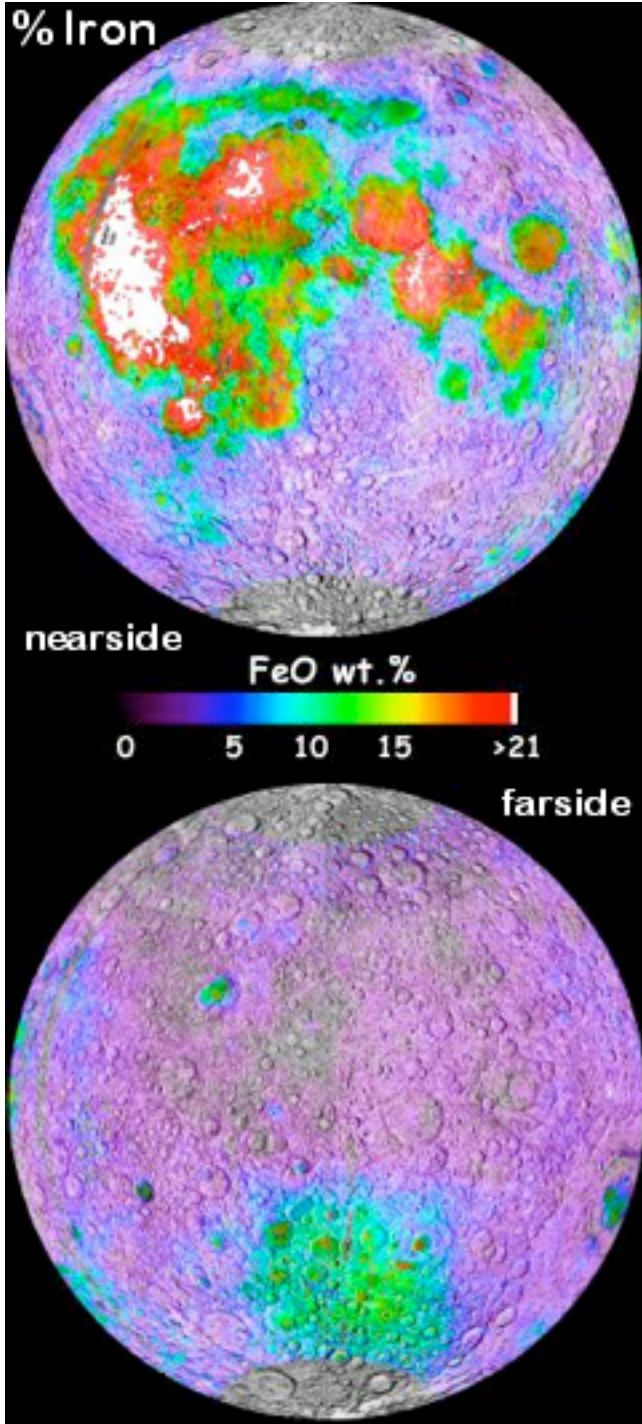
###

The Moon Revealed



Findings from Japan's Kaguya (Selene) And China's Chang'e-1

<http://www.space.com/scienceastronomy/090212-moon-far-side.html>



New observations from Japan's SELENE (**Kaguya**) lunar mission are shedding light on the perplexing geological differences between the near and far sides of the moon.

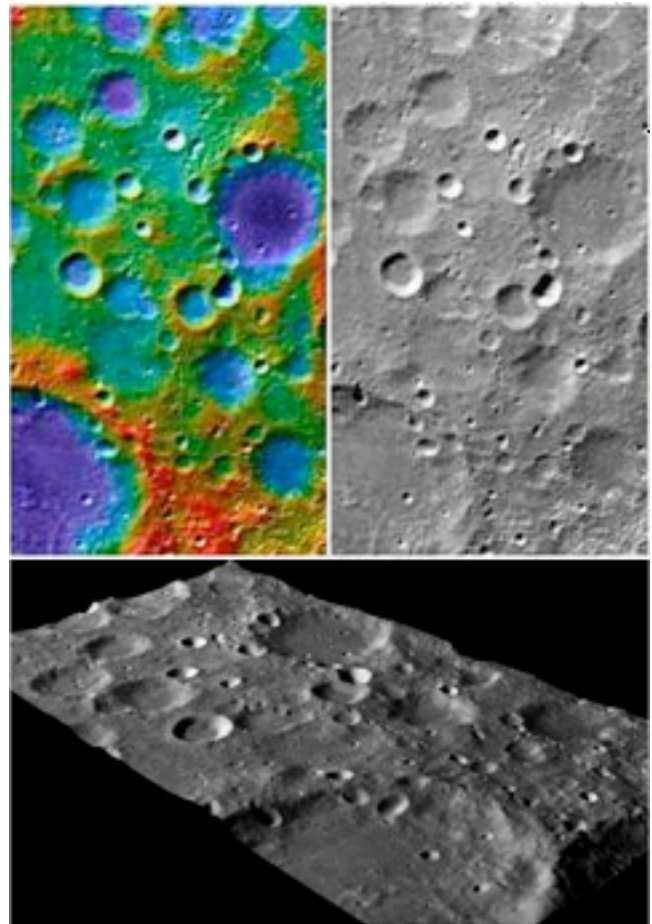
Not until the dawn of the Space Age were humans able to get a glimpse at the moon's far side, perpetually kept from Earth's view by the satellite's synchronous rotation about its axis in the same time it takes it to orbit the Earth.

Once spacecraft were launched that could take in the long-hidden view, we found that the moon was two-faced: the nearside was covered with smooth, dark volcanic maria (solidified pools of ancient lava), while the far side almost completely lacks these features and is instead covered by more heavily cratered bright material.

This difference is highlighted by the uneven distribution of iron [left], found in some abundance everywhere.

These differences in topography and composition imply that the two sides evolved differently during the more than 4 billion years of the moon's existence.

Chang'e-1 highlights moonscape ruggedness in 3D



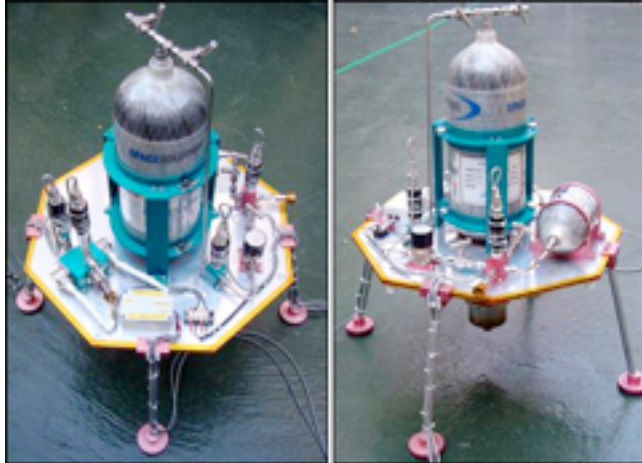
All 3 views above are of the same strip of lunar real estate.

Upper Left: colors illustrate the great differences in elevation with orange being the highest and blue the lowest/deepest. This typical highland terrain shows the difficulty we will have in traversing highland territory prevalent around both poles, the southern nearside, and most of the farside.

The plus side is there will be no shortage of "scenic highways and byways" for tourists! **MMMIQ**



Elsewhere in Asia



Made in Korea: Lunar Lander Unveiled

By Nancy Atkinson

<http://www.universetoday.com/2008/12/01/made-in-korea-lunar-lander-unveiled/>

The mini-sized lander, shown above is about 40 cm tall (15.5 ") and weighs 25 kg (55lbs). Scientists say it carry an additional 20 kilograms in payloads to the surface. It was built over a six-year period at the Korea Advanced Institute of Science and Technology (KAIST) The Institute has also developed a rocket engine that could deliver 100-200 kg payloads to the Moon for half the \$100 M figure estimated by NASA. The team's goal is to land a payload on the Moon by 2013. Early this year, Korea could become the 9th nation to put a satellite in space from its own soil. The nation wants to go to the Moon, however, as part of an International space research project, the ILN, a project aiming to gradually place six to eight fixed or mobile science stations on the lunar surface. The stations will form a robotic network to replace the hardware left by the Apollo program to continue studies of the Moon's surface and interior. Source: **Korea Times**

Below: Satellite in preparation



South Korea to enter Space Club

<http://spaceports.blogspot.com/2008/10/south-korea-to-enter-space-club.html>

Korea will build and test a 300 ton Korea Space Launch Vehicle-1 (KSLV-1) based on the Khrunichev Angara modular booster by 2017. Korea has a **new space launch centre at Doheung** on the southern tip of the Korean peninsula

China, Japan and S Korea set up world's largest radio telescope array

<http://english.people.com.cn/90001/90781/90876/6583163.html>

February 01, 2009

The Radio Telescope array will combine 19 radio telescopes operated by different communities in the three countries. The resulting array will have a diameter of some 6,000 km stretching from Hokkaido to Urumqi and Kunming.

China-Russia Mars mission set for takeoff

http://www.marsdaily.com/reports/China-Russia_Mars_mission_set_for_takeoff_999.html

The first joint Chinese-Russian mission to Mars is set to take off in October and reach the red planet in August 2010.

A Russian Zenit rocket will launch a Chinese **Yinghuo-1** satellite and a Russian **Phobos-Grunt** unmanned lander. Phobos-Grunt is expected to study Mars from orbit, including its atmosphere and dust storms, plasma and radiation, before landing on Phobos, one of Mars' two small moons.

Yinghuo-1, which means Firefly-1, will explore the Martian environment and carry out research into how surface water on the planet disappeared.

Meanwhile, China's second unmanned moon probe, **Chang'e-2**, is likely to be launched this year, a year ahead of schedule. Chang'e-2 will collect more detailed images and statistics of the moon's surface.

Iran Launches its 1st Satellite

http://news.bbc.co.uk/2/hi/middle_east/7866357.stm

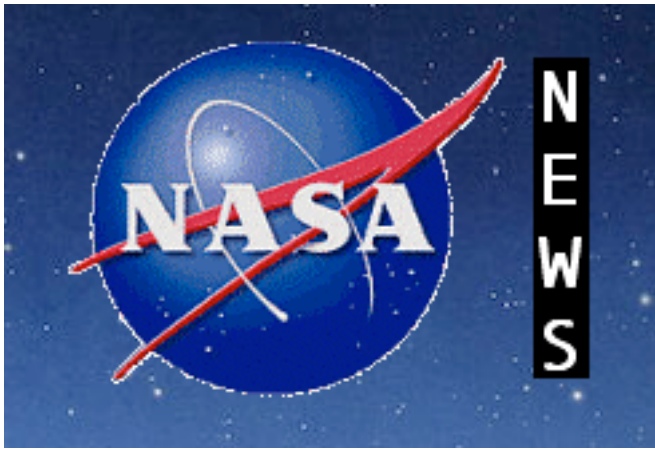
February 3, 2009 - The satellite, carried on a **Safir-2** rocket, is meant for telecommunication and research purposes, state TV said. The launch of the **Omid** (Hope) satellite had been expected and was timed to coincide with the 30th anniversary of the Iranian revolution.

Malaysia pins its Space Ambitions on a plan to become a center for Space Tourism

http://www.islamonline.net/servlet/Satellite?c=Article_C&cid=1189959273508&pagename=Zone-English-HealthScience%2FHSELayout

Send Asia Space News tips to:

mmm-india@moonsociety.org



LCROSS Heads to Florida for Spring Launch

http://www.nasa.gov/home/hqnews/2009/feb/HQ_09032_LCROSS.html ----- February 17, 2009

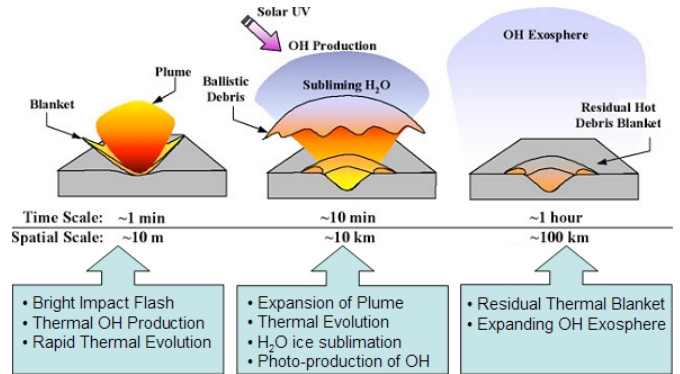
LCROSS - Lunar CRater Observation and Sensing Satellite

The primary Mission Objective of LCROSS is to confirm the presence or absence of water ice in a permanently shadowed crater in the Moon's polar regions. LCROSS will excavate the permanently dark floor of one of the Moon's polar craters with two heavy impactors in 2009 to test the theory that ancient ice lies buried there. The Centaur upper stage of our Moon rocket will be used as a 2200-kilogram kinetic impactor, excavating a crater approximately 20 meters wide and almost 3 meters deep. More than 250 metric tons of lunar dust will be lofted above the surface of the Moon. The specialized instruments aboard the LCROSS probe itself will analyze this plume for the presence of water (ice and vapor), hydrocarbons and hydrated materials. Then LCROSS itself will impact the area to create a second plume. It is hoped that both plumes will be observable from Earth as well.



LCROSS will travel to the Moon as a "hitchhiker" payload aboard the launch vehicle of the **Lunar Reconnaissance Orbiter (LRO)** which is designed to map the lunar surface and characterize landing sites for future missions.

Analysing the impact plume



Watch the Video on this page:

<http://lcross.arc.nasa.gov/index.htm>

NASA AMES is the project Center, and Northrup Grumman is the lead contractor for LCROSS.

Background (by editor)

The first such attempt was made on July 31, 1999 as **Lunar Prospector**, the first polar orbiter equipped with instruments to detect the signature of hydrogen and map its findings, impacted within a permanently shaded crater near the lunar south pole. Analysis of the plume was inconclusive.

On December 13, 1999 NASA released a statement that "The controlled crash of NASA's Lunar Prospector spacecraft into a crater near the south pole of the Moon on July 31 produced no observable signature of water, according to scientists digging through data from Earth-based observatories and spacecraft such as the Hubble Space Telescope."

Scientists were determined to try again. Of course it would be ideal to send a lander that could probe the soil in such a crater directly and report back its "ground truth" findings. But that would be a much more expensive undertaking than simply designing all future orbiter missions to terminate their missions in a south polar dark crater impact.

As part of the Beijing Declaration, signed on July 27, 2006, all participating spacefaring nations agreed to such a plan, and to coordinate their findings. The first nation to follow through was India, which included a specially designed impactor probe aboard Chandrayaan-1, which was successfully launched on October 2, 2008.



Between all these impactors, we hope to get some definitive answers, at least about the water content of the sites sampled by the various impactors. Whether we set up shop at the south pole or elsewhere may hang in the balance. ###

MMM-India Quarterly Editors:



Peter Kokh
kokhmmm@aol.com

http://www.lunarpedia.org/index.php?title=Peter_Kokh

Moon Society President
Ed: [Moon Miners' Manifesto](#)



Madhu Thangavelu
thangavelu-girardey@cox.net
Mother from Kerala, father from Tamil Nadu, grew up in New Delhi. Now teaching at U. of Southern California. Conductor, Graduate Space Exploration Concept Synthesis Studio USC Schools of Engg and Architecture



David A. Dunlop
dunlop712@yahoo.com

Moon Society Board,
Director of Project Development

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.

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*

Readers are encouraged to share and to distribute this first edition widely, either as an email attachment, or via the direct download address:

http://www.moonsociety.org/publications/mmm-india/m3india1_fall08.pdf

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 to addresses on a paid-subscription basis, Please contact us at mmm-india@moonsociety.org

Introducing a New Reporter for MMM and MMM-India Quarterly - Jayashree Sridhar

From David A. Dunlop – January 19, 2009

I am very pleased to announce that Jayashree Sridhar is a new reporter for the Moon Miner's Manifesto and MMM-India Quarterly publications of the Moon Society. Her affiliation is Chettinad Vidyashram, Chennai, Tamil Nadu.

Although in only her last of secondary education she has an amazing resume. She has won recognition for her academic work within Tamil Nadu and has received both national and international recognition. In addition to her academic accomplishments she has participated as the head of the student government in her school of over 10,000 students. She is a tennis player and has musical interests as well.

We are pleased that someone who has demonstrated early both her academic and leadership talents is also very interested in space and science and is a member of the Moon Society.

I was fortunate to hear her speak and meet her at the International Conference on the Exploration and Utilization of the Moon in Orlando, Florida last October

She is anticipating an interview with the head of India's Chandrayaan program at the end of January. ###

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.

The Sunita Williams Story

By Peter Kokh

Sunita Williams was born September 19, 1965 in Euclid, Ohio, a suburb of Cleveland. Her parents are **Dr. Deepak Pandya** and **Bonnie Pandya**, who live in Falmouth, Massachusetts. Deepak Pandya is a famous neuroanatomist. Williams' roots on her father's side go back to **Gujarat** in India and she has been to India to visit her father's family. She is of Slovene descent from her mother's side. Her ancestral village is Jhulasan, about 50 km from Ahmedabad, a major city of 8 million, and the home of ISRO's Space Applications Center (SAC.)



After High School in Needham, Massachusetts which she considers her “home town”, She went on to receive a Bachelor of Science degree in Physical science from the U.S. Naval Academy in 1987, and a Master of Science degree in Engineering Management from Florida Institute of Technology in 1995. She became a Naval Aviator in 1989, and went through the Naval Test Pilot School in 1993.

Sunita and her husband of 16 years are both helicopter pilots. She loves outdoor sports and her recreational interests include running, swimming, biking, triathlons, windsurfing, snowboarding and bow hunting. She is now a United States Naval officer and a NASA astronaut.

Sunita's accomplishments as an astronaut

Sunita joined the NASA Astronaut Corp in 1998. Williams worked in Moscow with the Russian Space Agency on the Russian contribution to the International Space Station (ISS) and with the first Expedition Crew to the ISS. She has worked within the Robotics branch on the ISS Robotic Arm

and the follow on Special Purpose Dexterous Manipulator. As a NEEMO2 crewmember she lived underwater in the Aquarius habitat for 9 days. Sunita Williams currently serves as Deputy Chief, Astronaut Office.



Sunita was a flight engineer aboard the International Space Station, launching with the crew of STS-116 on December 9, 2006, docking with the station on December 11, 2006. As a member of the Expedition-14 crew Sunita Williams established a world record for females with four spacewalks totaling 29 hours and 17 minutes of EVA. (That record has subsequently been broken). Her tour of duty as a member of the Expedition-15 crew ended when she returned to Earth with the STS-117 on June 22, 2007. During her increment in space, Sunita Williams broke the existing record by Shannon Lucid, setting a new record for females of 195 days in space.

Sources:

<http://www.jsc.nasa.gov/Bios/htmlbios/williams-s.html>

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

http://www.monstersandcritics.com/news/india/news/article_1360270.php/Sunita_Williams_is_Gujarats_most_admired_personality

<http://www.freshnews.in/sunita-williams-a-source-of-inspiration-for-indian-women-manmohan-singh-15614>

<http://www.freshnews.in/heros-welcome-awaits-sunita-after-195-day-record-space-odyssey-11344>

<http://www.freshnews.in/sunita-returns-home-after-195-day-space-odyssey-1133>

###

“Astronaut” “Cosmonaut” “Spacionaut” “Taikonaut”

What will India call *its* Space Explorers?

By Peter Kokh

We came across this article in The London Times:

www.timesonline.co.uk/tol/news/world/asia/article623487.ece

November 3, 2006

Antarikshyatri is the closest Sanskrit translation of astronaut, according to Chaudury Upender Rao, a Sanskrit expert at Jawaharlal Nehru University. But “antariksh-onaut” does not exactly roll off the tongue. So scholars say that “gaganaut” — from gagan, the Sanskrit word for sky, is the more likely choice.

Well, we are not especially gaga over gaganaut. It sounds too much like baby talk. We have another suggestion.

Vimana विमान (celestial vehicle)

- hence, **vimanonaut or vimannaut**

<http://www.atlantisquest.com/Samar.html>

<http://www.atlantisquest.com/Excerpt.html>

The Sanskrit term "vimana" is usually translated "airborne chariot," "aerial car," or "celestial car" (or sometimes simply "car") by the Hindu translators.

The word is found in the *Ramayana*, in the *Mahabharata*, and in the *Bhagavata Purana*

As a boy of fifteen in 1953, already learning the classical European languages of millennia ago, Latin and Greek, I became very curious about Sanskrit, the even older classical language of India. My fascination with Epic Poetry was a part of this interest: The Iliad and the Odyssey, The Aeneid, and the Ramayana. (In my Classical Greek class, we had to memorize the first stanzas of the Odyssey, in Greek, to the tune of the Star Spangled Banner! - I can still sing it!)

At the time, the UFO / Flying Saucer scare in North America was still captivating public attention. I had picked up a just-published book, “Flying Saucers Have Landed” by Desmond Leslie and George Adamski. Leslie’s contribution to the book was to talk about similar phenomena recounted in the histories of various ancient peoples.

When Leslie mentioned that the *Mahabharata* and *Ramayana* spoke of *vimanas* described in saucer-suggestive imagery, I went to the Milwaukee Public Library and asked the librarian if the library had a Sanskrit - English Dictionary. With raised eyebrows, she said “just a moment.” and in a few minutes she produced one: Sanskrit to English only.

It took me a couple of hours to master the Sanskrit alphabet and the alphabetical order of its characters, so that I could look up the word, **विमान** (vimana). I found it and to my delight it described it as an aerial vehicle used in war, that looked like “a mound of silvery antimony” (the saucer of the 1951 classic film “The Day The Earth Stood Still” popped into my mind.)

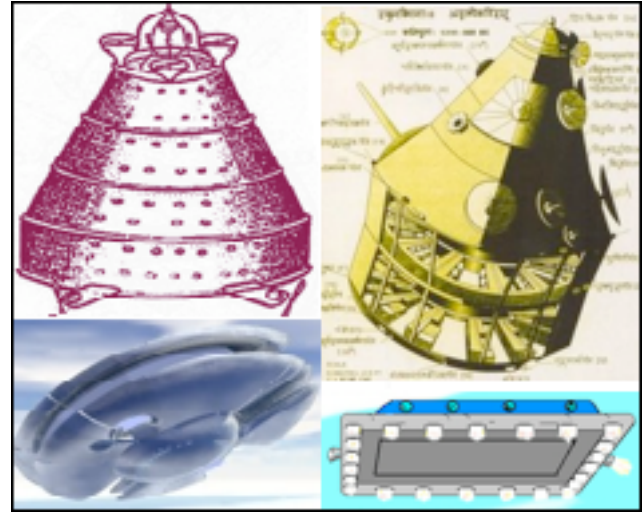
I grew out of this early interest in UFOs, of course, and did not have much chance to further explore Sanskrit either, and its beautiful alphabet. But I have always remembered the word, Vimana.

Now these vimanas may have been no more than a figment of ancient imaginations. But the point is,

here is a established word for a space vehicle, from the epic literature of India, a word with a three thousand year old Sanskrit pedigree.

So why would anyone want to turn to “**antariksh-onaut**” or “**gaganaut**” when the obvious, historically rooted word should be “**vimannaut**”?

A Google image search for “vimana” turns up a surprising number of illustrations. Below is a characteristic quartet: the upper two are more classical interpretations as “vehicles of war.” The lower two are newer interpretations in the inspiration of the UFO/flying saucer craze of fifty-some years ago.



It will be interesting to see what word for “astronaut” catches on in India. A special word, whatever it is, will help bring the idea that India may some day field crews of human space explorers, into the mainstream consciousness of the Indian public.

Oh yes! *About the first four terms in vogue.* I think that the French have it right. “Astro”nauts (traveling to the stars), and “Cosmo”nauts (traveling throughout the universe) are a bit pretentious, don’t you think? We are in the baby step stage, and while we may dream some day of going out to the stars, that’s much like the earthworm, popping its head out above the soil, taking a sniff, and dreaming of becoming an eagle. ###

“There are some who question the relevance of space activities in a developing nation.

To us there is no ambiguity of purpose...

...we must be second to none in the application of advanced technology to the real problems of man and society...”

- **Vikram Sarabhai**



Destination Moon:

India's Quest for the Moon, Mars and Beyond

Authors: Pallava Bagla and Subhadra Menon

(Forewords by: Dr. G. Madhavan Nair, chairman ISRO and Dr. K. Kasturirangan, Member of Parliament and former chairman ISRO.)

Pages: 224 + 8 color plates

Publisher: Harper Collins Publishers India

Price: Rupees 195.00

Release: August, 2008

From: pallava.bagla@gmail.com

To: indianspacetalk@groups.indianspace.in

Introduction to Destination Moon:

Fabled in songs and poetry, and romanticized by lovers down the ages, the earth's closest neighbor is still an enigma in material terms. Can it sustain life? Does it have water? How did it come into existence? And what is its exact relationship with the earth?

Chandrayaan-1, India's maiden moon craft, will seek to unravel these and other mysteries in the most ambitious exploratory mission to the moon in decades. Conceptualized by Indian scientists, it is in some ways a global scientific endeavor, with European and American instruments hitching a ride on a lunar satellite and rocket designed and launched by the Indian Space Research Organization.

When the mission was first proposed in 1999, it seemed wildly optimistic to most people. Could a developing nation with limited resources afford to invest so much money, time and effort on research into outer space? Yet, almost a decade later, India's science community has proven beyond doubt that it is capable of meeting the most exacting challenges.

This book is a celebration of that achievement. It tells the story of the moon mission from conception to launch – the genesis, the plan, the people, the science. Based on reportage, interviews and most important of all, a deep understanding of the processes involved, Destination Moon is a lucidly written and comprehensive guide to India's engagement with outer space – past, present and future.

Quotations:

'It is not a question of whether we can afford to go to the moon. It's whether we can afford to ignore it.'

Dr. K. Kasturirangan, Member, Rajya Sabha and Former Chairman, Indian Space Research Organization

'Twenty years from now when space travel is likely to become mundane like airlines travel today, we don't want to be buying travel tickets on other people's space vehicles.'

Dr G. Madhavan Nair, Chairman, ISRO

'India and the US are not racing to go the moon... we can hope to go together.'

Dr. Michael Griffin, Administrator, NASA or the National Aeronautics and Space Administration, USA

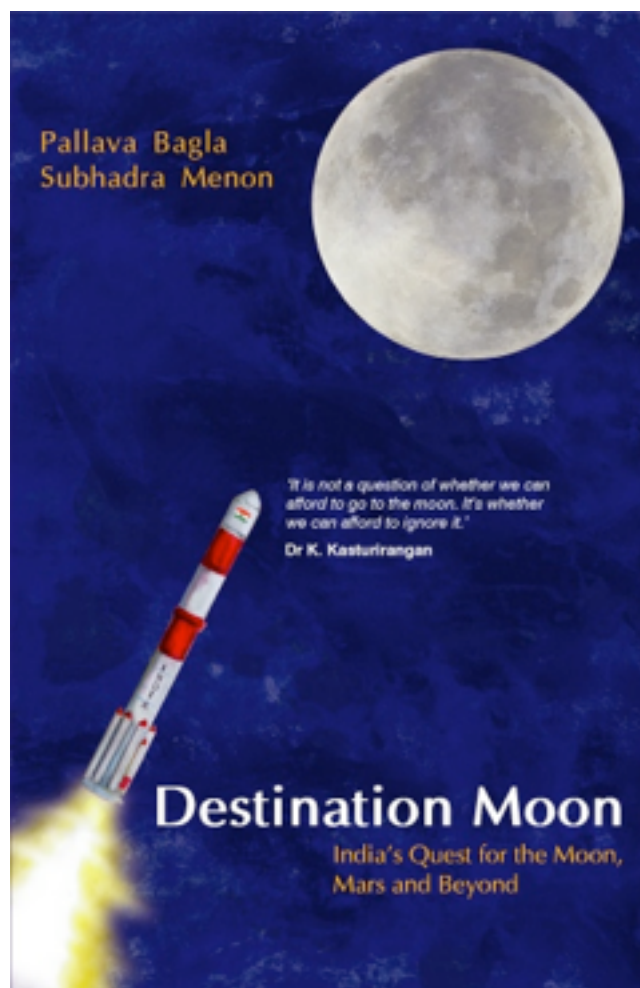
About the Authors:

Pallava Bagla is Science Editor, NDTV (New Delhi Television) and Chief Correspondent (South Asia) for the American weekly Science. In 2005 he was honored with the National Award for best science journalism in the print media by the Indian government and in 2003 he was awarded for 'outstanding journalism' by the United Nations. He is also a skilled photographer and images taken by him have appeared in National Geographic, Time, Newsweek, Nature and New Scientist. He has covered the Indian space and nuclear program for the past two decades.

pallava.bagla@gmail.com

Dr Subhadra Menon is an award winning science and health writer and a former correspondent for India Today. She has also contributed to New Scientist and Scientific American. She is the author of No Place to Go, a book on India's ailing health sector. She currently works with the Public Health Foundation of India, spearheading its communication efforts.

subhadra.menon@gmail.com



To Order:

www.harpercollins.co.in/BookDetail.asp?Book_Code=2029

Chandrayaan Wallpapers for your Desktop

<http://chandrayaan-indianmissiontomoon.blogspot.com/2008/08/chandrayaan-wallpapers-for-your-desktop.html>

Good Reads

“India on the ISS: it starts with a rack”

by Taylor Dinerman

Monday, November 17, 2008

First published in *Space Review*

<http://www.thespacereview.com/article/1253/1>

Some quotes:

“As the International Space Station (ISS) nears completion, the partnership that built it needs to expand.”

“India, ..., has opened itself to international cooperation and has proven itself a reliable and talented partner.”

“India has earned the right to be considered a full-fledged spacefaring nation. Inviting them to be a full partner on the ISS will simply make clear what everyone in the space industry already knows.”

“What makes sense for the ISS partnership in the short term is to offer India full control of an experimental rack.”

Editor’s Comment:

India shouldn’t wait to be invited! It should ask!

Chandrayaan-1 Clubs & Groups on the Internet

On Yahoo.com

<http://tech.groups.yahoo.com/group/chandrayaan/>

On Orkut.com

• **Chandrayaan: India on Moon** (9,765 members)
www.orkut.com/Main#Community.aspx?cmm=44662288

• **Chandrayaan – ISRO** (409 members)
www.orkut.com/Main#Community.aspx?cmm=7964902

• **ISRO** (6,389 members)
www.orkut.com/Main#Community.aspx?cmm=746653

On Google.com

• **Moon Vehicle** (3 members)
<http://groups.google.com/group/moon-vehicle?lnk=srg&hl=en>

• **Moon Rover** (12 members)
<http://groups.google.com/group/moon-rover?lnk=srg&hl=en>

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

[_From **The Hindu** Monday, Feb 02, 2009]

www.hindu.com/2009/02/02/stories/2009020260181100.htm

Chandrayaan-1 Scientist sees use of Moon’s Resources in the Future

Speaking in Bangalore, Dr. Carly Pieters, Principal Investigator for the **Moon Mineralogy Mapper** instrument aboard Chandrayaan-1, Dr Pieters remarked;

“Scientists around the world have come to understand that the Moon is clearly the stepping stone for the future of the human species beyond the Earth.”

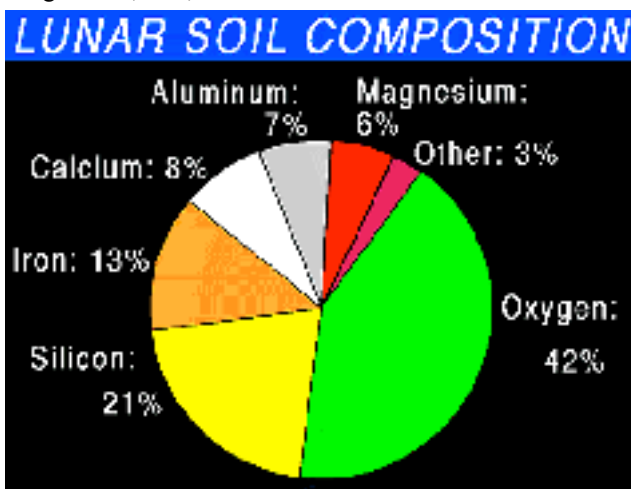
“And so it is no coincidence that four countries – India, China, Japan and U.S. – are showing simultaneous interest in the Earth’s celestial neighbour,”



Professor Pieters spoke to *The Hindu* about the Moon Mineralogy Mapper (M3), an imaging spectrometer developed by her team at Brown University in Providence, Rhode Island, USA, that will provide the first map of minerals on the entire lunar surface.

It will study the Moon as the “cornerstone” to unraveling the history of the solar system and Earth and also as a “very long term investment.”

[Editor: In general, we have a good gross picture of the composition of the Moon’s crust and it differs somewhat in the highlands and in the dark lava-flooded mare plains. The Moon is rich in oxygen, silicon, aluminum, calcium, magnesium, iron, and titanium.



But it is concentrations of key lesser elements that will be critical to tapping moon dust to make building materials. MMM will map many elements at unprecedented resolution, so we can pinpoint useful concentrations.]

Dr. Pieters adds “perhaps in the next 50 years,” we will be looking at using resources on the Moon. “But we still do not know what [precisely] those resources will be.”

As for scientific investigation, studying the Moon should teach us much about– records that have disappeared from the Earth” [d the Earth. “The Moon contains records for over four billion years ue to active geological processes and weathering.]

###

Return to the Moon

Written by HARRISON J. SCHMITT
Apollo 17 Astronaut-Geologist
Thursday, 05 February

Expanding the Earth's Economic Sphere

It has been suggested by President' Obama's Science Advisor and the Administrator of NASA that it is time to include the Moon in the "economic sphere of the Earth."

Both history and comparative analysis indicate that a privately financed and managed initiative would be the most efficient and productive approach to returning to the Moon in the foreseeable future and to accomplishing this long-term economic goal.

Any large scale private initiative focused on a Return to the Moon will have as its ultimate aim a return on investment from production and sale of lunar resources, in particular helium-3 for fusion electric power plants on Earth. In addition to helium-3 for fusion power, sales of by-products from its production, such as hydrogen, water and oxygen to customers in space, will add to bottom line income as well as to investor return.

The same can be said of ancillary services based on the existence of an investor-financed lunar settlement and the new space transportation systems required to establish and service that settlement. <HJS>

[Editor: a much earlier article laying out the foundations for a self-sustaining lunar frontier economy, was published in MMM #32, February 1990, pp. 3-4. This article is reprinted in MMM Classic #4, pp. 11-13, - download MMMC#4 at: http://www.moonsociety.org/publications/mmm_classics/

For your convenience, we reprint it here.

The Import >> Export Equation

To survive, a lunar settlement must earn more from exports than it pays for imports

By Peter Kokh

A. SETTLEMENT IMPORT CATEGORIES AND STRATEGIES TO CUT AND/OR AVOID THEM

1. CAPITOL EQUIPMENT: "MUS/cle" co-manufacture is easily the most promising approach. A minimal sintered iron and glass composite manufacturing capacity must be imported *first*. Thereafter, complex lightweight electronics-rich ("cle") "works packages" from Earth are mated to Massive Unitary Simple ("MUS") parts made on the Moon of Lunar materials and assembled on the site to make additional equipment for Energy Generation, Mining & Processing, Manufacturing, Construction, Fabrication & Repair, and for Food Production. [cf.: "M.U.S./C.L.E." in MMM # 18 September '88.]

2-SETTLERS: "*Bantamweights*" will do. For the Settlement will be run with brains rather than brawn. Weight savings on settlers can be applied elsewhere.

3-FARM PLANTS AND ANIMALS: Seeds only, and worms and bee colonies; Seeds packed in hot pure

N₂ to kill hitchhiking pests; Unpatented non-hybrid cultivars only; and pregnant female animals only.

4-VOLATILES: Hydrogen, Carbon, Nitrogen: The import burden can be softened by some careful measures faithfully pursued:

- (a) Harvesting, by heating, of the significant quantities of H, C, N, and other gases adsorbed to the fine regolith particles, thanks to eons of bombardment by the Solar Wind, during all those construction processes involving soil moving;
- (b) Out-sourcing to gravity wells shallower than Earth's e.g. Phobos and Deimos, Earth-approaching asteroids and comets;
- (c) Conservation of volatile-rich organic materials by religiously thorough recycling efforts. In support of this goal the Settlement will need "kosher" (organics not bonded to inorganics) knock-down- friendly ("KD") assembly methods; systematically thorough and foolproof sorting clues and handy routing managements; and above all the help of ingrained second-nature good habits and expected chore assignments.
- (d) 'Pre-co-designing' of all single-use containers for volume-matched secondary more durable uses. (An example already attempted was the elusive "World Bottle" design i.e. a bottle that could be reused as a brick; Effort not yet successful.)
- (e) Buttoning up pressurized areas for Nitrogen conservation by use of novel airlock systems: Matchlock "integrates" to allow suitless shirtsleeve transfer between vehicles and habitat areas; Liquid airlocks for some freight categories such as goods manufactured inside for use in vacuum and vice versa; and Turtle-back spacesuits that back into special mated airlocks for direct entry from suit to habitat and vice versa.

5-RARE METALS: An elegant way to painlessly "co-import" rare metals, and even some synthetics is by making all needed shipping containers end packaging out of such materials i.e. the easily forgotten category of "Tare". [Gross - Net = Tare] Making this standard practice could provide a tidy "cheap" endowment of badly needed materials hard to process from the Lunar soil such as copper, brass, other precious metals, other needed alloying ingredients, and even some volatiles in the form of lightly polymerized synthetics. Crates, Boxes, Barrels, Tanks, Cans, Bottles, and packing stuffing and dividers could all be made of such strategic materials.

6-HABITATS: To make the the Settlement construction camp, an original minimum number of tight-packed space station module type sardine cans can be followed by locally manufactured and constructed Big Dumb Volume Structures in which are placed "Works Core Modules" made on Earth. Such cores would contain Kitchen/Bath facility, electrical service, communications-entertainment center, air conditioning-heating-cleaning unit, etcetera. The total core package would be lighter (no massive hull) and cheaper to upport from Earth and the host habitat would be much more spacious and cabin-fever resistant. Such Works Core Modules, but with an ever greater Made-on- Luna "MUS/cle" content, also serves in Settlement Village Homes.

7-NON SELF-MANUFACTURED GOODS: For those needed and desired items Pioneers need but are not yet capable of providing for themselves, the "MUS/cle" formula is again part of the answer. But substituting metal, glass, Glax* [composites], and ceramics wherever possible for wood and plastics, and doing without wherever this is impractical must be Plan A. Mail order catalogs from Earth will be taboo and instead items from the hands of local artists and craftsmen will be treasured. A paperless all electronic society will be a top priority goal. [cf: "Paper Chase", MMM # 4 April 1987, republished in MMMC #1.]

B-STRATEGIES TO LOWER IMPORT COSTS AND/OR INCREASE IMPORT QUANTITIES

1-ALTERNATE SOURCES: the Settlement will need to import considerable quantities of hydrogen, carbon and nitrogen, most easily handled in the form of methane CH_4 and ammonia NH_3 . Discounting the amortizable capital costs of emplacing the needed equipment, these volatiles can be shipped at a fraction of the total fuel cost, from Phobos or Deimos, moons of Mars, at regular 26 month intervals. Such shallower gravity well sources also include occasional catch-as-catch-can Earth-approaching asteroids, comets, and wildcat-worthy inactive comet-hulks. The Moon's deficiency is the Solar System's gain. For settlers will have a do-or-die urgency in pioneering such markets.

2-LOWERING COST-OFF-EARTH will be above all a matter of developing (at last!) more economical surface-to-orbit launch systems. But our crafty settlers will also attempt to lower prices FOB Earth by buying goods on favorable terms Solar Power Satellite customer nations.

3-LOWERING COST-ONTO-MOON. Unlike both Earth and Mars, the Moon has no handy atmosphere to allow aerobrake assistance. But there are other more inventive alternatives to full retrobraking. These may include skid-landing on prepared regolith smoothways. [*Lunar Bases and Space Activities of the 21st Century*, W.W. Mendell Ed., Lunar & Planetary Institute, Houston 1985 pp. 848-50 "The Lunar Slide Lander" by Kraft A. Ehricke] and the "Edportation" scheme of Chicago inventor Ed Marwick. Passengers may not line up for such wild rides, but drone "sliders" could bring in needed bul0 materials and other hardy cargoes.

C-LUNAR EXPORT CATEGORIES

1-BULK MATERIALS: Liquid Oxygen; Regolith for shielding; Enriched ores for space processing.

2-OXYGEN CONTAINING PRODUCTS such as Water and Foodstuffs cheaper than from Earth even if they contain terrestrial Hydrogen and Carbon.

3-BUILDING MATERIALS AND COMPONENTS: Iron and Steel; Aluminum, Titanium, Magnesium alloy; Glass and Glass-Glass Composites; Ceramics & Concrete.

4-ITEMS MANUFACTURED ON THE MOON to cut imports are also marketable to LEO, GEO, L5, Mars Ph/D (Phobos, Deimos): Furniture and furnishings; Tanks, Holds, Appliance Cases, other items.

D-EXPORT DESTINATIONS

Low Earth orbit Space Stations and other manned facilities, Space Colony Oases at L4/L5 or in other orbits, and Mars-bound expeditions are all Markets for Lunar Lox, Food, Water, building materials products, and sundry finished goods all Lunar or MUS/cle assembly). Geosynchronous orbit is a destination for large multisatellite capacity platforms and Solar Power Satellites.

E-STRATEGIES TO INCREASE EXPORTS

1-LOWERING EXPORT LAUNCH & DELIVERY

COSTS: Mass Drivers, Bucket, and Pods should be upgraded to launch more profitable *value-added goods*. 1st Upgrade: enriched beneficiated ores: Fe, FeO, TiO, Al₂O₃, CaO, MgO, SiO; Batch-loads of glass matrix, glass fiber, and cement.

Second Upgrade: right-sized ingots: Fe, Al, Ti, Mg. 3rd Upgrade: shock-proofed pods of small manufactured parts. In addition, goods bound for Earth's surface could be shipped in no-transfer self-contained Earth-aerobrake-and-land "dynasoar" capsules.

2-INCREASING MARKET DEMAND:

- **Liquid Oxygen:** Would-be-pioneers should push development of "Stage Plus" Earth Deep-Space Launchers designed for on-orbit LOX refueling. Food deliveries to LEO stations and other space locales, will depend on selection, delivery, marketing.
- **Building Materials:** Lunar Owned Space Architecture and Space Construction Firms will channel a greater share of space construction profits back to the Settlement. *Promotion* of the 1/6th G lunar Gravity as a Standard for rotating space structures will mean quicker more frequent sales because the rotation rate linked minimum size and mass of such structures will be an order of magnitude smaller, a more attainable threshold.
- **Settlement made Consumer Goods** can be promoted along with Lunar-type material culture in general as the appropriate norm for near Earth facilities in the era of still expensive volatiles. Such goods involve material substitutions and a high profile for Art/Craft made wares.
- **Promotion of the Moon as the "Hub"** of the ETM (extra-terrestrial materials) economy will be an essential settler policy. Their do-or-die motivation and proven know-how will drive Lunar-initiated market development of Mars and its moons, and of the Asteroids. Key here may be the development of Minimal Mobile Biospheres. The larger deep-space long-cruising vessels have to be to hold self-contained mini-biospheres, the greater the obstacle to opening the asteroids.

3-MARKET TARGETING: Logical Earth Trading Partners for the Settlement are those nations which are at once

- Energy Importing Countries (Solar Power Satellite sales, Helium-3 sales) *and*
- Sources of elements not economically Lunar-sourceable yet strategic to settlement development. Many of these countries are in the "Urban Tropics."

Continued next page

4-MAXIMIZING TOURIST INCOME.

The lure to well-heeled sightseers can be intensified in several ways.

A "Seven Wonders" list, carefully drawn up and publicized, and a variety of enticing itineraries will encourage repeat trips or at least longer stays.

Special ways to taste the settler way of life can be offered to visitors.

- Stays in lunar homes
- working tours
- Art & Craft classes
- special tours e.g. of factories and recycling systems, and
- the opportunity to actually participate in unique Lunan sports.

Customs regulations can entice tourists to trade all their Earth garb (for Lunar Stage/Theater Use) in exchange for souvenir Made-on-Luna apparel.

Shopping Spree Tours for unique arts, craft, and clothing pieces at the Settlements cottage industry flea markets should be marketed.

5-TELEVISION & FILM MEDIA SALES:

Advertising Revenues could be appreciable enough to wholly finance:

- **Development of Unique Lunan Spectator Sports**, which in turn could be televised to Earth audiences hungry for something new and exotic.
- **Construction of any facilities** such sports may require
- The same goes for the "ethereal" Settlement **Ballet** Company, probably awaiting the coming of age of the first native-born generation.
- Documentaries about the Settlement and Lunar activities at large will vie with space adventure films for the use of the Out Of This World film studio in the Settlement.

6-EXPORTING KNOW-HOW:

Technology transfer is a potential money-maker for The Settlement. Hopefully much of the technology needed to make The Settlement a thriving reality will have been predeveloped for profitable terrestrial applications and thus served to keep Settlement up front costs far lower than they otherwise could be.

But enterprising young pioneers will develop new products and processes salable Greenside. <MMM>

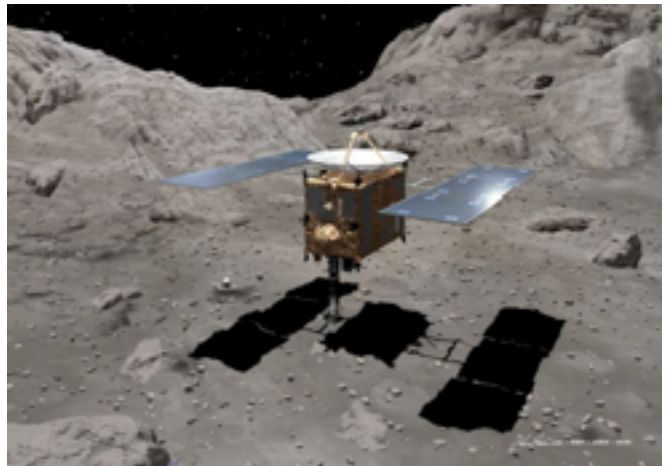
NOTE: Earth's "Econosphere" already includes "off-planet" elements,

In 2007, some **\$139 billion US Dollars in world-wide business** involved satellites in **Low Earth Orbit** and in **Geosynchronous Orbit**.

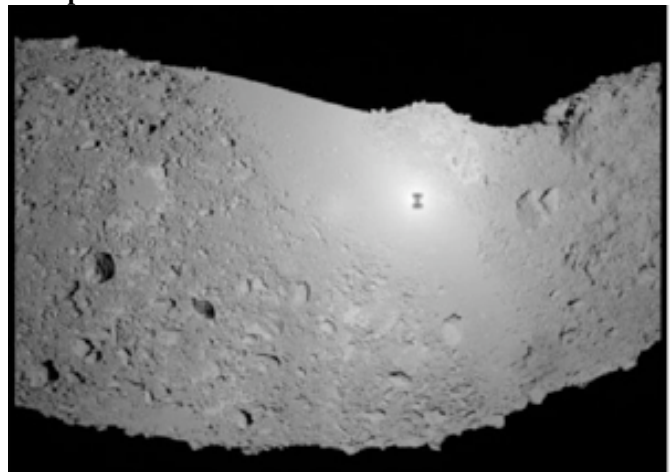
This trend can only continue to grow. In the near future this economic activity will include **Space Tourism** and **Space Manufacturing**.

Extending Earth's Econosphere to include the Moon is but the next logical step.

MMM - INDIA GALLERY



Above: artist conception of Japan's Hayabusa Probe hovering over asteroid Itokawa. Below: Hayabusa did capture its own shadow cast on the asteroid's surface



Hayabusa, after a remarkable journey and effort, is now limping home, but whether it succeeded in capturing an asteroid surface sample is in doubt.



Test recovery capsule for ISRO Manned Spacecraft



*SEDS India takes pleasure to announce
its annual national conference*

“SEDS India National Conference 2009”



VIT University, Vellore, Tamil Nadu
<http://www.vit.ac.in/>
February 28 and March 1, 2009



Host: the SEDS chapter at VIT, SEDS-VIT
Theme: Vision of the Indian Space Program

This conference aims to get the diaspora of budding Indian talent and focus their interests towards the promising field of Space Science and Technology.

SINC 09 is also sponsored by ISRO, the Indian Space Research Organization.

Events include a
National Level Lunar Rover Competition

This competition will test the cruisibility and such other attributes of rovers made by students of various notable Indian Universities on a simulated Lunar Terrain

<http://vit.ac.in/sinc09/html/lunartrek.html>

The Moon Society will also cosponsor this event by contributing to the prizes to be won by the contestants, as well as providing some support to the operation of this event, and by promoting the event in this publication.

**The first of its kind National Level
Moon Rover Competition**

Some of the most challenging chores for the rover are maneuvering the rough and unknown terrain, rock samples collection and analysis, transmitting and receiving data, etc.

In this scenario, a rover’s efficiency is tested in transporting a rock sample to a designated spot through the uneven course.

The rover is required to steer through the uneven terrain to place a rock sample (5cmx5cm) that it is carrying in the predefined test facilities where they shall be analyzed. The course is *not* in the line of sight of the rover’s controller/s (the participant /s).

The course is isolated from the rover-controlling unit as in the real-time scenario.

Final terrain design:

The final design will consist of similar huge craters and hills, as in the map. There will be numerous small craters and lumps all over the area. The destination can be the volcanic terrain facility or the normal facility. The normal destination is located diagonally opposite to the starting point. The choice is left to the controller to decide his path. The normal facility is behind the volcanic terrain facility, and hence the distance that has to be travelled is much more than the volcanic terrain destination.

The course is spread over an area of 9m² (3m [10 ft] on a side) and is nearly covered with sand, soil and fairly covered with tiny pebbles of not more than 8 cm³ in volume (will not be higher than 2cm). The Rover starts from the 25cmX25cm starting square (marked grey-Fig 2).The track has two hills of 70 cm dia x 15 cm high and 50cm dia x 10 cm high respectively behind which the facilities of 35cm dia (marked with a grey speck in the design-Fig 2) are present where the given rock has to be placed. It also has two craters of 60 cm dia and 40 cm dia and of depths 10 cm and 12 cm respectively.

<http://vit.ac.in/sinc09/html/text/lunartrek.jpg>

The biggest of the barriers is inspired from a volcanic terrain design and the biggest of facilities is right behind it and placing the rock sample there will enable you to win 25 % more points than what you would get by passing through the craters and hills.

Rover Specifications:

- The rover should not be more than 25cmX25cmX15cm [10”x10”x6”] in size (the last dimension being the height).
- The vehicle must be powered with readily available rechargeable batteries.
- The rover should be controlled by Transmitter/Receiver via a radio link or autonomously.
- The vehicle and all control equipment must fit within a box measuring, on the inside, 25X25X15cm.
- The vehicle must come from the box fully assembled. *Any expansion or extension must be done by the vehicle itself during the competition run.* (Antenna is exempted from this constraint).

To support this competition, write: Avinash Siravuru
sirneonash@gmail.com

Return to the Moon: Looking Glass 204

2008 Team Project Focus: University of Southern California
Space Exploration Architectures Concept Synthesis Studio

CONTACTS: Madhu Thangavelu, Instructor
thangavelu-girardey@cox.net, (310) 378-6259

Dell Cuason, Student Coordinator, ASTD. (213) 821-5817



As we lay down plans for returning people to the Moon, alternative concepts are being proposed about activities to conduct there in order to prepare for more ambitious expeditions to Mars & beyond.

The USC Looking Glass Project throws a challenge to the space agency and interna-

tional community as we embark to commit large resources :

What activities precisely can we do on the Moon that can immediately (very short timeframe-20 years) benefit not only the scientific community but also humanity as a whole, on a permanent basis ?

The establishment of a sturdy cislunar communications system followed by essential physical infrastructure to support the emplacement of a suite of permanent evolvable observatories, long range traverses to conduct geology and astrobiology, and critical crew support are addressed. These activities will directly advance the experience necessary for interplanetary missions. The philosophy of crew and robots working together to accomplish various buildup activities was preferred over the linear robots first approach in order to maintain high public interest that is essential for such a high visibility project which involves a substantial outreach component as well as international collaboration and US leadership in this new century.

Course Methodology

This highly interdisciplinary course is all about the formulation and articulation of creative ideas. It is also about speculation; visualizing future applications for space technology. The aim is to encourage and refine programmatic and conceptual design synthesis skills for the creation of complex high technology projects. Space exploration and space applications are the areas of focus. Inductive and analogous processes, associative logic, metaphorical models and other system architecting tools are employed to quickly create alternative "concept architectures", which in essence, are rudimentary but global ideas or visions of a project. These alternative concept architectures even precede engineering requirement documents and, in fact, they help in critically examining the need for a project and then assist in creating solid requirements through the crucial iterative processes involving inductive reasoning, debate and discussion. This exercise directly contributes to the speedy evolution of resilient "strong boned" complex architectures.

Besides presenting poignant, project specific, interdisciplinary scientific concepts and engineering theory behind space system architectures, participants will be introduced to architectural concept generation theory, methods,

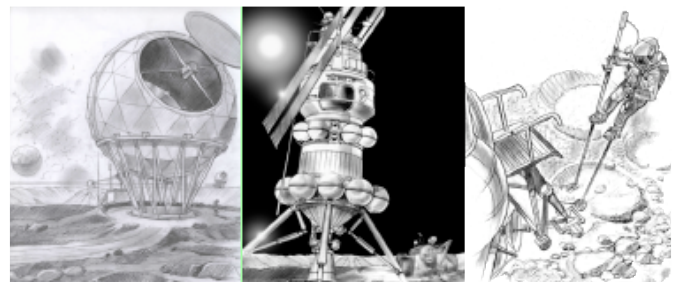
form finding processes, visualization and presentation techniques followed by a unique, hands-on studio approach that allows the participants to realize their own concept architecture project in a rapid manner. Participants will work on both a small individual mini project and a larger team project. These concept architectures are then presented to an expert panel of faculty, agency, industry professionals for feed-back and discussion. The class also featured lectures on relevant topics by visiting professionals who are experts in the field.

For the individual mini-project (due at mid-term) participants are free to explore creative, new ideas of their own choice as well for space transport and human and robotic facilities in space. Options for concept architectures include but are not limited to:

1. Space Transportation systems and their evolution
2. Orbital debris mitigation systems
3. On orbit assembly of large scientific platforms, modular stations/vehicles
4. Solar Power Satellites
5. Innovative communication satellite architectures
6. Solar System Exploration strategies and expeditions to the Moon, Mars and beyond
7. Recreational vehicles/facilities, advertising in space and other innovative ideas
8. International Collaboration and Outreach

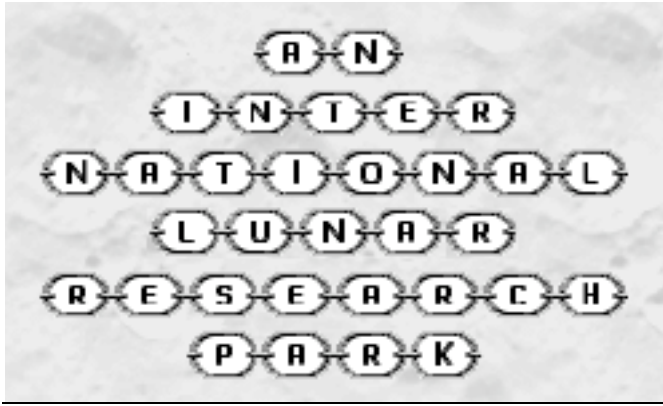
Textbooks / References

1. The Moon : Resources, Future Development and Settlement - Schrunk, Sharpe, Cooper & Thangavelu Springer /Praxis 2007, ISBN 978-0-387-36055-3
2. The Lunar Base Handbook – Peter Eckart, McGraw Hill 1999, ISBN 0-07-240171-0
3. Spaceflight Life Support and Biospherics – Peter Eckart, Microcosm Press, 1996, ISBN 1-881883-04-3
4. Space Systems Concepts Creation Class Notes - M. Thangavelu



- An interdisciplinary USC Space Exploration Design Team.
- Dynamic systems engineering concepts design environment
- Real-time interaction with NASA, industry professionals
- Evolve space exploration mission scenarios requirements.
- Variety of Space Exploration Vehicles, Facilities, Elements.
- Create and visualize synergetic concepts
- Learn inductive, associative, analogous, complex concepts generation skills: concept creation, visualization, graphics, model building and presentation techniques.
- Heuristic, inductive and architectural form-finding methods to create, evolve, refine and present complex Space Exploration concepts.
- Critiques, reviews by a panel of experts.
- Present your concepts to NASA Space Exploration Mission Design

###



An Open-ended Lunar Initiative

By Peter Kokh and David Dietzler

Current Prospects

The United States, under former President George W. Bush, redirected its ISS and Planetary Exploration-focused Space Program to a “return to the Moon” and “beyond to Mars.” This direction will probably continue under President Barack Obama. Meanwhile, China, India, and Japan have launched lunar probes and spoken of putting crews on the Moon. Whether these will be one time “science picnics” à la Apollo or real efforts to establish permanent facilities to support manned exploration sorties and other activities remain to be seen.

The Question

If each nation picks a different location on the Moon for its surface activities, areas of cooperation are limited to data sharing, tracking, and other support activities.

If, however, some or all national lunar outpost efforts are concentrated at one and the same location, be it at the north or south lunar poles or somewhere else, then the opportunities for shared facilities is enormously increased, and with it could come major savings by reducing unnecessary duplications.

Shared Facilities: Corporate Partners

Of course, then the question becomes “who will build and provide the facilities to be shared? And right here we have the opportunity to introduce new parties: contractor companies. Possible contractors could include Boeing, Lockheed-Martin, EADS, Antrim, and other names associated with the Aerospace industry, but also other major contractors. To pick a few: Bechtel, Halliburton, Mitsubishi, and on and on.

Additional Players: Enterprise, University Consortia

If we collectively choose to establish not a collection of national outposts, collocated or not, but an “International Lunar Research Park” the possibilities for future expansion, elaboration, and outgrowth – *even into the first human lunar settlement* – will increase enormously.

Facility Lists

The lists below are meant to show how great are the possibilities for diversification and outgrowth. The items in **bold** will come first. Plain type next, *italics* last. Note, that this subclassification is just one person’s first attempt, and

corrective input is most welcome. No one expects to “get it right” the first time! What we want to do is to put out the general concept of how enormously the choice of an International Lunar Research Park could bust the future wide open. After the itemized lists (we surely have forgotten or not thought of many items!) we will give our thoughts on just what must come first.

National Outpost “core” elements

- **base habitat**
- **base laboratories**
- **basic life support**
- **command center**
- **airlock**
- (power generation)
- (power storage)
- (warehousing)
- (landing/launch pad)

The items in parentheses are things that in our judgement could be contractor-supplied.

Contractor Corporations

- **site preparation**
- **spaceport services**
- **construction equipment**
- **shielding services**
- **fuel storage**
- **fuel production**
- **power production**
- **power storage**
- **warehousing systems**
- **thermal management**
- ISRU Research
- ISRU Manufacturing
- habitat expansion modules
- biospheric maintenance
- road construction
- connectors
- gas scavenging

Enterprise Opportunities

- **commons with meeting space**
- **restaurant(s), pub(s)**
- **recreational facilities:** exercise, sports, dance, theater
- **TV/Radio Facilities**
- Instruction<<<
- **Financial services**
- **hotel facilities** for visitors, tourists, overflow between crew changes
- **cabotage** (outfitting) services
- **vehicle maintenance**
- **space suit services**
- **tools, equipment**
- tour coaches & excursion services
- marketplace
- green (horticultural) services
- waste treatment
- recycling services
- reassignment services (new roles for scavenged parts of landers etc.)

- agricultural production
- customization services
- event management
- surface recreation vehicles
- archiving services

University Consortia

- **Medical Center**
- Continuing education
- research facilities
- astronomy installations

Joint Civic

- **road planning local**
- **road planning regional**
- **Environment protection**
- **environment enhancement**
- (parkways, gardens)
- outstation planning

Discussion – where you come in!

It would be miraculous if the list above did not have many holes, even if nothing was mis-classified. Your input is most welcome!

The effort above is an attempt to start a discussion and to keep us, nationals of the various countries contemplating lunar surface activities, from being blind-sighted to the enormous advantages to be gained not only by collaboration between the various national agencies, but by *restraining agency hybris and taking the plunge to invite corporate, enterprise, and university consortia as equal partners in a joint “human” effort.*

The idea is for the national outpost agencies to buy or lease or tent equipment and services from the contractors and enterprises as their needs change and expand. This should provide not only substantial cost savings but a greater variety and supply of equipment and services.

Agencies need not provide quality and other specifications, because corporate and enterprise personnel would be just as much at risk from improperly designed and manufactured equipment as would national agency crews. Toss out the mind-boggling bureaucratic paperwork, and down comes the costs.

Corporation employees would need housing, and all the other life support services as needed by the agency crews so it is natural, that as they begin to construct pressurized modules and other equipment from lunar building materials that they could provide for expansion of national outposts as well at considerable savings.

The national outposts would be “anchor tenants” so to speak, but as in shopping malls, in time their share of the economic value of total activities and facilities at the site might become, even though essential.

Some sort of Civic Council representing all of these Parties would be needed to make decisions that affect everyone, decisions about growth directions, environmental safeguards, and so on. As this unfolds, the International Lunar Research Park will have become the first lunar settlement!

It is time for humanity to open the next continent, one across a different kind of sea. The “out of Africa” effort

is ready for the next act. Only humans as a species, not horse-blinded agency managers, have the vision to grasp what is needed – and it is *not a collection of agency outposts!*

What Comes First?

Frankly, national agency planning puts the cart before the horse. Why? because two things come first, and no one is giving either one more than trivial attention.

Part I: Technologies for using lunar resources

We are not going to anything of lasting significance on the Moon unless we learn how to process useful building materials out of the elements in moon dust. Known by the uppity Latin term “*In Situ*” Resource Utilization (“*on location*” works just fine!) various processes have been proposed to isolate oxygen and other elements, but few have been tested either in laboratory scale or (more importantly) in mass production scale. How do we advance the “readiness” state” of these technologies? It is important to have them ready to go when we land on the Moon. Getting there, and then having to scratch our heads for additional time-wasting decades makes no sense. But that is the path we are on.

This topic will be the subject of the next article, “Improving the Moon Starts on Earth” - reprinted from MMM #s 132,133, February and March 2000.

Part 2 – Site Development

No site on the Moon, no matter what advantages are touted on its behalf, is anything more than “unimproved” land, what in America might be called “Florida swampland.”

Before the first national agency manned lander sets down on a chosen site, it makes sense for a corporate contractor to have already “improved the site” – conferring on it various advantages that will make outpost deployment, construction, and operation so much easier.

This is the subject of the second paper below, “**The Developer’s Role**” – reprinted from Moon Miners’ Manifesto #131, December 1999.

[We have seen many a proposal of how to jump-start a frontier with land grants and land sales. Maybe I don't understand them. To me, they seem like so many pyramid schemes based on nothing. Yes, the Moon is more than nothing. The ingredients for "stone soup" are all there. But it takes more than the right chemical elements in sufficient quantity to make a land valuable. They have to be present in a form we know how to mine and produce. And on the Moon that is not the case. The land has theoretical value only. What can we do with it when the tools to do anything do not exist?]

"Improving" the Moon Starts on Earth

By Peter Kokh

A. Poor Ore Mining Technologies

The considerable "bricks & mortar" portion of Earth's economy, which will never disappear or become irrelevant, has been built entirely upon the tapping of "enriched" resources. It is obvious that it will be cheaper to mine rich veins of ore than more homogenized concentrations of the elements vital to industry. It is obvious, too, that if we

are to have self-reliant settlements on space, that they must also be able to "produce" economically, the elements needed for their own industries.

The hitch is that concentrated ore bodies are a terrestrial asset which we are unlikely to find elsewhere in the solar system. No where else has there been billions of year of geological processing of a world's crust and mantle in the presence of water. Not even on Mars, where such processing may have started only to be nipped in the bud much too early.

For accessing necessary resources on the Moon, on Mars, and even on the asteroids (where there is an unsubstantiated widely held belief that concentrated ores may indeed be found), we need to develop mining, beneficiation, and processing technologies that are economical in unenriched deposits. Talk to a mining engineer, and it is likely that if you bring up the subject of "mining the Moon" or Mars, you will be greeted with a contemptuous, condescending put down. No one knows with confidence, how to "produce" metals or other elements from such "poor" ores economically on Industrial production scales. To point to lab-verified pathways of getting oxygen, for example, is neither helpful or useful.

We will see no self-reliant resource-using lunar or Martian settlements until we have such technologies. Give us CATS ("Cheap Access To Space") and we will still have nothing! Nor would continued political and public taxpayer support make a lunar or Martian "outpost" a confirmed agenda item change this situation.

"Local Industry" beyond a few relatively easy and simple symbolic things, "will not be needed" for the token outposts such a political project might put on the agenda. We must not assume that if NASA (i.e. Congress) did indeed commit itself to lunar resource utilization, the agency would undertake crash programs to develop such technologies.

There is another way, a very mundane way to get the job done. Sadly, space-enthusiasts in general are too much too impatient to sidetrack their efforts to indirect methods that may in fact be much more powerful. These very same "**Poor Ore Mining Technologies**" would be very useful on Earth, whether we ever do go on to open up the space frontier or not.

Consider Earth's economic geography. The distribution of iron ore, copper, bauxite (aluminum), uranium, and other elements vital to industry has in large measure predetermined which nations have thrived and which have not. Of course, other factors play vital roles: arable fertile soil, access to the sea, forests, and the enterprise quotient of the people.

Poor Ore Mining Technologies would usher a substantial equalizing force into the world economy. Soils everywhere contain abundant aluminum and iron, but not necessarily in the concentrations and in the mineral forms we "know how to" work with cost-effectively.

Chemical engineers must blaze new pathways that balance favorably energy inputs, secondary marketable byproducts, and environmental impacts. Concrete specific proposals tailored to the mineralogical circumstances of the various candidate locations need to be made to local or non-local investors and partners that stand to profit. Some of these poor ore mining technologies may have direct or indirect application to the situation we will find on the Moon or Mars

or elsewhere. But even where this is not the case, we will be building up a pool of people with a "can do" attitude to supplant the present unhelpful crowd of "can't do" mining experts.

Molecular technologies under exploration by people like Steve Gillette of the University of Nevada-Reno offer some real revolutionary promise of an end run around present mineral-cracking hurdles. When it comes to producing strategic elements that are much less abundant, like copper, zinc, silver, platinum, gold, etc. where a 1% ore is considered rich, bio-extraction technologies need to be pushed. Without concentrated ore bodies, such elements are often present in only parts per million [ppm], or even parts per billion [ppb]. Bioengineered bacterial cultures may be able to greatly beneficiate or enrich these ambient concentrations. Here on Earth, such technologies would make many nations less dependent on others, less subject to political blackmail.

B. Novel Building Materials

On the Moon, there are neither forests to supply us with wood, nor petroleum reserves to supply us with chemical feedstocks for the host of synthetic materials to which we are addicted. Even on Mars, with a carbon and nitrogen rich atmosphere and plenty of hydrogen at least in polar ice, bringing such traditional building materials and manufacturing stuffs on line will be a trick. But is the situation any different for scores of countries on Earth that do not have appreciable forests, or who cannot afford to make further inroads into those they still have, and without native oil reserves?

Glass-glass composites have been proposed, and lab-researched, as a promising option for lunar settlement industry. But if we learned to produce a versatile array of glass composite building products and manufacturing stuffs, that could be an immense aid to the economies of countries that must presently import vast quantities of lumber and other products. There would seem to be ample economic incentive for taking this exotic stuff out of the labs, make fortunes in doing so right here on Earth, and in the process develop, debug, and put "on the shelf" a ready-to-go industrial technology that could be a backbone of early lunar and Martian industrial settlements. We developed this idea in more detail in MMM # 16, June 1988. But while glass fibers are finding their way into new concrete formulations, no one has bothered to try to earn a buck by taking glass composites themselves beyond the laboratory curiosity stage.

Metal alloys also deserve more research. Most pure metals have poor performance characteristics and benefit greatly from inclusion of varying amounts of "alloying" ingredients. Yet it does not seem to dawn on most space supporters that the Moon's considerable "on Paper" wealth in iron, aluminum, magnesium, and titanium - the four "engineering metals" - does not guarantee the easy and economic production of the various alloying elements we are used to using to improve the performance characteristics of each. Steel needs carbon, in poor supply on the Moon. Aluminum alloys generally are rich in copper, a ppb trace on the Moon. Metallurgists who step in to research more "frontier-feasible" alloys which are still "serviceable" may end up producing alloys with considerable marketability here on Earth.

C. "Biospheric" Technologies

Biosphere II was an attempt to come up with a centralized solution for biological life support. Though the specific experiment "succeeded" only by "cheating", in fact we learned much. The only thing that can be dismissed as a failure, is an effort from which we learn nothing. It is much easier to dismiss than to criticize constructively, and when reading such negative reports, one should always discount for the temperament of the reporter.

Beyond Earth, settlements must reencradle themselves in mini-biospheres that each settlement must establish, grow, and maintain. This will entail the unprecedented challenge of "living immediately downstream and downwind" of oneself. - are centralized methods of growing and controlling economies. Modular "market" techniques must be the basis of any effort to establish, grow, and maintain space frontier biospheres. Systems that treat human wastes at the origin and greatly reduce any residual problem that must be handled on a larger scale, are much better suited for non-ivory tower communities of non-static size.

In fact, many people are experimenting with "living machines" and other techniques to integrate plants, air quality maintenance, and waste treatment in unit-sized systems. Such an approach will not only make city-size biospheres a more practical prospect, but will also enable appropriate-size life support systems for spacecraft on long deep-space journeys. We need technologies that are "scalable." In contrast, solutions addressing fixed, static size situations are not helpful at all.

The terrestrial profit prospectus of modular biospheric technologies is immense. In the last few decades we have seen the emergence of gargantuan urban complexes in the third world. For the most part, such cities have grown and continue to grow faster than urban utilities can add capacity to keep up with them. The pressure on centralized water treatment facilities is unreal, and the loser is public health. Inexpensive ways to tackle human wastes home by home, unit by unit, that freshen interior air, and provide additional sources of food, would do much to make such monster "blob" cities more livable. There is a market! Let's make money now, and learn how to do space right in the process.

The Gospel of "Spin-up"

The traditional fare of the space faithful is what has long been known as "spin-off." NASA spends hundreds of millions or even billions of dollars developing new materials and technologies that the agency needs for use in space, all at taxpayer expense. Then these technologies are made available to industry at large, providing the usual mantra of "benefits for the public" of space research.

"Spin-up" would take the opposite path. Enterprise would brainstorm technologies deemed vital down the road in space for their potential Earth-market applications, so as to make money now. The frosting on the cake is that technologies also needed on the space frontier, would be predeveloped now *at the expense of the consumer*, rather than the *taxpayer* (yes, there is a world of difference in this distinction), and would be ready in time "ready to go" and at relatively low cost to those who will in due course attempt to open the space frontier to genuine self-reliant local resource-using communities beyond Earth's biosphere and atmosphere.

"Spin-up" is a more economical and efficient way to get the research done in a timely fashion. It is the only path not dependent on uncontrollably fickle political tides. And in so far as it is consumer-user financed rather than tax-payer-forced, it is a more moral way to achieve "minority goals" such as ours.

But above all, the "spin-up" route is the only sure way to get the job done. To rely on the traditional route means putting all our eggs under a hen that is not motivated by instinct or any other reliable force to hatch them. We have complained before that those who want to open space by political coercion are abdicating the responsibility for the fulfillment of *our* dreams to those who do not share them, and cannot be made to share them.

Appeal to the reader:

If you are blessed with the talent to be an entrepreneur, consider that getting involved in pioneering some of the terrestrially useful technologies needed also in space may do more to guarantee the timely opening of the real space frontier than any amount of seemingly more direct involvement in micro-satellites and micro-launchers.

We do not expect those with electronics and propulsion expertise to get into totally different fields. Each of us must do our thing. Rather, we want to encourage and set loose the untapped talents of others who have not realized that they have a potentially powerful role to play, however indirect. The important thing in opening space is not instant gratification. It is well-targeted patient hard work.

If you are a young person not yet established in a career, consider chemical engineering, poor ore mining technologies, new materials science, "from scratch" synthetics production, bioextraction technologies, molecular mining technologies, experimental agriculture, and modular environmental systems as rewarding fields in which you can make a difference, both down here and out there.

Rocket science can take us to other worlds. It cannot enable us to do anything useful once we get there. Iridium may have failed. It was a detour. There are other, ultimately more powerful and profitable ways to build up to a space frontier economy. Do not waste a moment wallowing in discouragement at recent setbacks. In the end, they won't matter.

Rocket science can take us to other worlds.

It cannot enable us to do anything useful once we get there.

Entrepreneurs could make a tidy bundle here and now by developing technologies needed on the space frontier that also would have a real market on Earth. Poor Ore Mining Technologies, for one. Not only could one make money selling such technologies to "resource poor" nations on Earth, not only would you end up putting "on the shelf" technologies needed on the frontier, but even more important, just by doing so, you would make that land on the Moon much more valuable. For the R&D being done, the resources on this world will become more than "theoretical" - they will become real. They will become something we know how to work with. Then, only then, is any talk of land grants and land purchases something more than wild-eyed pie-in-the-sky.

<MMM>

[In our article above on a proposed "International Lunar Research Park, the two most prominent partner categories are national agency outposts and corporate contractors.

Ah! the classical "the chicken or the egg" conundrum! Clearly, we need a "rooster" or our outpost egg is not going to hatch. And that is a corporate "Site Developer."]

"Improving" the Moon: the Developer's Role:

By Peter Kokh

Reprinted from MMM # 131 December 1999

Foreward

The Moon "as is" is not an attractive piece of Real Estate. Putting together a package to attract anchor tenants and a "viable mix" of other clients, splitting costs & burdens, may be just the "accelerant" needed to start Lunar Development in earnest.

Improved Real Estate

Most readers will be aware of the distinction between "improved" and "unimproved" real estate. "Improved" real estate has on site or boundary access to utilities like water, gas, and electric. The lot may or may not have other "improvements" e.g. drainage grading. "Unimproved" real estate is just raw ground, with no utility access, perhaps not even road access, the kind of stuff Florida and Nevada fly-by-night "developers" want to sell you in the middle of a swamp or desert for a "bargain of a lifetime" price/ Lot's of luck doing anything with it!

All lunar real estate is "unimproved"

That does not mean that some locations are not better advantaged than others. Polar sites may have access to water-ice reserves. Highland/Mare Coastal sites have access to both major suites of pre-pulverized (read "pre-mined") regolith. Sites along the Mare Imbrium rim are richer in Potassium and Thorium and KREEP elements. And so on. But these are natural assets. No land on the Moon is man-improved, i.e. with utility access, or with any other kind of location-location-location traffic generating engineered "improvements." This is a daunting, if not intimidating fact facing anyone who has a free enterprise idea for a lunar location.

Allen Wasser has proposed a lunar "land grant" program to attract lunar development. But perhaps the only ideal customer for such a real estate regime is the "developer" who will go into the prospect site and make improvements that will render it especially attractive to specialized mining, processing, manufacturing, and other types of private enterprise. The first such developer to "improve" a resource-rich well-situated site, may, in the process be founding the first genuine lunar settlement. Even if there is already a scientific outpost on location, without improvements the "settlement" will not come.

The perspective of other interested parties

The mining company, the manufacturing company, the hotel operator, do not want to have to do such unaccustomed preliminary work as setting up power supplies, providing water, building a space port, providing communication relays, etc. If these things were already in place, ready to

"plug into" and ready for "hook up", the location would be immensely more attractive. Industrial and commercial enterprise would not have to assume the extra burden of paying for these improvement costs up front, but would merely tap in, and pay a monthly or annual usage charge: utility bills. This drastically cuts their financing costs as well as the time between arrival on the Moon and first returns on investment. It makes their job in closing a deal at a bank that much easier, more realistic.

The Lunar Site Developer's tasks:

(1) Picking a Site for Improvement:

The first task is to analyze candidate sites on the basis of "strengths & weaknesses". The developer should draw up an "Existing Conditions Map." This will include the topography within the area, noting potential obstacles and assets for construction. If there is a science outpost already established, any sharable assets (power, communications, roadways, launch pad) should be noted.

Do assets outweigh liabilities? Are there any "targets of opportunity" such as proximity to uncommon but valuable resources, passages through topographical obstacles such as passes through nearby ridges, natural bridges over nearby rilles? Are there known intact lavatubes in the vicinity? What is the ratio of highland-derived to mare-derived soil in the local regolith? Are there scenic highlights in the area? Is there enough flat terrain for emplacement of large solar arrays? Is there a logical location for a spaceport?

What are the liabilities? Lack of easy access to neighboring areas of the Moon? Uneven terrain? A large number of inconveniently placed boulders? Rilles or ridges that are not easily negotiated? Such liabilities must be weighed along with assets.

Next the developer needs to brainstorm this mix of assets and come up with a winning strategy to attract enterprises to buy in the development.

(2) The Site Development Plan

Site development plans should work with the lay of the land, develop topography suggested transportation corridors in the vicinity. The location must be picked for the spaceport with adjacent surface warehousing and shipping/receiving areas. Will the spaceport provide loading and unloading equipment so that incoming freighters do not have to carry the extra mass of self-unloading equipment? Developing the Port Facility will be part of Phase One.

A graded Road Network linking identified industrial park properties and residential and commercial areas and other special identified use areas must be provided. Easily gradable roadways to important nearby off-location resource-rich areas should be identified and marked. Care must be taken that all such identified sites are easily serviceable both by road and by utility providers.

3) Financial Considerations:

The proposed development must be

- * market supportable
- * physically doable
- * financially viable

To this end, the developer needs to take on "natural partners" in order to subdivide the task and conquer the load.

"Natural Partners" will include:

* a power generation company (solar &/or nuclear)
an*oxygen production facility. Among potentially competing proposals, one that employs processes that produce enriched tailings especially attractive to other potential manufacturers should be given the nod. Such beneficiated byproducts will help identify and attract other clients.

*a water production facility. If the site is not proximate to polar ice fields, and the developer does not wish to co-develop such icefields along with a means of transporting water, or hydrogen produced from it, to the development site, then, if hydrogen produced by heat-scavenging of any and all regolith moved in development of the site does not produce enough to be reacted with locally produced oxygen to meet needs, the balance must be brought from Earth. The only rational way to meet primary water recovery and waste treatment needs is on the spot where the water is grayed. This will be a burden each tenant-client of the development must assume. The development's shared mini-biosphere must be modular both in construction and in maintenance. This means primary treatment at the source of the problem for both water and air.

*a mining processing-building component manufacturer to turn out prefab modular building components to fit customer needs, in order to defray the cost of bringing additional pressurized volume from Earth at much greater expense.

Such a partner building component manufacturer could then enter into a joint venture with the developer to produce "turnkey" factories, ware-houses, commercial and residential properties for other clients on the basis of need and request.

Additionally, such a company could construct "hanger sheds" or space-frames constructed of glass composites or steel, covered with plates of the same material, then over-blanketed with regolith to provide "improved" radiation proof "lee vacuum" for easy set up of modular habitat structures, especially less expensive, lighter, cheaper to ship inflatables and hybrid rigid-core inflatables (on the TransHab model). Such hangers or ramadas might be built as rille-spanning vaults: virtual man-made or more exactly, man-restored lavatubes, which is what most sinuous rilles originally were.

Another joint venture would be to provide improved access (graded ramps and elevators) to any buildable lavatubes in the area. Shafts drilled through the lavatube ceiling/ roof filled with fiber optic cables, with sun collector on top and light defuser within the lavatube, would be an immensely attractive improvement, as would be a lavatube floor topographic map. No enterprise will buy space within a lavatube, no matter how many theoretical advantages it offers, without solid concrete information, and prepared access and minimal lighting.

These Natural Partners will be the "anchor" tenants" necessary to attract other partners, clients, and tenants to the development. These latter must be identified with special care to create a viable mix of enterprises that will both provide a healthy balance of diversified exports and meet a major portion of the physical needs of the growing community of

people locating in the development to run and operate the various enterprises:

- * modular housing, other pressurized structures
- * furniture and furnishings
- * food
- * other basic products

Summary

This is a plan in which costs are identified and shared in a manner that makes the development

- * physically doable
- * financially viable
- * environmentally compatible
- * politically feasible

It is a prescription for a rational plan to share both equity and debt, to remediate any waste problems, and to share the costs of further improvements useful for all or most parties.

Caveat

I worry that the site currently preferred by most writers, the Shackleton crater rim at the Moon's South Pole, is both too rugged and too constricted (c. 300 acres / 125 hectares) to serve even minimally for the kind of open-ended development outlined above. I worry that the site advantages are exaggerated and that the site liabilities are too casually dismissed. But that is fodder for a separate article.

We say this not to discourage or to dissuade anyone from present objectives, but in the hopes that those who make a final site determination do so fully weighing objectively all the plusses and minuses that pertain to various site options. Currently, such discussions are squelched by the desire to be aboard the "bandwagon" of premature majority opinion. Yet these considerations are essential if instead of a small collection of agency outposts at the South Pole, we decide on the much more pregnant option of an "International Lunar Research Park" as an open-ended development that could quite easily become the first true lunar settlement.

The goal, after all, is not just limited exploration of the Moon, but integration of the Moon and its resources into an Earth-Moon "Econosphere" that promises a better future for the vast majority of humans who will remain on Earth.

Admittedly, this is a vision that many are not yet ready to embrace. But once we do our homework, *pre-developing the technologies needed to make use of lunar resources*, the possibilities will become much more clear.

<PK/MMM>

Online Reading:

Improving the Moon & the Developers Role

www.lunar-reclamation.org/papers/improving_moon_paper.htm

The Outpost Trap

www.lunar-reclamation.org/papers/outpost_trap.html

The Moon: Why and How we should return

http://www.lunar-reclamation.org/papers/moonreturn_positionpaper.htm

MUS/cle Strategy for lunar Industrial Diversification

http://www.lunar-reclamation.org/papers/muscle_paper.htm

STORIES OF INTEREST

New Delhi Office Building Experiment Picks Three Best House Plants for Lunar Outposts

<http://greenspaces.in/blog/ted09/>

These three houseplants do the best job of cleaning interior air of various common indoor pollutants and irritants, and keeping the air fresh, greatly increasing productivity.



- Key:**
1. “The Living Room Plant” - “Areca Palm”
(*Chrysalidocarpus lutescens*)
http://en.wikipedia.org/wiki/Dypsis_lutescens
 2. “The Bedroom Plant” - “Mother in Laws Tongue”
(*Sansevieria trifasciata*)
http://en.wikipedia.org/wiki/Sansevieria_trifasciata
 3. “The Specialist Plant” - “Money Plant”
(*Epipremnum aureum*)
http://en.wikipedia.org/wiki/Epipremnum_aureum

Moon Trivia



The first footprint on the Moon was 33 cm long and 15 cm wide (the size of Neil Armstrong's space boot).

USC ASTE Course Participants – see page 18.



Lunar Libraries & Book Shelves

Apogee History of Spaceflight Books

70 + Individual Paperback Volumes - Titles

http://www.cgpublishing.com/Space_Series.html

Gallery of Apogee Book Covers

http://www.cgpublishing.com/Books/SPACE_SPLASH.html

Pocket Space Guides

www.cgpublishing.com/Books/POCKETS_SPLASH.html

Assorted DVDs

http://www.cgpublishing.com/Books/SER_SPLASH.html

Moon Society list of Books on the Moon (with covers)

<http://www.moonsociety.org/info/moonbooks.html>

Ken Murphy's Extensive Lunar Library

<http://www.outofthecradle.net/categories/lunar-library/>

Books for Children

<http://www.moonsociety.org/info/moonbooks.html#childrens>

Home on the Moon by Marianne Dyson

<http://www.mariannedyson.com/hotmreviews.htm>

Moon (National Geographic Children's Books)

http://www.educationoasis.com/ch_book_reviews/reviews2/moon.htm

Science Fiction involving the Moon – Book Lists

http://www.biblioinfo.com/moon/sf_moon.html

Lunar Study & Observing Certificates

<http://www.moonsociety.org/certificate/>

http://www.amlunsoc.org/lunar_certificate.htm

<http://www.astroleague.org/al/obsclubs/lunar/lunar1.html>

<http://www.rasc.ca/williamson/index.shtml>

Lunar Calendars

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

[http://www.lunar-](http://www.lunar-reclamation.org/papers/mooncalendar_paper.htm)

[reclamation.org/papers/mooncalendar_paper.htm](http://www.lunar-reclamation.org/papers/mooncalendar_paper.htm)

Miscellaneous

LPOD – Lunar Photo of the Day

<http://www.lpod.org/>

Directory of Lunar Place Names*

<http://www.lunarrepublic.com/gazetteer/index.shtml>

Lunar Glossary & Dictionary*

<http://www.lunarrepublic.com/info/glossary.shtml>

The Full Moon Atlas*

<http://www.lunarrepublic.com/atlas/index.shtml>

Our listing of these pages does not imply endorsement of the Lunar Republic's land/property sales program.

Student Space Organizations in India

The Planetary Society of Youth (TPSY)

<http://www.youthplanetary.org/> (website lost)

Shri. R.V.Burli, President

The Planetary Society of Youth
Opp. VRL Office - Bagalkot - 587101
Karnataka - India
Tele: (R) +91-8354-222725
(M) +91-9343110567

E-mail: president@youthplanetary.org

Mr. Amrut Yalagi, Secretary

The Planetary Society of Youth
21st, Main Road, Vijay Nagar, Near Engg.College
Bagalkot - 587 102, Karnataka - India
Tele: (R) +91-8354-233911
(M) +91- 9880071339

E-mail: amrut@youthplanetary.org
amrut1243@gmail.com

Astronautical Society of India Student Chapter (ASISC)

<http://www.indianspace.in/>

Astronautical Society of India Student Chapter
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

(Students for the Exploration & Development of Space)

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

SEDS India,
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)

The Chapters Under SEDS INDIA:

1. SEDS VIT - Vellore Institute Of Technology
University (Vellore)
http://www.vit.ac.in/seds_vit/index.html
2. National Institute Of Technology (Suratkal)
3. National Institute Of Technology (Trichy)
4. Jawahar Lal Nehru Technical University
(Hyderabad)
Kumaraguru College Of Technology (Coimbatore)

Pro-Space Organizations in India

Astronautical Society of India

<http://www.asindia.org/default.aspx>

IndianSpaceTalk@groups.indianspace.in

National Space Society Kolkata chapter

http://chapters.nss.org/a/lists/International/ChapList_IN.s.html

Dr. Satadal Das

drsatdas@hotmail.com 91-33-24683336

76 Satyen Roy Road, Kolkata, , 700 034 India

Planetary Society of India

[Organisation for promotion of astronomy]

<http://planetarysocietyindia.blogspot.com/2008/08/space-camp-india-astronaut-training.html>

<http://planetarysocietyindia.blogspot.com/>

<http://planetarysocietyindia.org/>

Space India - ISRO Newsletter - twice a year

<http://isro.gov.in/newsletters/newsletters.htm>

Aeronautics & Aerospace Journals & Magazines Published in India

(Stress on AEROspace)

International Aerospace Magazine India

<http://www.internationalaerospaceindia.com/default.htm>

Vayu Aerospace Review – India

<http://www.vayuaerospace.in/>

30 ISRO Facilities

A complete list of;

- Research Facilities (5)
- Test Facilities (1)
- Construction & Launch Facilities (4)
- Tracking & Control Facilities (4)
- Human Resource Development Centers (3)
- Commercial Centers (1)
- Other (12)

Can be found on Wikipedia

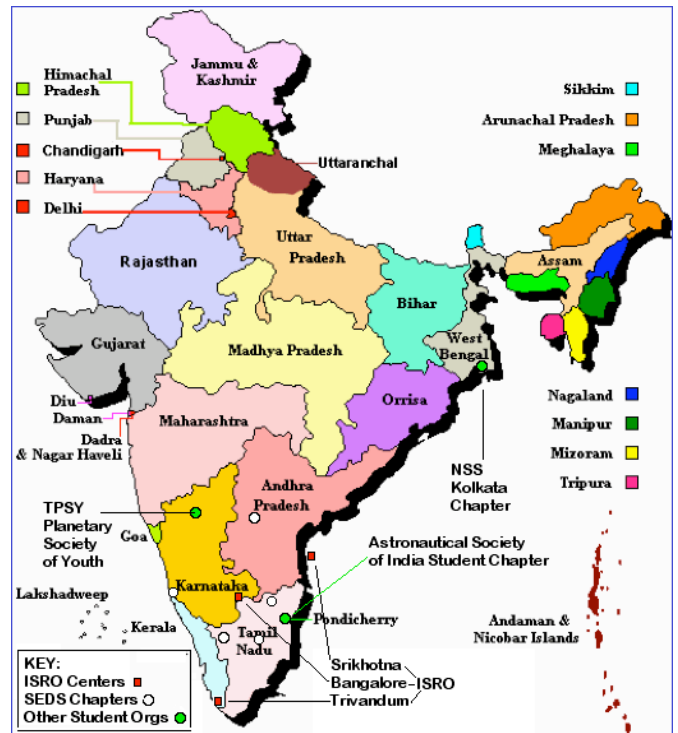
http://en.wikipedia.org/wiki/Indian_Space_Research_Organisation#Research_facilities



**A
View
From
Space
India
At the
Center**

MMM-India Quarterly #2 - Feb 2009 Index - Table of Contents

- p 2 About The Moon Society, MMM, M3IQ
- p 3 Chandrayaan-1 Progress Report
- p 4 Chandrayaan-2 Looking Forward
- p 5 India's 2-man Capsule Design
- p 6 ISRO Director Addresses Students
- p 7 The Moon Revealed
- p 8 Elsewhere in Asia
- p 9 NASA's LCROSS Lunar Impactor
- p 10 Editor's Page
- p 11 The Sunita Williams Story
- p 12 What will India call its "Astronauts?"
- p 13 Book Review: Destination Moon
- p 14 Lunar Resources in our future
- p 15 Return to the Moon; Import/Export Equation
- p 17 M3IQ Photo Gallery
- p 18 SEDS-India and SINC 09, Rover Competition
- p 19 USC Return to the Moon Design Exercise
- p 20 An International Lunar Research Park
- p 21 Improving the Moon Starts on Earth
- p 24 The Developer's Role
- p 26 Stories of Interest; The Lunar Bookshelf
- p 27 Space Organizations in India



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

and you would like to add your email address
to our distribution list,

Write mmm-india@moonsociety.org

Put "Subscribe" in the subject line of your email.

Include any comments you would like to make!

Feel free to send us email addresses of others

Individuals and/or organizations or lists
that you think would like to receive future issues.

Moon Society Chapters in India?

The Moon Society is interested in helping to
establish local chapters within India.

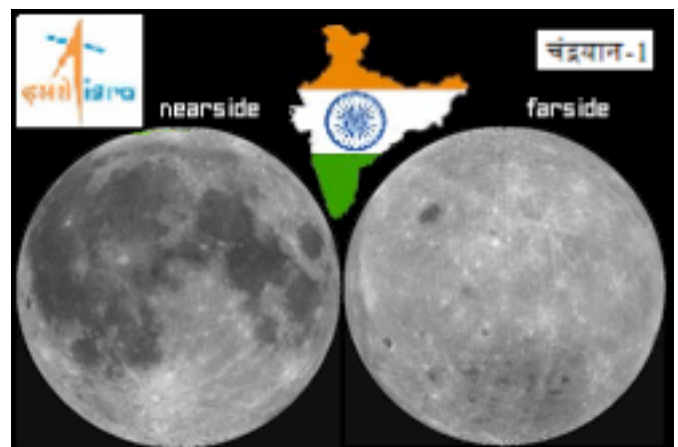
For information on how to proceed, write:

chapters-coordinator@moonsociety.org

Put "India Chapter" in the subject line of your email

Note: We are also interested in partnering with
existing local organizations, be they campus-based
or community-based. And we are interested in
collaborating with various space-interest national
organizations in India as well.

Together, we can do more!



The Moon Society



www.moonsociety.org