Peterborough Astronomical Association
The Reflector

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Rare Red Auroras Storm Peterborough

A strong geomagnetic storm hit the Earth on October 24 sparking rare red auroras in the Peterborough area. Our club president was lucky enough to photograph them above his home in Keene. (Photo: Rick Stankiewicz)

On the evening of October 24th, the Earth was buffeted by a geomagnetic storm from the Sun. The last time I saw really obvious auroras was about this time of year in 2004.

Auroras are produced by subatomic particles — electrons and protons — blown off by the Sun. The particles are propelled into space on the solar wind. Typically, when the Sun releases a Coronal Mass Ejection (CME) toward Earth, we can expect a good chance of seeing auroras. When the solar wind and the Earth's magnetic field interact, electrical energy is produced. The resulting electrical discharge in the upper atmosphere around the poles creates auroras in the same way a discharge works in a neon sign. The gases give off photons, or light, and we see the aurora. Your location relative to the magnetic field makes a difference for observing aurora. Normally, a location as far south as Peterborough is not an ideal location to see auroras because we are so far from the north polar region, but every now and then we get lucky

see "Auroras" on page 4

President's Photos

Here's Your Chance to be a Star

The year is quickly drawing to a close and the upcoming Annual General Meeting (AGM) will be here in another month. With the "changing of the guard" and a few executive positions to be filled, I trust you have all done some soul searching in considering what you can do to see that the PAA continues on a steady course into the future? You might have more to offer than you think, so don't sell yourself short. The President, Vice President, Light Pollution Abatement Director and Librarian's positions are going to be vacated for sure, so seriously consider your possible role or talk to another equally qualified member to "step up to the plate". We all need you and we will be right there for you, to help you along.

There are so many things going on in the night sky this coming month! Jupiter is putting on quite the show all night long, there are nice conjunctions of planets and crescent Moons to look forward to and there is even a comet (Garradd) to hunt down. Then on the night of the 17th is the annual Leonid Meteor Shower. You don't get these opportunities every day or month for that matter. I know the weather has not been cooperating lately for observing, but astronomers are a patient lot. Just know that there will be better days and nights ahead, so don't lose faith. Two things for sure, the skies will clear up and it will be getting colder. If nothing else, you can curl up next to the fireplace and read this current issue of *The Reflector* to inspire you. One consolation is that with colder weather, however, comes better viewing, so bundle up and head out the next chance you get and remember to... keep looking up!

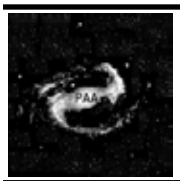
Rick Stankiewicz

Letter from the Editor

In lieu of a president's message (our esteemed Chair of the Club is away) he sends some photographs from last month's PAA meeting held at Emily Provinicial Park, northeast of Omemee. Guest presenter, Randy Attwood, from the Mississauga RASC, lectured about the history of NASA's Space Shuttle missions with the title: *"The Space Shuttle — 30 Years of Winged Spaceflight"*.

An impromptu trip to Toronto dragged me away from this meeting and I am sorry I missed it. But, we have another meeting this month with PAA member Brian McGaffney, of Nutwood Observatory near Apsley, as our guest. Brian is a first-rate deep sky object astrophotographer and we've published a number of his work in this newsletter. Not to be missed.

Phillip Chee
Editor, The Reflector



Peterborough Astronomical Association

The Reflector is a publication of the Peterborough Astronomical Association (P.A.A.) Founded in 1970, the P.A.A. is your local group for astronomy in Peterborough and the Kawarthas.
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November is a Winter Warm-up Lap for Stargazers

John Crossen

Aside from being notoriously cloudy in south-central Ontario, the month does give you a chance to tune-up for what's coming in a couple of months.

With that in mind it's time to remember that layering your clothing makes for a warmer you. Fancy-Dan vented activewear isn't all that warm when you're just standing around staring at the sky. Jeans are also null-and-void when it comes to winter warmth. Thick fleece track pants and sweaters with a wind-proof top layer are better body wrappers. We'll get into warm wear later. For now, let's see what's up this month.

Jupiter is the absolute king of the night sky. Aside from the Moon, it's the brightest celestial object up there. The gas giant was at opposition on October 29th so it will be well up in the November night sky as darkness falls. I've been watching Jupiter with my telescopes for the past couple of months. The dark brown belts are back and watching Jupiter's moons change positions from night to night as they orbit the planet is especially fascinating to me. It's particularly nifty to watch the shadow of one of the moons move across Jupiter's cloud tops as the moon transits the planet. You're watching an eclipse, but from the Sun's point of view.

The Seven Sisters—also known as the Pleiades—will also be rising in the east as the Sun sets. The ladies of the night are a terrific target for binoculars. In fact telescopes are usually too powerful to view them in their entirety. To the naked eye they appear as a misty patch in the

See "November Nights" on page 15

Photo: Phillip Chee

continued from first page

Auroras

with a really strong blast of particles from the Sun and we get a decent display even here or further south.

In a typical auroral display, the light is a mixture of many colors. There's actually a fair bit of blue, but the human eye does not see it very well. We see much better in the green part of the spectrum, and there is a strong yellowish-green component in the light of a typical aurora, so we often see greenish displays. Green auroras, and green auroras with a reddish lower border, occur at an altitude near 100 kilometers above the Earth.

Rare, all-red auroras occur much higher, at 300 to 500 kilometers above the Earth and are associated with a large amount of electrons. These electrons are moving too slowly to penetrate as deep into the atmosphere: they actually have less energy than the electrons that create more common auroras.

At this high altitude, the electrons lose their energy only to oxygen atoms. The process produces light as pure as that from a laser; there's no mixture of colours for us to see. Instead, light is produced in the 6300 and 6364 ångström units range of the spectrum, and we see red aurora.

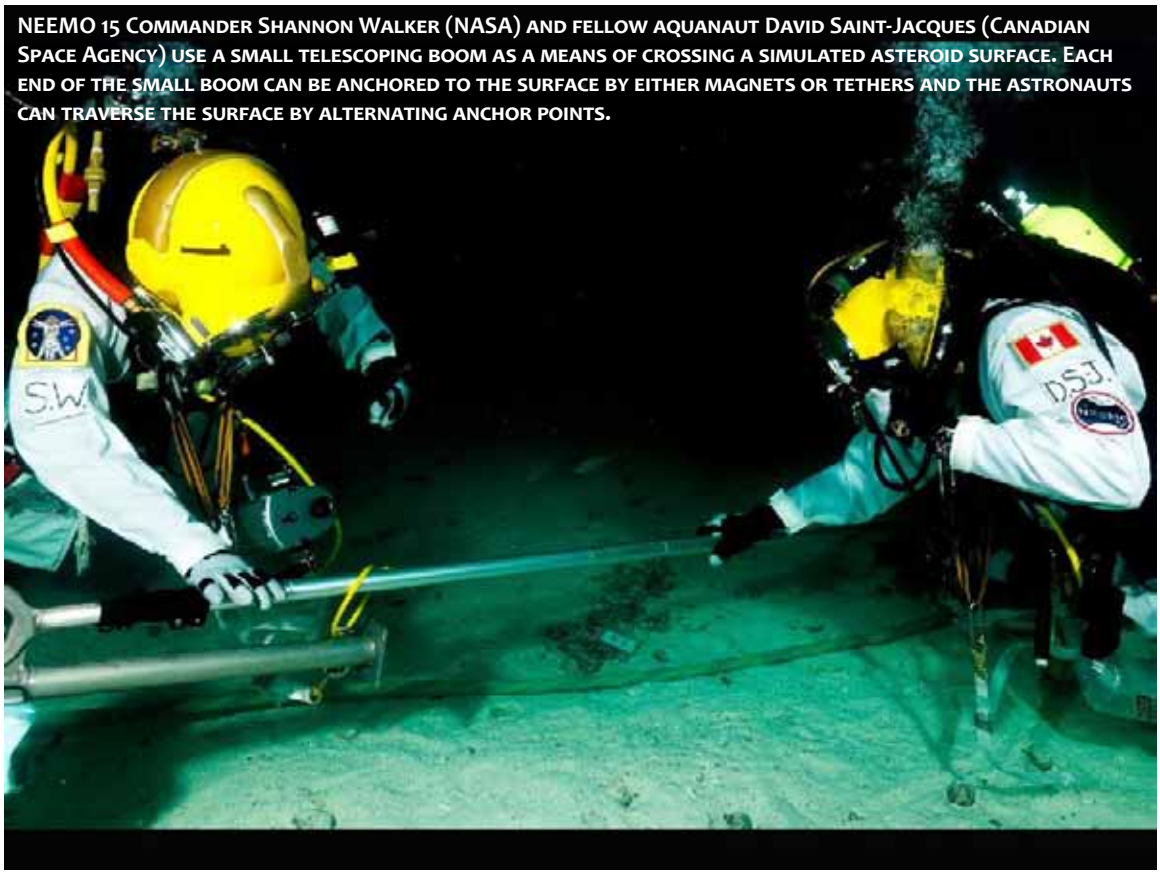
Scientists do not yet fully understand the cause of all red auroras. They know it is associated with intense solar activity and heating of the upper atmosphere from a large influx of low-energy electrons; they have not yet explained the mechanism producing this occurrence.

I was fortunate to have a neighbour that noticed the auroral display this evening and they gave me a call. I was out in a flash and set up my tripod and camera to take pictures for the next hour while the red glow and some greenish spikes moved around me. It was not an intense display that I saw, but my camera (Canon modified 50D) captured the display quite nicely and picked up the subtle colours that my eye could not even see. I used a Sigma 10-20mm lens and settings of ISO 800 and f/4.0 for 20 seconds. Except for the light pollution from the city of Peterborough to the north, I had a pretty good recording session right over my house as I faced west. It was a clear evening and Jupiter along with the stars were shining through which added to this dazzling display. Keep looking up!

Rare Ruby Red Auroral Recorder, Rick.

Photo: Rick Stankiewicz

Will Captain NEEMO Visit an Asteroid Soon?



NEEMO 15 Commander Shannon Walker (NASA) and fellow aquanaut David Saint-Jacques (Canadian Space Agency) use a small telescoping boom as a means of crossing a simulated asteroid surface. Each end of the small boom can be anchored to the surface by either magnets or tethers and the astronauts can traverse the surface by alternating anchor points.

John Crossen

Welcome to an exciting new acronym — NEEMO. With a little stretch of the imagination, and apologies to Jules Vern, NEEMO stands for NASA Extreme Environment Mission Operations.

NASA is constantly on the search for environments that replicate the hostile surroundings astronauts will encounter in space. Their latest efforts have given birth to a new breed — the aquanaut. The aquanaut's missions aren't the testosterone-inflated stuff of a Hollywood Navy Seals action flick. Instead the missions are designed to test equipment and ideas that may or may not work on a mission to an asteroid or elsewhere in space. In fact, outer space and "water world" have a great deal in common.

In a previous article I explored the use of mini-submarines designed to operate in the crushing depth of the ocean. Yet they are perfect laboratories for learning to live in confined surroundings and for developing the manoeuvring skills necessary for piloting a small craft in an alien environment. They are also ideal for seeing first hand extremophile life forms that lurk in an alien world — right here on Earth.

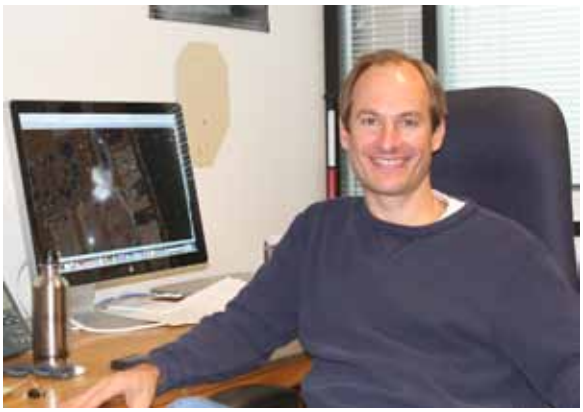
Imagine fish that can withstand thousands of pounds of pressure or tube worms that surround and thrive near scalding hot deep sea vents. If they can exist here, why not elsewhere in the solar system?

We have life forms that are as weird and wonderful as any that the astronauts

See "Finding NEEMO" on page 15

You Never Know Where Curiosity Will Take You

John Crossen



When he was eight Dave Patton was curious about everything, especially astronomy. So Dave's parents bought him a telescope at Radio Shack. At the time they would never have guessed what that telescope and Dave's curiosity would lead to.

Throughout high school and into university Dave continued his curious ways. Ultimately his "need to know" led to a degree in Applied Mathematics from the University of Waterloo. But a curious mind needs constant feeding. So a few years later Dr. David Patton graduated from the University of Victoria with his PhD in Astronomy.

Today Dave, as he prefers to be called, is an associate professor at Trent University where he teaches astronomy, astrobiology and physics. But his curiosity hasn't ended. He and a group of colleagues are researching colliding galaxies. His previous work just earned him a $140,000 grant from the Natural Sciences and Engineering Research Council (NSERC). The grant is spread out over the next five years. This leg of the journey is The Role of Galaxy-Galaxy Interaction in Galaxy Evolution.

Before we get fancy, let's understand what a galaxy is. It's easy to confuse the terms universe and galaxy. The universe is the really big fella. It's as big as big gets and it's still expanding. Within the universe are billions of galaxies. And within each galaxy are billions of stars, countless solar systems, as well as lots of dust and gas.

In a universe that's 13.7 billion years old, the gravity that holds galaxies together has also been tangling them up for the last 10 billion or so years. Those entanglements are one of the ways galaxies, like our Milky Way, grow bigger. And as Dr. Patton and his colleagues have discovered, galaxy interactions are also one of the primary mechanisms that can turn a galaxy's black hole from inactive to active.

The popular concept of a black hole is that it is like a shark forever feeding. But some small galaxies may have no detectable black hole at their centre. Or if they do it may be quiescent, just licking up a snippet of star stuff now and then. Conversely, in a large galaxy with a massive central bulge, the bulge most likely is home to a black hole.

When the merger of two massive galaxies is imminent the ensuing gravitational perturbations can stir the appetites of both black holes. The black holes of one or both galaxies are now active and draw in the nearby gas, dust and star stuff to the point that the material whirling around the event horizon heats up to produce energy in the form of X-rays. It's called an accretion disk and can be viewed by the Chandra X-ray Observatory from Earth orbit.

Galactic mergers can also promote star formation. Infalling gas and dust near the galaxy's core is compressed by gravity and thereby creates new stars. Dr. Patton and his colleagues have found evidence of both effects.

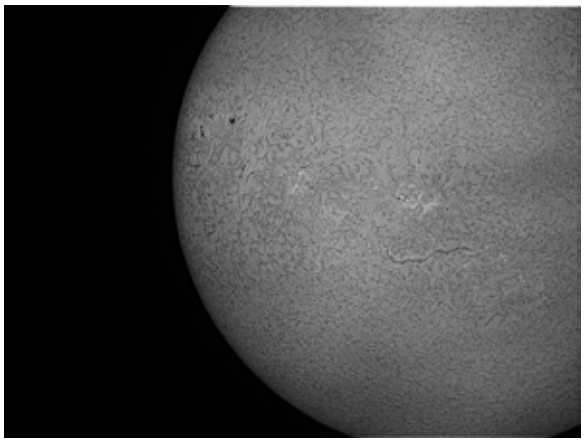
See "Galactic Mergers" on page 14

Shooting Stars of the Kawarthas

John Crossen

They're called Astro-imagers. They shoot digitally, either with a Digital Single Lens Reflex camera — DSLR — or a specially designed Charged Coupling Device known as a CCD camera. But whatever the camera used, they capture remarkable celestial images.

Brian Colville specializes in solar and planetary imaging. He lives in Cambray, Ontario near, but not too close to the light polluted sky of Lindsay. Shown below is an image of the Sun taken during some intense solar activity. That evening, as a result of the charged particles blasted towards Earth, we were treated to one of the best aural displays in years. Naturally it was raining at Buckhorn Observatory.

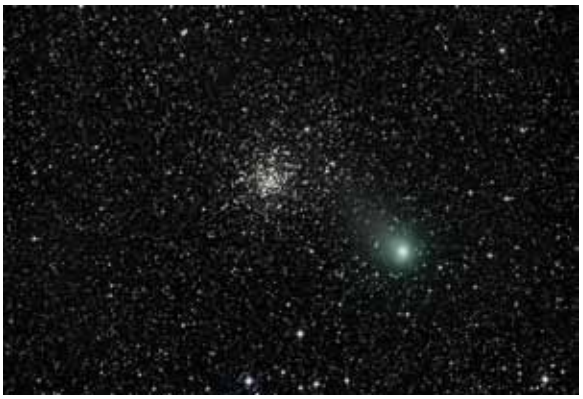


Brian Colville's solar image.

Rick Stankiewicz is a different kind of shooter. Rick's specialty is atmospheric phenomena. Moon dogs and Sun dogs may be most familiar to you. Rick has imaged a number of other atmospheric oddities. Shown here is a Sun Pillar. These are usually seen at sunrise or sunset and are caused by ice crystals high in the atmosphere which reflect the sunlight and make it appear to be a glowing tower. Rick is President of the Peterborough Astronomical Association and lives in Keene, Ontario.

Rick Stankiewicz's sun pillar.

Brian McGaffney is also a member of the Peterborough Astronomical Association. He likes to concentrate on deep sky objects like galaxies, star clusters and nebulae. From his observatory near Apsley, Ontario Brian collects his imaging data via a CCD. Doing so can take hours, and then there is more time to be spent processing the image to "tickle" out faint details and balance the colours. Shown here is his Comet C2009/P1 gliding past star cluster M71 in Sagitta the Arrow.



Brian McGaffney's Comet C2009/P1 and M71

The work of these gentlemen rivals that of professionals in the big observatories from just a few years ago. Today technical developments have made it possible for mere mortals to capture images that would have been impossible ten years ago. That's not to say it doesn't take a lot of talent and patience, but it can be done by folks like you and I.

PHOTO GALLERY

M13

Brian McGaffney imaged the M31 cluster from Nutwood Observatory using his 14-inch Astrograph. Exposure data took approximately 6 hours. Processing was done with MaxIm DL and Photoshop CS5 Extended. Post-processing took about 16 hours.

Eye In The Sky

I was not originally thinking of an Alan Parsons Project song from 1982 when I looked into the night sky on October 11th, but that is what it reminded me of, as the near full Moon was visible through a high, thin cirrus cloud cover. These clouds were enough to dim the Moon, but not obscure the detail on its marked lunar face. The moisture within the clouds, however, was enough to form a hazy coloured "ring" around the lunar disk. This was not the typical "lunar halo" of about 44-degrees that I am used to seeing, but rather a much smaller approximately 22-degree halo or ring, called a lunar corona.

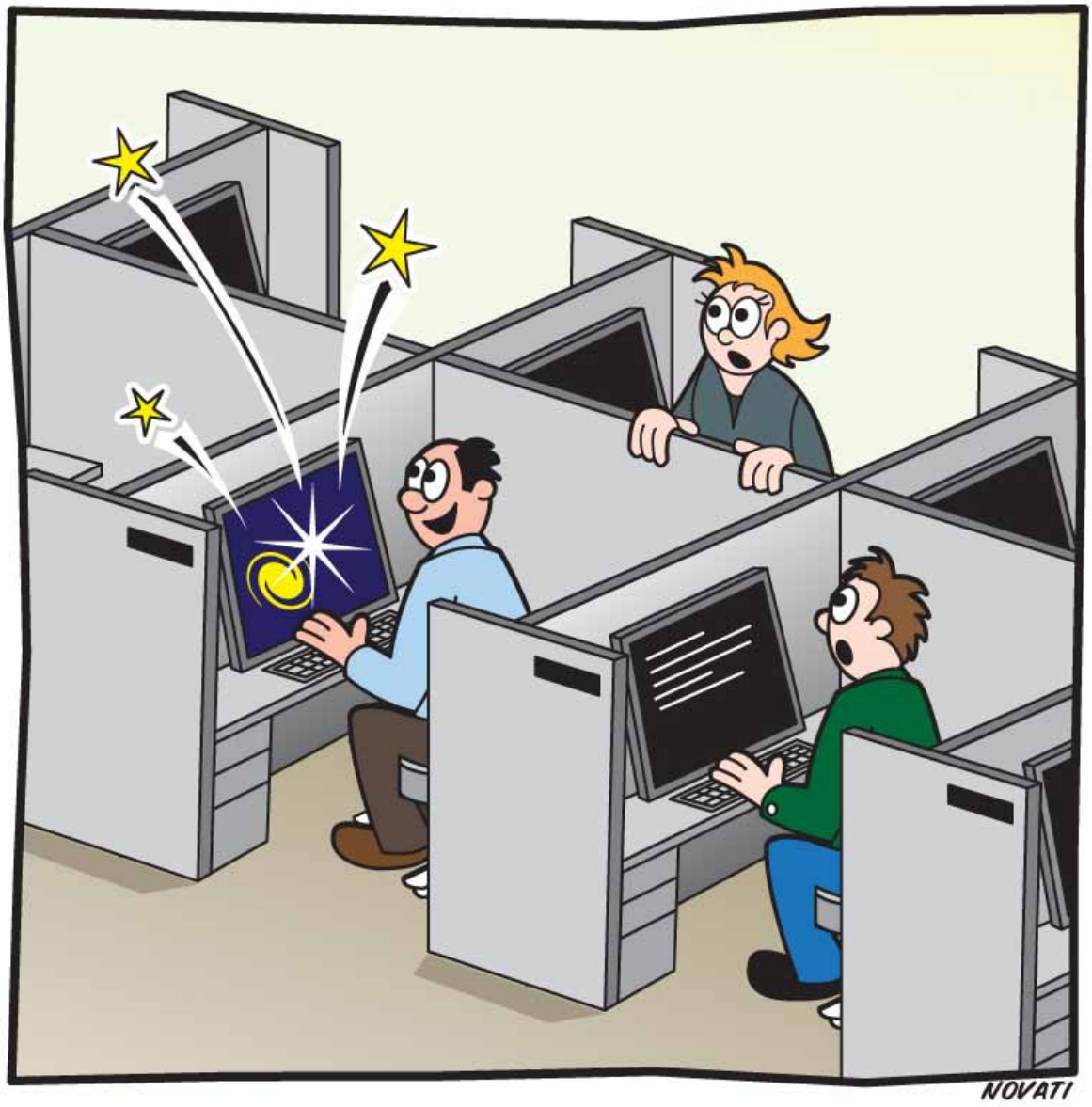
It was like looking into a giant "eye in the sky" (Alan Parsons Project reference—http://en.wikipedia.org/wiki/Eye_in_the_Sky_(song)). The clouds within the corona added a textured look, similar to the iris of an eye. The pupil was the Moon and it was all very mesmerizing, to say the least.

To capture the corona a tripod mounted camera was set to f/4.0 and 1/6 of a second was required (this greatly over exposed the Moon though). The proper exposure to capture the lunar disk with detail was f/4.0 and 1/640 of a second (but then the corona was not evident). Both images were taken at 200 ISO and a lens setting of 100mm. Editor, Phil Chee, helped merge these images to try and show what the scene really looked like on this particular night. It shows that even a light cloud cover can still make a trip outside worth your while. You just never know what you might "see"!

Spellbound Observer,

Rick Stankiewicz

The Gray Cubicle You Want to Work In



Some of the employees of NASA's Science Mission Directorate may work in gray cubicles, but their jobs are anything but dull. They get to study Earth, the Sun, the Solar System, and the Universe!

by Dr. Tony Phillips

It's another day at the office.

You're sitting in a gray cubicle, tap-tap-taping away on your keyboard, when suddenly your neighbor lets out a whoop of delight.

Over the top of the carpeted divider you see a star exploding on the computer screen. An unauthorized video game? No, this explosion is real. A massive star just went supernova in the Whirlpool Galaxy, and the first images from Hubble are popping up on your office-mate's screen.

It's another day at the office ... at NASA.

Just down the hall, another office-mate is analyzing global temperature trends. On the floor below, a team of engineers gathers to decode signals from a spaceship that entered "safe mode" when it was hit by a solar flare. And three floors above, a financial analyst snaps her pencil-tip as she tries to figure out how to afford just one more sensor for a new robotic spacecraft.

See "Cubicle" on page 16

Just When I Thought NASA is a Lost Cause ... Surprise!

John Crossen

I freely admit that my attitude towards NASA has been shaken if not disturbed. First, the commitment to return to the Moon was cancelled. It's been over 40 years we last did the Moon walk. Today you have more computing power in your cell phone, but Huston, we don't have lift off. That's ridiculous. The trip certainly isn't beyond our capabilities. We should have a Moon base there and be colonizing dear old Luna along with the Russians, Chinese, Japanese, Europeans and a host of other countries.

Next on my list of disappointments was the cancellation of the James Webb Space Telescope. It was to have been the next big step after Hubble and promised to take us to the very brink of our universe and back to the first star formations. It would have been the closest to the "big bang" we may ever get visually.

Unfortunately none of the above happened. But some programs are still alive and launching. Most recently was the Juno Mission to study the cloud layers of our solar system's largest planet. Juno took its name from the goddess who could see through clouds and that's just what the job is.

Jupiter may be 1000 times larger than planet Earth, but it is mostly composed of weather in the form of thick layers of clouds. Juno's task is to tell us not just what lurks beneath the clouds, but why. What is causing the "weather" on and in Jupiter?

NASA's Messenger Mission orbiting Mercury is already sending back reams of data on the little Sun-hugger. *Messenger* lifted off the launch pad before the austerity program began, but it still requires — and has — on-going funding.

Yet another success for us space exploration fans is the Grail Mission which will take a close up look at the Moon's magnetic make up and — via remote sensing – dig down to the core of our celestial dance partner. Startling new evidence reveals that the Moon may not be geologically dead. Grail may be able to shed some light on what may be gasses leaking from beneath the lunar surface.

Happily NASA doesn't have to shoulder the entire load for space exploration. ESA, the European Space Agency has a number of projects on the go, including the current mission to Venus.

The Japanese Aerospace Exploration Agency JAXA has a very ambitious program and have landed on and returned a mission from an asteroid. And, while the Chinese may be late starters, they

See "NASA" on page 15

Seeing Is Believing
Perigee to Apogee

Rick Stankiewicz

With the largest and smallest Full Moons of 2011 out of the way, it might be worth "reflecting" on what happened from March 18th to October 11th this year.

In March, the Full Moon was closest to Earth (perigee) than it would get in its elliptical orbit. This resulted in the largest Moon of the year. This was balanced with the smallest Moon in October, when it was the furthest from Earth in its orbit (apogee). This is not just theoretically true; it actually happens. You can see for yourself, by comparing the two images of the Moon taken seven months apart. Both these images were taken with the same tripod mounted camera and lens combination (Canon 400D with Sigma 70-300mm). The camera settings were the same too (ISO 200; f/5.6; 1/500 second).

The main differences between the two images of the "Super Moon" versus the "Mini Moon", are an approximately 13% size difference and 30% brightness variation, all in favour of the perigee moon of March. How can this be? Remember that the orbit of the Moon is elliptical and with a variation of about 50,000 km, there should be a difference.

The only other difference between the two images you have to compare here is that the apogee moon was taken when there was a very little high cirrus cloud haze, which would have dulled the brightness ever so slightly. Otherwise, the pictures speak for themselves and we all know that a picture is worth a thousand words, but it helps to have the background in order to know what you are looking at and how to interpret it.

Having said all this, from my perspective all Full Moons look big and the size change is so subtle from month to month that you can't see the incremental differences over a seven month period. This is why I decided to try this photographic test myself and share it with you because seeing is believing!

Perigee Moon of March 2011

Apogee Moon of October 2011

For Sale

Minolta Binoculars

7x50mm with bino mount $75

8-inch Newtonian Reflector

- Dobsonian mount with rocker box
- Focal length 1,638mm (64.5") f/8
- Tube length 65"
- Telrad Finder
- Dew Shield

Eye Pieces

- 32mm low power TeleVue Plossl
- 11mm high power TeleVue Plossl
- Meade 2x4000 Barlow
- Sky Instrument 2" rack-and-pinion focusser
- Moon Filter

Accessories

- Tube End dust covers
- Full length Dust Shroud

Aluminium Case for Accessories

- 2 Red Lights
- 1 Headband Light with 3 settings
- CD Photos documenting construction of the telescope

Contact Rene Bowe, 705-742-9113

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Galactic Mergers

There is much more to discover about merging galaxies and how mergers affect galactic formation. Dr. Patton, along with key colleagues Dr. Sara Ellison, Dr. Trevor Mendel and Dr. Luc Simard have completed the groundwork for doing so.

Meanwhile there's this Radio Shack telescope that Dave still has. His six-year-old son and four-year-old daughter are just starting to view the Moon through it. Dave, quite naturally, is curious to know where it might lead them.

Zodiacal Mnemonics

Recently I wanted to learn the signs of the zodiac or more accurately, I wanted to learn the zodiacal constellations in their proper order to aid me in becoming even more familiar with the night sky. With 88 modern day constellations to learn (No, I don't know them all), I figured that knocking off 12 obvious ones would be a good start. So starting with Aries (The Ram) due south about 10:00 p.m. around November 25th, the rest of the zodiac will take their turns at prominence in the southern sky throughout the year as they proceed from east to west. Next to follow are Taurus, then Gemini, Cancer, Leo, Virgo, Libra, Scorpius, Sagittarius, Capricornus, Aquarius, and finally Pisces.

Well no better way to start then with the use of a mnemonic rhyme. I found a couple to work with. Maybe one of them will work for you, if you are so inclined?

1. "**A**ll **T**he **G**reat **C**onstellations **L**ive **V**ery **L**ong, **S**ince **S**tars **C**an't **A**lter **P**hysics"
1. "**A**s **T**he **G**reat **C**ook **L**ikes **V**ery **L**ittle **S**alt, **S**he **C**ompensates **A**dding **P**epper"

Have fun and don't be shy, to learn the night sky, there is much to discover, and so little time, so try a rhyme!

Rick Stankiewicz

(He's a poet and didn't know it, but his ears are Longfellow's!)

The Sky this Month

Mercury in western evening sky and remains 2° from Venus during first half of the month. Lies between Venus and Antares on the 9th and 10th. Greatest elongation east (23° on the 14th.) Vanishes into evening twilight towards the end of the month.

Venus is low in the southwest evening twilight sky. From the 8th to 11th is 5° degrees from Antares. Moon passes 3° north on the 27th.

Mars in eastern morning sky in Leo. Passes 1.4°N of Regulus on the 10th.

Jupiter visible most of the night just past opposition and retrograding near the Aries-Cetus-Pisces border. Sets near dawn.

Saturn low in pre-dawn sky in Virgo.

S. Taurid Meteors peak at 7:00 PM on the 5th.

N. Taurid Meteors peak at 5:00 PM on the 12th.

Leonid Meteors peak at midnight on the 18th.

Moon Phases

First Quarter	11:38 AM	November 2
Full Moon	3:16 PM	November 10
Last Quarter	10:09 AM	November 18
New Moon	1:10 AM	November 25

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November Nights

eastern sky about the size of your thumb. In binoculars they turn into a pin-point sharp cluster of bright stars shaped like a little dipper or a question mark.

Another good target for the bingo-brigade is the large open cluster known as the Hyades. Like the Pleiades, it too is in the constellation Taurus. But unlike the Pleiades the Hyades is a very coarse open cluster that fills your binocular's field of view. Notice, too the different colours of the stars that make up the Hyades.

Insomniacs can welcome the arrival of Orion the Hunter late at night. Of particular interest to binocular observers is the Orion Nebula which is the bright patch below the three stars that make up Orion's belt. The nebula is a major star birthing area. It is the radiating energy from the new-born stars that illuminates the huge cloud of hydrogen gas. How huge is huge? It would take the fastest rocket we have today about one million years to travel from one side of the nebula to the other. So don't forget your toothbrush.

Naked-eye stargazers have the new constellations Auriga, Taurus and Orion to take in. Autumn's cast of characters such as Cassiopeia, Cepheus, Perseus, Andromeda and Pegasus are overhead now. The Big Dipper is starting to crawl up the sky and by winter it will be standing on its handle.

So get out under the stars. There's a lot to watch—uninterrupted by commercials.

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NASA

have already put a man into space and are reaching higher in the form of their own space station.

Perhaps it's time for a little shared technology. Gazing at Earth from space a number of Cosmonauts and Astronauts have commented that you don't see borders and countries. You see one Earth and one race—the human race. NASA, JAXA and ESA are already working together. China is already a dominant manufacturing and financial power. This would be a good time to bury old grudges and look to the future of mankind.

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Finding NEEMO

may encounter. Perhaps beneath the icy surface of Jupiter's moon Europa or on Saturn's geyser-spewing moon, Enceladus. Even Mars is now suspected of having running water near its surface and we know it has lots of water ice.

Here on Earth, the astronauts—or should I say aquanauts—practice working underwater because it is as close as they can come to working in the micro gravity on a mission to the International Space Station. The only difference between neutral buoyancy and outer space is that there's no water resistance in space.

Of current interest to NASA are asteroids. Not the kind that could result in a life-eradicating global impact. Instead they are interested in asteroids as future mining camps and fuel stops. The reasons are simple.

Many asteroids may harbour water in the form of ice. The hydrogen in that water can be converted into rocket fuel—are you listening Mr. Exxon? And when it comes to minerals, the sky's the limit because everything in the universe is made of common elements. So why not tap into an asteroid that's rich in an element that's rare on Earth. The computer industry is always looking for rare-earth elements. And with computing capabilities doubling every 18 months...well you get the idea.

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Cubicle

These are just a few of the things going on every day at NASA headquarters in Washington, DC and more than a dozen other NASA centers scattered around the country. The variety of NASA research and, moreover, the variety of NASA people required to carry it out often comes as a surprise. Consider the following: NASA's Science Mission Directorate (SMD) supports research in four main areas: Earth Science, Heliophysics, Astrophysics, and Planetary Science. Read that list one more time. It includes everything in the cosmos from the ground beneath our feet to the Sun in the sky to the most distant galaxies at the edge of the Universe.

Walking among the cubicles in NASA's science offices, you are likely to meet people working on climate change, extraterrestrial life, Earth-threatening asteroids, black holes or a hundred other things guaranteed to give a curious-minded person goose bumps. Truly, no other government agency has a bigger job description.

And it's not just scientists doing the work. NASA needs engineers to design its observatories and build its spacecraft, mathematicians to analyze orbits and decipher signals, and financial wizards to manage the accounts and figure out how to pay for everything NASA dreamers want to do. Even writers and artists have a place in the NASA scheme of things. Someone has to explain it all to the general public.

Clearly, some cubicles are more interesting than others. For more information about the Science Mission Directorate, visit science.nasa.gov. And for another way to reach the Space Place, go to http://science.nasa.gov/kids.

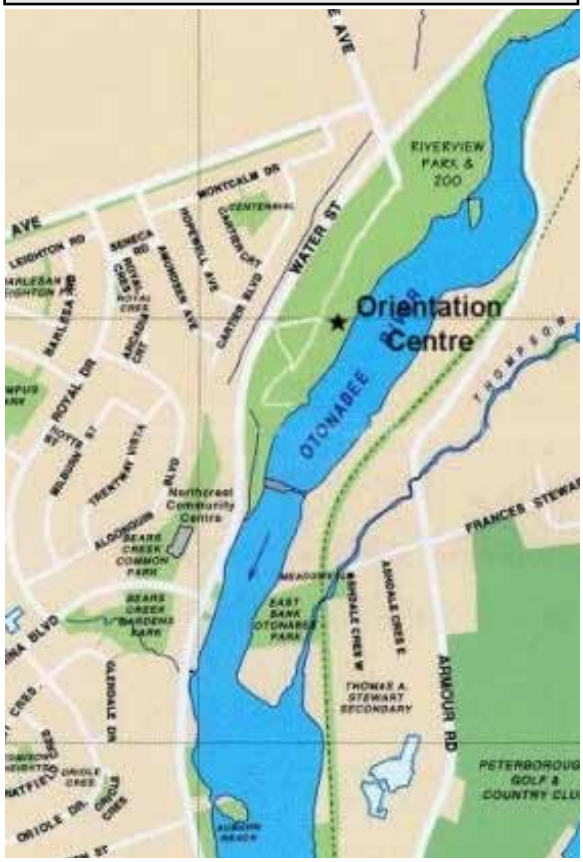
This article was provided courtesy of the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.

Articles

Submissions for *The Reflector* must be received by the date listed below. E-mail submissions are preferred (Microsoft Word, OpenDoc, ASCII and most common graphic formats are acceptable). If your article contains photso or graphics, please provide a separate file for each. 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:

phillip.chee@gmail.com

NEXT SUBMISSION DEADLINE:
NOVEMBER 25, 2011



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 p.m. P.A.A. executive business will be conducted starting at 7:30 P.M. Members and the public are welcome to attend the earlier time.