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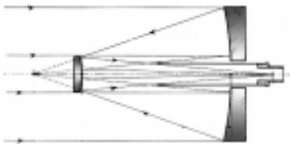
PETERBOROUGH ASTRONOMICAL ASSOCIATION

THE REFLECTOR



Volume 6, Issue 1 January 2007

Editorial

It is now 2007, and the PAA schedule has some interesting speakers lined up for this year. To start us off, Randy Attwood will be joining us on January 5th to tell us about his "Eclipse Expeditions." Another guest speaker you won't want to miss will be visiting us on February 2nd. Talmon Firestone, Vice President of NSD-Fusion, will talk about the dozens of companies' endeavors to work on space frontiers.

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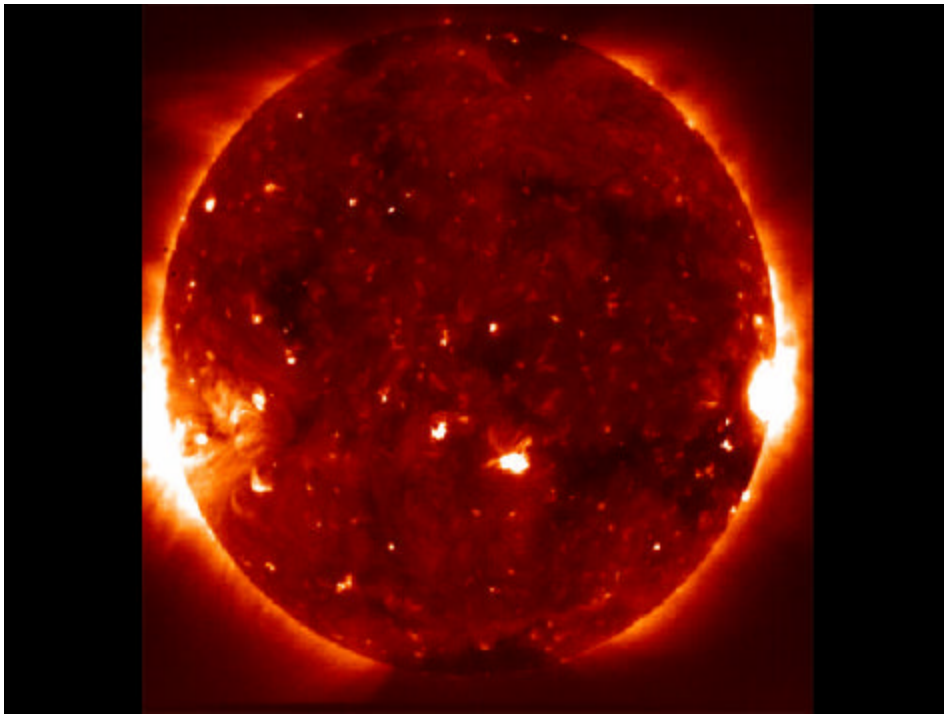
Solar-B

There is a new "mission to the sun," called Solar-B, that has many different space agencies collaborating together. These agencies include Japan, United States, United Kingdom, and Europe. Their goal is to investigate the interaction between the Sun's magnetic field and its corona with the new Hinode, or "Sunrise," spacecraft.

Now why would anyone want to "investigate" this? Well, there's good reason. Solar activity can interfere with our satellite communications, the electric power transmission grids on Earth, and they are a threat to astronauts working and traveling in space. The scientists with Solar-B are hoping to identify the specific changes in the Sun's magnetic field that lead to explosive energy blasts. This information would be useful in predicting future occurrences.

The Hinode spacecraft is circling the Earth in a sun-synchronous polar flight, which means that it will be in sunlight for nine months out of the year. Hinode is equipped with three different instruments: the Solar Optical Telescope, the X-ray Telescope, and the Extreme Ultraviolet Imaging Spectrometer.



One of the first images of the Sun taken by Hinode. Image credit: JAXA NAOJ.

The Solar Optical Telescope will be the first instrument to precisely measure the strength and direction of the Sun's magnetic field. It will also give us magnified views of the Sun's surface. The X-ray Telescope will take X-ray images of the Sun's corona (the outer atmosphere). By combining the information from the optical and X-ray telescopes, scientists will study how the Sun's magnetic field triggers solar flares and coronal mass ejections. The Extreme Ultraviolet Imaging Spectrometer can measure the speed of solar particles and give the temperature and density of the ionized gas that engulfs the Sun and surrounding areas. Lately, scientists have been checking and calibrating the instruments on Hinode. Soon it will be up and running for full-time observing.

For more information go to :
www.nasa.gov/solar-b

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Inside This Issue

Mighty Orion Rules The January Sky

Orion is one of the most popular collections of dots that stargazers connect. Perhaps that's because 7 of the sky's 70 brightest stars can be found in this familiar winter constellation. Another big hint is the line of three bright stars that comprise his belt. Plus, he's big, occupying about 25 degrees of celestial real estate.

As soon as darkness falls you can spot the mighty hunter in the eastern sky. Marking his right shoulder is the bright red-giant star, Betelgeuse. Pronounced Bet-el-jews, this monster star is so large that if it were to take the place of our Sun, all the inner planets including Earth and Mars would be orbiting inside of it. But Orion's show piece is in the handle of the sword that hangs from his belt.

Known to astronomers as the Orion Nebula this gargantuan cloud of gas and dust is 1,600 light years away. Yet it can easily be seen as a misty patch with the naked eye. Hoist a pair of binoculars to your eyes and you'll see that its glow spreads impressively. Seen through a telescope, it is so large that it can't all be included in one field of view.

The giant nebula is primarily comprised of dusty debris, the gasses hydrogen and helium, and small amounts of other elements. It has been estimated that the Orion Nebula contains enough water to continuously refill all the oceans on the Earth every 12 seconds.

The Orion Nebula is also one of the most significant star birthing areas in our part of the Milky Way galaxy. The Hubble Space Telescope has photographed numerous new stars in the process of radiating away the remnants of dust from which they coalesced. Some of these new-born stars also had planetary systems forming around them. With that discovery, the theory of how our solar system evolved became a scientific fact. But Orion has another side, steeped in mythology.

It is said that he is in constant pursuit of the Seven Sisters of the Pleiades. And, indeed, if you draw a line upwards through his belt it leads to the lovely cluster of star-nymphs just north of Taurus the Bull. Follow the same line through his belt in the opposite direction and you will come to the brightest star in the Northern Hemisphere, Sirius. Sometimes called the Dog Star, Sirius is a part of the constellation Canis Major which is said to be Orion's hunting dog. Speaking of hunting, why not bundle up tonight and track down the mighty hunter.

Until we meet again in the back yard, keep the lights down and the stars bright. You'll save money, energy, and the beautiful Kawartha night sky.

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Three stars in a line mark Orion's belt. Hanging from it is his sword and the Orion Nebula, seen here as a misty patch. To the Egyptians, Orion was known as Osiris, the god of life and death, while Arabs call him al-Jabbar, the giant.
Photo by John Crossen.

Canada takes A More Active Role In Space Exploration

In November of 2006 more than 100 of the leading astronomers in Canada gathered in Montreal to discuss our partnership and leadership roles in future space ventures. The two-day super brainstorming session resulted in a number of exciting possibilities.

Rene Doyon, Professor of Astronomy at the University of Montreal, acknowledged that Canada is well known for its partnership role with NASA on a number of missions. He also said that our future 'wish list' of missions will continue to pursue the answers to essential questions such as the origin of life and the birth of our universe. But Canada also needs a more visible leadership role.

Hubble-class space telescopes with ultraviolet capabilities are top priorities. Their orbital position lets them study light from objects that is obscured by our atmosphere. Hubble and Europe's coming Herschel telescope has ultraviolet capabilities and future space exploration will require more telescopes with this ability.

Continued...

Phobos is the larger of the two Martian moons. In keeping with Mars' reputation as the planet of war, Phobos is the root of the word phobia and its other moon, Demos is a form of the word Demon. Photo by the ESA.

Perhaps the most exciting 'dream' prospect would be a Canadian mission to Mars' largest moon, Phobos. Orbiters and rovers bearing the red maple leaf could someday be zooming around and across this mysterious Martian satellite, most of which is unexplored and may have potential for future manned missions.

Other projects high on the list of priorities include a sample-return mission to the Moon around 2020 and our continued participation in developing hardware for the James Webb Space Telescope which is due to launch in 2013.

This telescope will be about the size of a tennis court and will be capable of viewing the first galaxies formed in our universe, over 14 billion years ago. Canada's current involvement in the Webb scope includes developing a fine-guidance system and a sophisticated camera with a tunable filter system.

Canadian scientists are also anxious to play a more visible role in the current search for extrasolar planets. Participants in this exciting field have already discovered over 200 planets orbiting stars in the far-reaches of our galaxy. Taking direct images of an extrasolar world may be possible from balloon-borne telescopes. We're already gaining experience in this field in Antarctica where BLAST (Balloon-borne Large Aperture Sub-millimeter Telescope) is performing galactic surveys.

Naturally gaining a higher profile in the space-travel community has its price, so Canada's scientists are hoping to get a boost in funding from the government. According to Professor Doyon, the cost estimate for a single flagship mission would be in the $100 million range spread over a 20 year period. It's quite within the range of possibility.

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Aloha #9 – UH 0.6 Meter Telescope

As we continue our tour of the giant telescopes of Hawaii's Mauna Kea, we now come to both the oldest and smallest telescope on the summit, the University of Hawaii's 0.6-meter telescope. It is located on the upper eastern rim of the peak at the 4,186 meters (13,735 feet) elevation level. Our tour thus far had been going through the telescopes in order from the southern rim around the western side to the north and now we will tour the eastern side.

As the pioneer telescope on the mountain, it saw first light in 1968 when it was set-up by the U.S. Air Force in preparation for the first landing on the moon in 1969. Have things ever changed since then!

This is the only telescope on Mauna Kea that is used by astronomers for observing and that is open to the night air. There is no heated control room here (What were they thinking?) This telescope is currently for the University of Hawaii undergraduate's studies. Its 0.6 meter (24 inches) diameter is used as an optical telescope. Not something I would mind in my backyard or in a location like the Buckhorn Observatory. The type of work that this scope is involved in also includes CCD imaging of star clusters and the search for planets around nearby stars.

As part of our sunset tour the second image (page 4) shows what we saw looking south with Mauna Loa in the background and the dome of the UH 0.6 in

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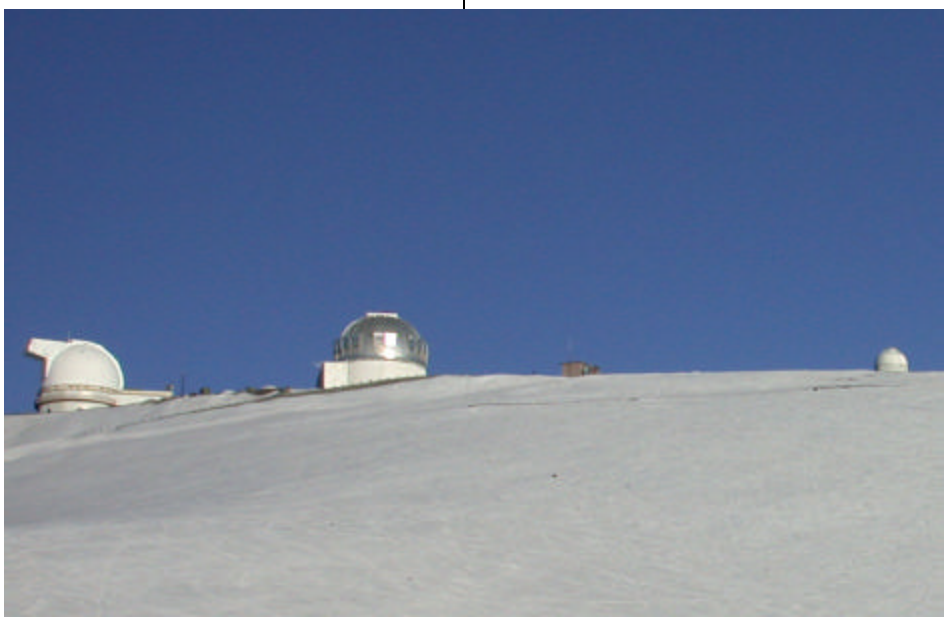

The attached image shows the relatively tiny dome (far right) for this 0.6 meter scope (that you could probably still park a full-sized vehicle inside of) next to the United Kingdom Infra-Red Telescope and the University of Hawaii 2.2 Meter Telescope.

UH 0.6 at sunset.

the foreground. It was nice evening no matter how you looked at it.

For more information about the UH 0.6 Meter Telescope, check out their website: www.ifa.hawaii.edu

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January's Stars Shine Overhead – And In Peterborough

In January the best known star cluster in the Northern Hemisphere is up before the Sun goes down. Called the Seven Sisters of the Pleiades, the cluster is an easy naked eye target. To find the celestial sorority, look high in the south-eastern sky as soon as it is dark. To the unaided eye the Pleiades will be a faint, fuzzy smudge about the size of your thumbnail viewed at arm's length. If you're still having trouble spotting the girls, draw a line through the three stars in Orion's belt and continue up until you come to the smudge.

In Greek mythology the sisters are the daughters of Atlas, the giant and Pleione, daughter of the sea god Oceanus. Orion the hunter was fetched by the beauty of the young girls, so Zeus turned the girls into stars and placed them safely in the heavens. Orion still chases the girls across the sky, but he'll never catch them.

Other cultures are also familiar with the ancient cluster. In Arabic it is known as Ath-thuravva or "the crowd." In Spain the stellar grouping is called "the nanny goats" or Las Cabillus. To modern Greeks it is often called "the hencoop." In Denmark it becomes "the eve hen." And Russians call the cluster Nasedha or "the sitting hen." Could this be why we sometimes call girls "chicks" today?

Randy Attwood will speak on his eclipse tours at the Orientation Centre of Riverview Zoo at 8:00 pm on January 5th. There is no charge. Parking is free. The facility is wheelchair accessible and washrooms are available.

Once you've spotted the Seven Sisters of the Pleiades, try viewing it through a pair of binoculars. It is quite stunning and will delight anyone who has joined you for an evening of winter stargazing. Here are some facts to share with your fellow observers.

The cluster is about 100 million years old. In cosmic terms, that makes the girls spring chickens. It is also very close to us, residing at a distance of 440 light years*. Despite having the number seven in its name, the cluster contains about 500 stars and occupies a chunk of celestial real estate almost 15 light years across. While the cluster is quite compact to the eye, it will eventually spread out and blend in with the rest of the starry night. But that will take another 250 million years, so don't hold your breath.

A star of another kind will be shining in Peterborough the evening of January 5th. Randy Attwood is Past President of the Royal Astronomical Society of Canada. He is also an avid eclipse chaser and has toured the world more than a few times in search of the Moon's shadow as it blocks the Sun from view. Solar eclipses take place roughly every 18 months and can be seen from only a small portion of our planet. Mr. Attwood's talk guarantees that you'll see several eclipses all in one comfortable evening.

*One light year is the distance a photon of light will travel in space during a year. Whistling along at 300,000 km per second that equals 10 trillion km or 6 trillion miles.

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NASA Space Place

Space Weather For Air Travelers

At a time when much of the airline industry is struggling, one type of air travel is doing remarkably well: polar flights. In 1999, United Airlines made just twelve trips over the Arctic. By 2005, the number of flights had grown to 1, 402. Other airlines report similar growth.

The reason for the increase is commerce. Business is booming along Asia's Pacific Rim, and business travel is booming with it. On our spherical Earth, the shortest distance from Chicago to Beijing or New York to Tokyo is over the North Pole. Suddenly, business travelers are spending a lot of time in the Arctic.

With these new routes, however, comes a new concern: space weather.

"Solar storms have a big effect on polar regions of our planet," explains Steve Hill of NOAA's Space Weather Prediction Center in Boulder, Colorado. Everyone knows about the Northern Lights, but there's more to it than that: "When airplanes fly over the poles during solar storms, they can experience radio blackouts, navigation errors and computer reboots- all caused by space radiation."

In 2005, United Airlines reported dozens of flights diverted from polar routes by nasty space weather. Delays ranged from 8 minutes to 4 hours, and each unplanned detour burned expensive fuel. Money isn't the only concern: Pilots and flight attendants who fly too often over the poles could absorb more radiation than is healthy. "This is an area of active research- figuring out how much exposure id safe for flight crews," says Hill. "Clearly, less is better."

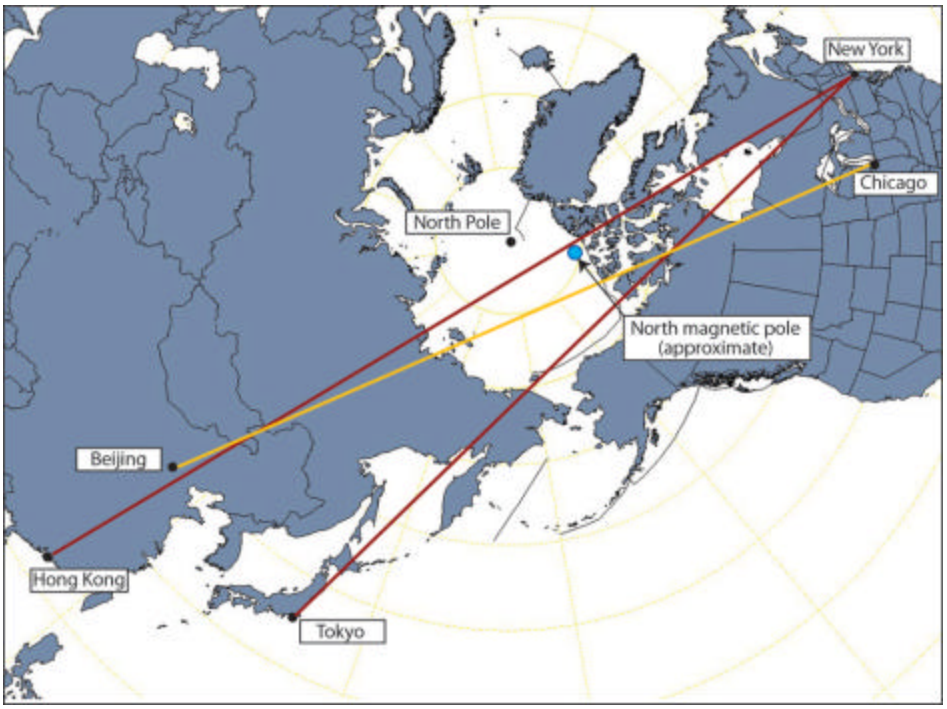
To help airlines avoid bad space weather, NOAA has begun equipping its GOES weather satellites with improved instruments to monitor the Sun. Recent additions to the fleet, GOES 12 and 13, carry X-ray telescopes that take spectacular pictures of sunspots, solar flares, and coronal holes spewing streams of solar wind in our direction. Other GOES sensors detect solar protons swarming around our planet, raising alarms when radiation levels become dangerous.

"Our next-generation satellite will be even better," says Hill. Slated for launch in 2014, GOES-R will be able to photograph the Sun though several; different X-ray and ultraviolet filters. Each filter reveals a somewhat different layer of the Sun's explosive atmosphere- a boon to forecasters. Also, advanced sensors will alert ground controllers to a variety of dangerous particles near Earth, including solar protons, heavy ions and galactic cosmic rays.

"GOES-R should substantially improve our space weather forecasts," says Hill. That means friendlier skies on your future trips to Tokyo.

This article was provided by the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.

By Dr. Tony Phillips



More polar airline routes means more exposure to space weather. Image credit: NASA

A New Paradigm For Lunar Orbits

Science@NASA

It's 2015. You're NASA's chief engineer designing a moonbase for Shackleton Crater at the Moon's south pole. You're also designing a com-system that will allow astronauts constant radio contact with Earth.

But you know that direct transmissions won't work--not always. As seen from Shackleton Crater, Earth is below the horizon for two to three weeks each month (depending on the base's location). This blocks all radio signals, which travel line of sight.

The solution seems obvious. Simply

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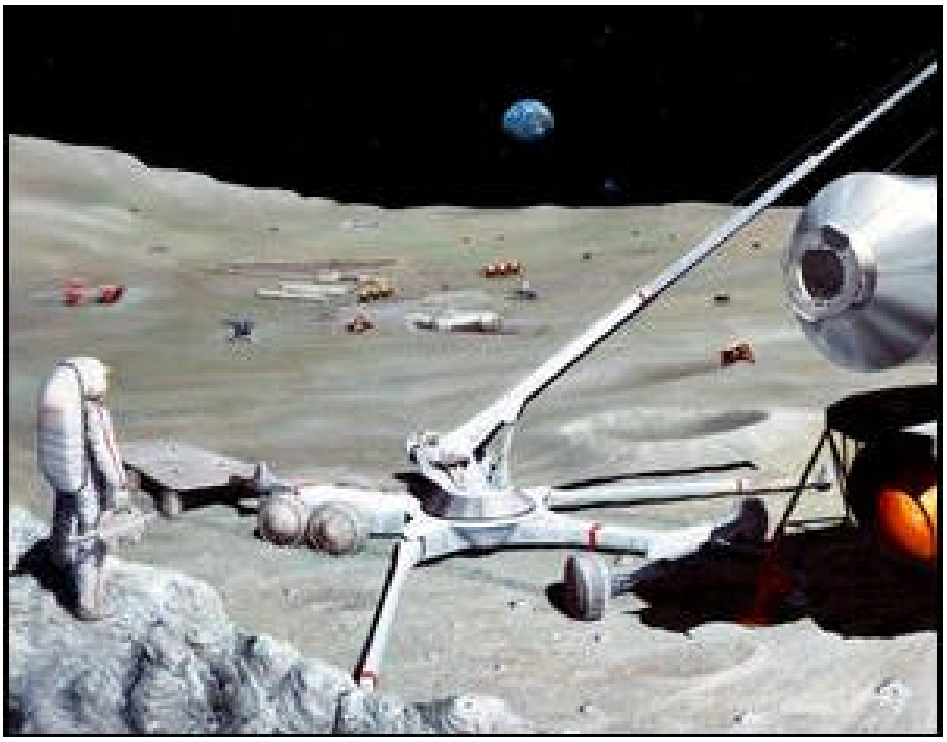

Artist Pat Rawling's concept of a manned lunar base.

place a satellite in a high, circular orbit going almost over the Moon's poles. Better yet, place *three* satellites into the same orbit 120 degrees apart. Two would always be above the lunar horizon to relay messages to and from Earth.

There's just one problem.

"High-altitude circular orbits around the Moon are unstable," says Todd A. Ely, senior engineer for guidance, navigation, and control at NASA's Jet Propulsion Laboratory. "Put a satellite into a circular lunar orbit above an altitude of about 750 miles (1200 km) and it'll either crash into the lunar surface or it'll be flung away from the Moon altogether in a hyperbolic orbit." Depending on the specific orbit, this can happen fast: within tens of days.

Why? Earth is responsible. The gravity of massive Earth only 240,000 miles (400,000 km) from the Moon constantly tugs on lunar satellites. For a lunar orbit higher than 750 miles, Earth's pull is actually strong enough to whisk a spacecraft out of the game.

Satellites in Earth orbit don't experience this sort of interference from the Moon. The Moon has just 1/80th Earth's mass—scarcely more than 1%. Relatively speaking, the Moon is a gravitational pipsqueak. Indeed, to any satellite in Earth orbit, the gravitational pull of the Sun is 160 times stronger than any lunar influence.

Any satellite in orbit around the Moon higher than about 750 miles, however, finds itself in a kind of celestial tug-of-war between Moon and Earth. Earth's pull can actually change the shape of an orbit from a circle to an elongated ellipse.

Stable circular lunar orbits do exist below an inclination of 39.6º, says Ely, but they spend so much time near the equator that "they are terrible orbits for covering the poles."

NASA wants to explore the Moon's polar regions for many reasons--not least is that deep polar craters may contain ice, which astronauts could harvest and melt for drinking or split into hydrogen and oxygen for rocket fuel and other uses. The instability of polar orbits poses a real problem for exploration.

Now for the good news. Ely and several colleagues have discovered a whole new class of "frozen" or stable high-altitude lunar orbits. Pictured below, they are all inclined at steep angles to the Moon's equatorial plane so they get far above the horizon at the lunar poles, and--surprise--they are all also quite elliptical.

"For better South Pole coverage, you want an ellipse with an eccentricity of about 0.6, which is pretty oval," Ely says. An eccentricity of 0 is a circle, along which a satellite travels at a constant speed around a primary body (say, the Moon) at its center. With Earth nearby, that's out of the question: "An inclined circular orbit is kind of a blank canvas where Earth can quickly work its will," Ely says.

In contrast, an eccentricity of 0.6 is an ellipse about as oval as an American football minus the pointed ends; the Moon would be at one focus of the ellipse. "The ellipse effectively 'locks in' the satellite's behavior to make it tougher for Earth to change," Ely explains. [See the appendix below for details.] How stable are they? Ely and his colleagues calculate that certain elliptical, high-

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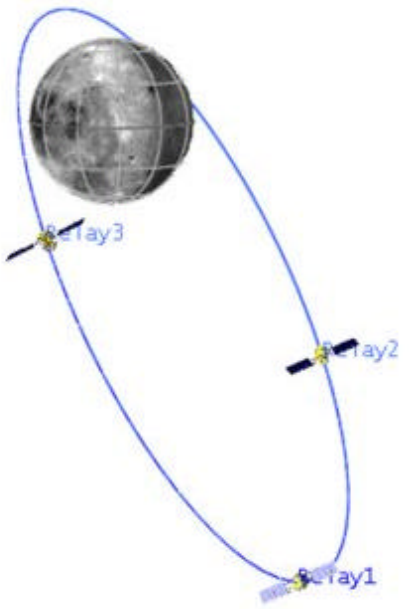


A whole new class of "frozen" or stable high-altitude lunar orbits.

inclination, high-altitude lunar orbits may remain stable for periods of at least a century. Indeed, Ely hypothesizes the orbits could last indefinitely.

For lunar communications and navigation, Ely recommends spacing three satellites 120º apart in the same elliptical orbit at an inclination of 51º. Each satellite in turn would go screaming down past periapsis (closest approach to the lunar surface) only 450 miles (700 km) above the north lunar pole, but would each linger fully 8 hours of its 12-hour orbit at 5,000 miles (8,000 km) above the horizon over the south lunar pole. In this configuration, two of the three satellites would always be in radio line-of-sight from a South Pole moonbase.

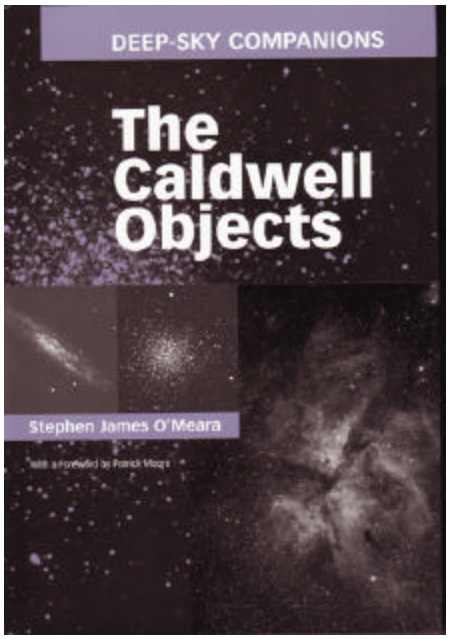
High-inclination, highly elliptical orbits being cheapest and most stable for communications satellites around the Moon? To Earth-centered satellite engineers used to thinking in terms of circular equatorial orbits, "it's a new paradigm," Ely declares.

Editor's note: This story describes problems keeping satellites in high orbit around the Moon. Low-orbiting satellites have problems, too. Lunar "mascons" tug on them and cause them to crash into the ground. Earth affects high orbits, mascons affect low orbits. For more information read Science@NASA's Bizarre Lunar Orbits.

Submitted by: Mark Coady
Author: Trudy E. Bell
Editor: Dr. Tony Phillips
Credit: Science@NASA

Book Review: The Caldwell Objects, By Stephen O'Meara (2002)

You will notice a new book on the PAA club library list from this past summer (if you are using the library, hint, hint). This impressive new 484-page hard cover book was given to the library from the publishers of Sky & Telescope (that's another story). What a stellar gem this one is too.



This volume is part of a two book set of Deep Sky Companions that author Stephan James O'Meara created to aid in touring the universe. The first volume details the Messier Objects and by many accounts, is the definitive work on the subject. This second volume is the sequel because it is the definitive work on the Caldwell Objects. Some may ask, "What are the Caldwell Objects?" and this is where the story gets interesting.

The famous British astronomer, Sir Patrick Alfred Caldwell-Moore thought that it would be a good idea to expand upon the concept of the Messier objects (109 comet-like objects), but he took the idea much further. Sir Patrick came up with his own 109 objects of the night sky, the difference is that these objects are not only ones that the Messier's missed, but they include objects that the Messier's could not have seen because some are found in the southern hemisphere (all the Messier objects are visible from northern latitudes).

The concept being that once you have mastered the Messier's list, then try Sir Patrick's list. There are some great visual challenges, especially if you have to travel the world to do it! This idea was so well thought of, that in the December 1995 issue of Sky & Telescope magazine this list of 109 new objects were published, and you might say the rest is history. People all over the world embraced the idea and now Sir Patrick's list of 109 objects is a standard part of any GoTo scopes databank.

Now the naming question. Sir Patrick could hardly have used "M" for Moore because of the obvious conflict with "M" for Messier. A prolific writer, Sir Patrick goes by Patrick Moore, but his official proper name is Patrick Alfred Caldwell-Moore. The answer was obvious, use "C" for Caldwell-Moore, or Caldwell for short. Now you know the rest of the story.

Have you seen all the Messier's? If you are up to the challenge, try and do the Caldwell's. You have likely seen some of them or at least heard of them already and not known it. Have you heard of or seen the E.T. Cluster (C13); Double Cluster of Perseus (C14); North American Nebula (C20); Eskimo Nebula (C39); Hyades (C41); Eta Carinae Nebula (C92) or the Tarantula Nebula (C103)?

In any case, when you start your journey into the Caldwell Objects, you will want this "bible" with you. The author has meticulously included the popular names, NGC reference, type of object it is, which constellation it is in, RA/Dec., magnitude, size, distance and who the discoverer was, for every Caldwell. Plus there is a black and white photo and finder chart for all 109 objects. The text for each will give you the history and details to wet your appetite and satisfy your curiosity all at once.

So take the challenge, get the book and enjoy the night sky all over again!

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NASA Facts

www.nasa.gov

* The average distance from the Earth to the sun is 93 million miles. It takes light eight and a half minutes to travel from the sun to the Earth.

* A sunspot appears as a dark region on the surface (photosphere) of the sun. Temperatures in sunspots are cooler than the surrounding area of the photosphere, which is why spots are dark. Sunspots are magnetic regions, in which the strength of the magnetic field is thousands of times stronger than Earth's magnetic field.

* The Altus II unmanned robot plane can circle for up to 24 hours over wildfires, beaming images and data back to computers via satellite. Originally introduced as part of the Environmental Research and Sensor Technology (ERAST) Program, Altus II can map dozens of fires in a day with no risk to a pilot.

* On January 31, 1958, Explorer 1 became the first artificial satellite launched into space by the United States. Onboard was a cosmic ray detector designed to measure the radiation environment in Earth orbit.

Peterborough Astronomical Association

The Reflector is a publication of the Peterborough Astronomical Association (PAA). Founded in 1970, the PAA is your local group for astronomy in Peterborough and the Kawarthas.

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The Sky This Month

MERCURY

Mercury passes behind the Sun in superior conjunction early in the month (the 7th), and thus is not readily observable until late in the month when it appears low in the southwestern sky after sunset.

VENUS

After the first week or two of the month, Venus dominates the west-southwest shortly after sunset. It is there at the beginning of the month, but rather low. It rapidly gains altitude this month for northern hemisphere observers. As is the case with Mercury. Venus is our "morning star" until early August.

MARS

Mars is a morning object in Ophiuchus and Sagittarius (into which it moves on the 11th). Rising only about 90 minutes before the Sun, currently it is small target in telescopes. It will be several months before Mars rises sufficiently ahead of the Sun to be free of the dawn twilight.

JUPITER

Jupiter rises about two hours before the Sun and about an hour before Mars, not far from the star Antares (although Jupiter is across the border in Ophiuchus). Although low in the sky, it offers a nice telescopic sight, complete with satellites, for early risers.

SATURN

Saturn is in the constellation Leo, near Regulus. It rises 2-3 hours after sunset at mid-month and is visible the remainder of the night. Look for it in the east by mid-evening, high overhead about 2 a.m., and in the western sky shortly before sunrise.

URANUS

Uranus is in Aquarius. This gas giant sets before midnight so look for it in the west after sunset.

NEPTUNE

Neptune is in Capricornus. A small telescope is necessary to view the most distant planet in the solar system. However, with conjunction approaching early next month, it is probably too close to the Sun to observe.

METEOR SHOWERS:

The Quadarantids peak on January 3/4th.

For details, see http://comets.amsmeteors.org/meteors/calendar.html.

J O K E ! J O K E ! J O K E ! J O K E !

Jupiter came down to Earth one day and decided to help these two

criminals to rob a bank. Anyway, to make a long story short,

they got caught and the three of them found themselves in court.

The judge sentenced the two earthlings to fifteen years, and Jupiter

was a bit shocked when he was sentenced to ten years.

"But your honor" said Jupiter, "I didn't even take part in the robbery!"

"Yes" said the judge. "But you helped them ... Planet!".

! J O K E ! J O K E ! J O K E ! J O K E

ARTICLES

Submissions for *The Reflector* must be received by the date listed below. E-mail or "sneaker-net" (i.e., floppy disk) submissions are preferred (Microsoft Word, ASCII and most graphics formats are acceptable). Typed or hand-written submissions are acceptable provided they are legible (and not too long). Copyrighted materials will not be published without written permission from the copyright holder. Submissions may be edited for grammar, brevity, or clarity. Submissions will be published at the editor's sole discretion. Depending on the volume of submissions, some articles may be published at a later date. Please submit any articles, thoughts, or ideas to this address:

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or via e-mail at:
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Please contact me first if you are sending a large file.

NEXT ISSUE'S DEADLINE IS
Jan. 15, 2006
⌘

MEETINGS

The Peterborough Astronomical Association meets every first Friday of most months at the Peterborough **Zoo Orientation Centre** (Next to the PUC Water Treatment Plant) at **8:00 pm**.

CALENDAR OF EVENTS

January 5, 2006	**General Meeting—** Speaker - Randy Attwood on "Eclipse Expeditions"
February 2, 2007	**General Meeting—** Speaker - Talmon Firestone on "Space Entrepreneurship"
March 2, 2007	**General Meeting—** Speaker Guy Nason on "Asteroid Occultations"

Moon Phases

Full Moon	**January 3, 2007**	**February 2, 2007**
Last Quarter	**January 11, 2007**	**February 10, 2007**
New Moon	**January 18, 2007**	**February 17, 2007**
First Quarter	**January 25, 2007**	**February 24, 2007**