

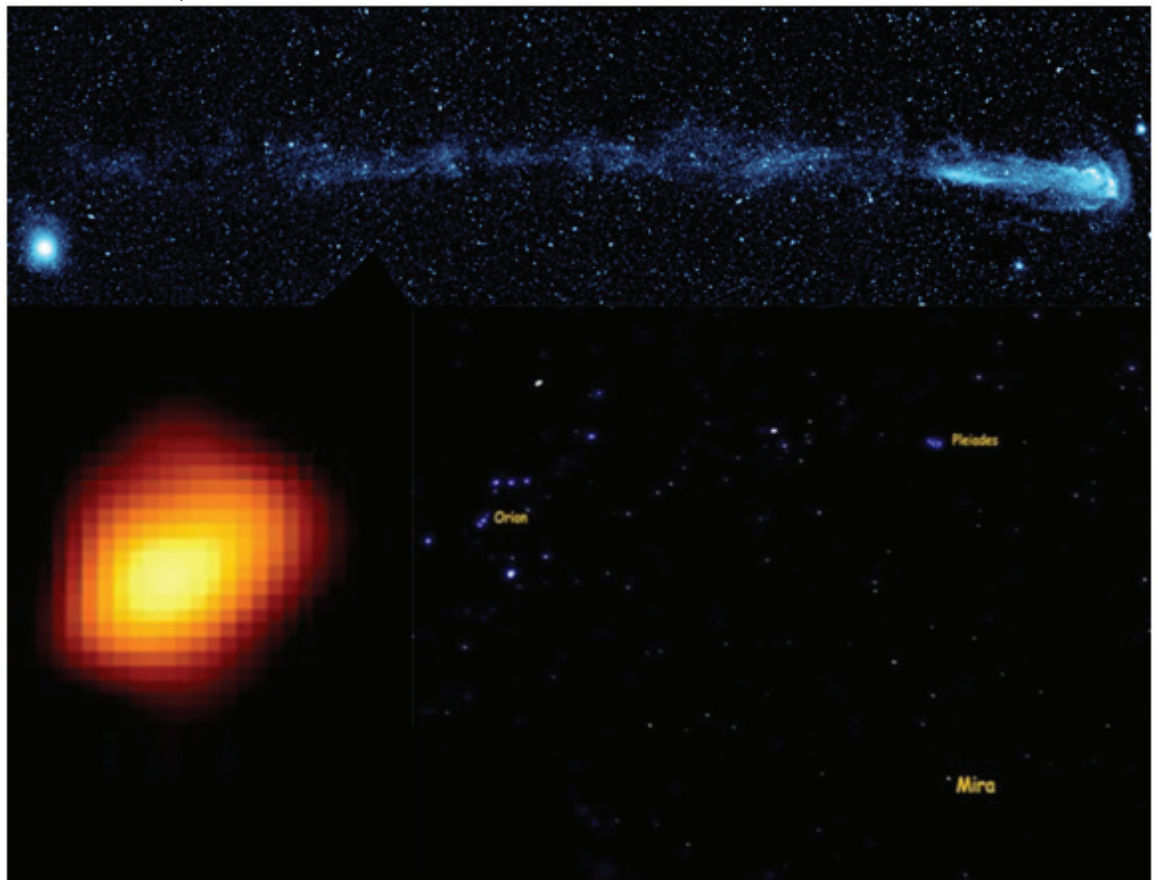
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The Reflector

Newsletter of the Peterborough Astronomical Association

Twinkle, Twinkle Variable Star

Images credit: NASA's Galaxy Evolution Explorer (GALEX) spacecraft, of Mira and its tail in UV light (top); Margarita Karovska (Harvard-Smithsonian CfA) / NASA's Hubble Space Telescope image of Mira, with the distortions revealing the presence of a binary companion (lower left); public domain image of Orion, the Pleiades and Mira (near maximum brightness) by Brocken Inaglory of Wikimedia Commons under CC-BY-SA-3.0 (lower right).



DR. ETHAN SIEGEL

AS BRIGHT AND STEADY as they appear, the stars in our sky won't shine forever. The steady brilliance of these sources of light is powered by a tumultuous interior, where nuclear processes fuse light elements and isotopes into heavier ones. Because the heavier nuclei up to iron (Fe), have a greater binding energies-per-nucleon, each reaction results in a slight reduction of the star's mass, converting it into energy via Einstein's famous equation relating changes in mass and energy

output, $E = mc^2$. Over timescales of tens of thousands of years, that energy migrates to the star's photosphere, where it's emitted out into the universe as starlight.

There's only a finite amount of fuel in there, and when stars run out, the interior contracts and heats up, often enabling heavier elements to burn at even higher temperatures, and causing sun-like stars to grow into red giants. Even though the cores of both hydrogen-burning and helium-burning stars have consistent,

steady energy outputs, our sun's overall brightness varies by just ~0.1%, while red giants can have their brightness's vary by factors of thousands or more over the course of a single year! In fact, the first periodic or pulsating variable star ever discovered—Mira (*omicron Ceti*)—behaves exactly in this way.

There are many types of variable stars, including Cepheids, RR Lyrae, cataclysmic variables and more, but it's the Mira-type variables that give us a glimpse

see "Mira" on page 16

President's Message

We Win a Few Against Mother Nature

August and September offered a few observing opportunities that worked out very well with great skies. On August 23rd we were at Emily Park with a good turnout by members with telescopes and binoculars. We were clouded in until about 9:30 p.m. then the sky cleared and we had marvellous viewing. On September 19th we were at the Crebar Observatory and once again enjoyed a good night of viewing. Finally on September 26th we went to the Peterborough Museum and Archives for an evening with the Canadian Family Health Collective's "Free Family Fun Event." Here with five telescopes set up and two

sets of binoculars we had line-ups at every station as the crowd exceeded 250 people. Check out the article by Rick Stankiewicz in this issue.

Once again I put the call out for someone to act as "Election Chair" for the December meeting. There are some executive positions to be swapped out and your help is needed.

Rodger Forsyth
PAA President

Letter from the Editor

A Loony Month

Total eclipses are rare but common events. We're more lucky seeing total lunar eclipses than solar eclipses so it should be no surprise another lunar one is upon us this month. Get up at dawn on October 8th to witness this latest one. Totality begins at 6:25 a.m. and reaches full totality at 6:54. But the moon will be low in the western horizon as it is due to set at 7:29 a.m.

John Crossen and Rick Stankiewicz provide most of our content this month, ranging from observing session reports to articles about the the Sun, Moon, astrology and Chris Hadfield. We have a couple of wonder images from Rick Stankiewicz and Brian McGaffney in the Gallery and an image from our friend John Chumak in Ohio.

In addition to the total lunar eclipse there's a partial on the 23rd that we can't

see but there are the Draconid and Orionid Meteor showers. Those these aren't strong by Perseid standards, at least the Orionids on the 21st are favorable as it comes a few days before the New Moon.

Enjoy and see you back here next month, just a lunar cycle away.

Phillip Chee
Editor, The Reflector



The Reflector

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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Family “Wishes” Event

This is the view of the pavilion during the Family Wish Event on Armour Hill, September 26th, 2014. Note Mars and Antares to the upper right of the pavilion shortly after sunset. Photo by Rick Stankiewicz.



WHAT A NIGHT WE had on Friday, September 26th, with the Peterborough Family Health Collective. The event was the first ever (hopefully annual) free family fun event outside at the Peterborough Museum and Archives pavilion and hill. What started as an unknown event with the PAA being asked to partner with the Peterborough Family Health Collective to offer local families a free opportunity to spend a few hours outside under the stars, proved to be

a resounding success. The event ran from 7:00 to 9:00 p.m. and everything cooperated including the weather. It was a perfectly clear, cloudless evening with no wind or moisture and minimal bugs. Setting up our telescopes and binoculars on the grassy knoll up from the pavilion on Armour Hill proved an ideal location.

The evening started for us with the PAA members gathering to set up and preparing for the throngs that would eventually

See “Family Wishes” on page 15

Hadfield: International Cooperation Key to Space Exploration



CHRIS HADFIELD. Former astronaut Chris Hadfield thinks it's time to bring the Chinese into club of space exploring nations. He is excited about going to Mars, an asteroid and perhaps back to the Moon and he thinks it will happen faster if all the nations work together to achieved these goals. Photo by CTV News.

JOHN CROSSEN

EXPLORING OUR SOLAR SYSTEM and beyond is one very big dream. To make it a reality is going to take more than any single nation can handle. The research, manufacturing and funding are mind-boggling. The answer is shared responsibility—a big job divided into smaller, more doable segments.

It was that kind of cooperative thinking that made the International Space Station (ISS) a reality. In all 15 nations have contributed to the ISS. Thanks to that, the ISS has grown in size and capabilities as a unique research facility where even the staff are part of an overall study into human adaptation to micro gravity.

But there is one nation that is noticeably absent from the “space club”. It is a nation which has launched humans into space, built its own space station, landed a rover on the Moon and this September was host to the International Planetary Congress (IPC). But despite these achievements it

is still going it alone with a very ambitious space program.

That nation is China and the prime opposition to partnering with the world's largest nation comes down to a simple matter of trust. The United States and China have immense political differences. But wasn't that the same 20 years ago when Russia and the U.S. began a cautious partnership involving the ISS? I don't want to sound like some dewy-eyed peacenik from 1967, but trust is something you have to earn and learn.

So why not start with cooperative projects that are small and non-arms related? There is already a Chinese technical team working on the laser system for the Thirty-Metre-Telescope (TMT) being built in Hawaii. Plus there's a Canadian who is coordinating the work numerous other countries are contributing to this mammoth project. Again, when you dream big you have to include the whole world.

See “Hadfield” on page 13

September 19 Club Observing Session Report



OBSERVING SESSION ATTENDEES. From the look on these faces, you can tell PAA members know how to have a good time. Pictured here (L to R) are John Cameron, Jean Crebar, Rodger Forsyth, Pat Crebar, Boyd Wood, Sean Dunne, Mike McCarthy and Rick Stankiewicz (Colin Cross missing).

RICK STANKIEWICZ

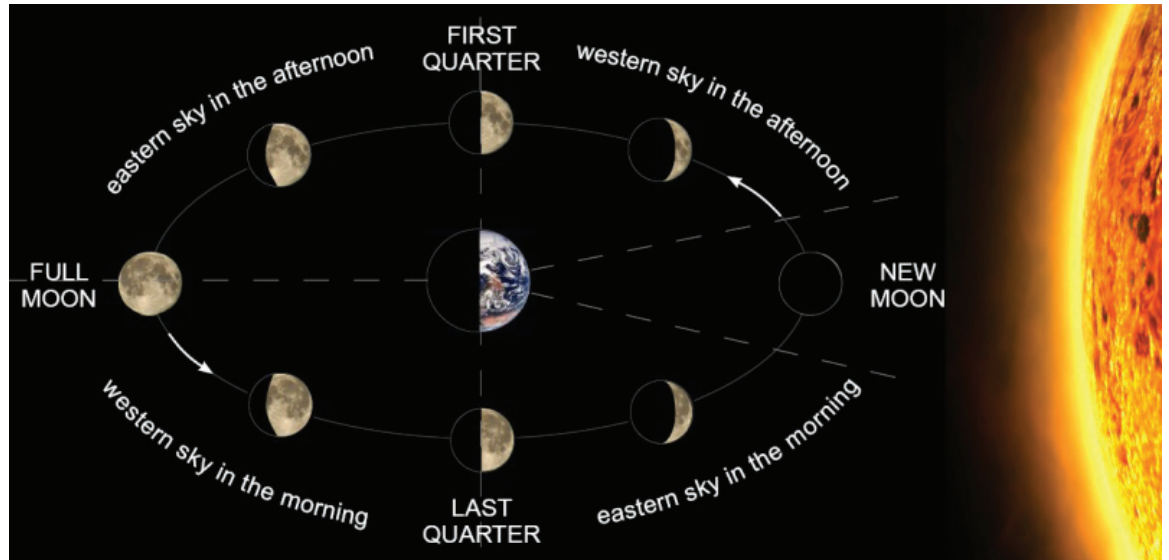
THE MOST RECENT CLUB observing session was hosted by Jean and Pat Crebar in the Keene area just south east of Peterborough on Friday, September 19th. Nine members were in attendance and over the first couple hours of the evening there was a chance to do only a bit of observing as some clouds did start to mess up the viewing, but this group was not to be deterred from having a good time.

The Crebar's were ready with a Plan "B" and so everyone was welcomed into a warm and cozy kitchen and served coffee and homemade cake. Then came the real social side of the hobby and the stories started to roll. It is always a nice feeling to be in good

company and this bunch of club members are no exception. Just about everyone left by 10:45 p.m.

I had arrived a little late so when I went outside to leave I could see that the clouds were drifting away so Jean, Pat and I decided to fire up the big C-14 putting the Crebar Observatory's telescope through its paces looking for some NGC galaxies and star clusters to add to our lists. By 12:30 a.m. it was late enough for all of us as a thin layer of cirrus clouds headed our way to force us to close the roof for the second time this evening. A good time was had by all, but how could you not with hospitality and friends like this.

The Moon is an Amazing Celestial Dance Partner



MOON PHASES. This chart shows why the Moon appears to change shape and why we can sometimes see dear old Luna during the daytime.

JOHN CROSSEN

JOIN ME IN MY time machine as we whistle back about 4 billion years. Our Sun had just formed and the left over material from the giant nebular cloud that gave birth to the Sun has now begun coalescing into planets.

During this period in our solar system's formation there were up to 20 planets whizzing about our newly-formed Sun. A part of their growing process was to collect debris in their orbital paths. Sometimes that debris took the form of other planets.

The then-molten Earth sustained one of those impacts. It was a glancing blow that blasted material from Earth and the impacting body into space, but not out of Earth's gravitational pull.

As the molten Earth collapsed into the gap it made by the collision, the material orbiting Earth pulled itself into a ball that we call the Moon. Now let's scat back to 2014.

When it comes to moons, size matters. In Earth's case, it matters a lot. Our home planet spins at about 1,600km/h. And like a spinning top, it is prone to wobble. Thank-

fully the gravitational tug of the Moon keeps Earth from staggering like Uncle Bob on his waddle home from the Dixie Pixie.

Minus the Moon, Earth would swing so wildly the weather would be a cacophony of storms. We'd shift from arctic cold to desert hot. Oceans would be rife with tsunami and to put it simply, there wouldn't be the stability needed for life forms to take hold.

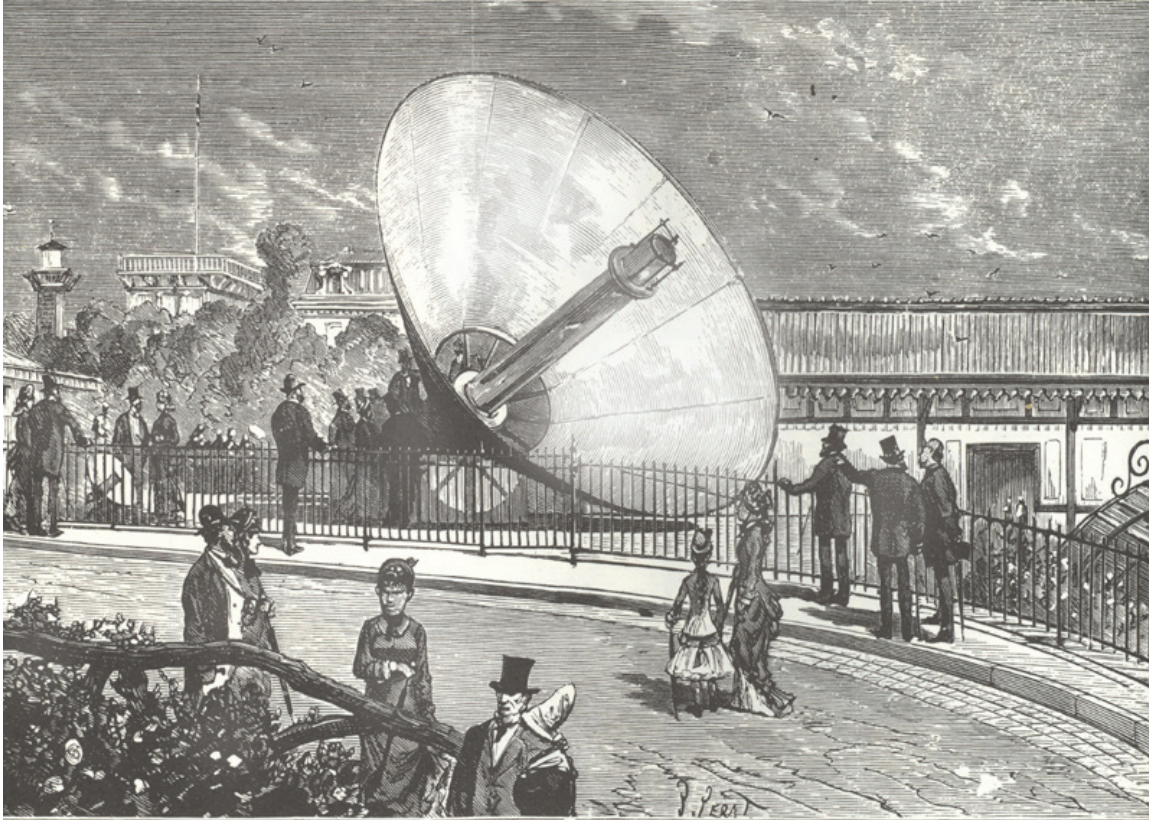
But thanks to the Moon being about one quarter the size of Earth, it helps us maintain a constant 23.5 degree tilt as we spin from day to night.

So how come we don't see the Moon every night and why does it change shapes from one night to the next?

The Moon orbits Earth once every 29.5 days. That's the time it takes to go from the New Moon phase back to New Moon again. In New Moon phase the Moon is lined up with the Sun shining on its backside. As a result we see no Moon on that night. The alignment for this phase is Sun – Moon – Earth. But as the Moon contin-

See "Moon" on page 13

Shedding a Little Light on Our Sun



AGUSTINE MOUCHOT'S SOLAR ENERGY CONVERTER. French inventor Augustine Mouchot displayed the first solar mirror that converted the Sun's energy into electric power. The year was 1878. Unfortunately we still can't get over our dependence on fossil fuels, no matter what the cost to our environment.

JOHN CROSSEN

WE'VE HAD SO MANY cloudy days this summer let's start with something we've seen far too little of—the Sun.

At the Sun's core the temperature is about 15 million degrees Celsius. In this hellish domain the atoms are so tightly packed that hydrogen atoms are fused into helium atoms. It's called the thermonuclear process and it's the same as that which takes place when a hydrogen bomb explodes. If that doesn't blow your mind, let's try this on for size.

A by-product of this fusion is energy which travels through the Sun's radiative layer at 300,000 km/s—the speed of light. However those little photons of light don't travel as the crow flies. Instead they bounce

around like a Hollywood starlet at a cocktail party. As a result it takes about 170,000 years plus 8 minutes and 19 seconds for them to reach Earth. That means the warm glow of sunlight on your face this morning originated about 60,000 years before the last ice age began. How cool is that!

Difficult though it may be to believe that something as bright as our Sun could harbour a dark heart, but its core is pitch black. Almost all of the posters and cut-a-way illustrations you see of the Sun show a bright, glowing core. But in truth the atoms are so tightly packed that it is as black as coal.

Sometimes a name can be misleading. For instance the Sun is classically referred to as a yellow dwarf. But that just doesn't

See "The Sun" on page 12

Crescent Nebula



The Crescent Nebula (also known as NGC 6888, Caldwell 27, Sharpless 105) is an emission nebula in the constellation Cygnus, about 5,000 light years away. It was discovered by Friedrich Wilhelm Herschel in 1792. It is formed by the fast stellar wind from the Wolf-Rayet star WR 136 (HD 192163) colliding with and energizing the slower moving wind ejected by the star when it became a red giant around 250,000 to 400,000 years ago. The result of the collision is a shell and two shock waves, one moving outward and one moving inward. The inward moving shock wave heats the stellar wind to X-ray-emitting temperatures.

This image is a composite of the following, (Ha+L) (HaR+G)+(O111G) taken over 15 hours last week. Equipment on this was an Astrograph 300 Ceravolo (modified) with an Apogee U16M guided on an ME mount.

Brian McGaffney

The Shadow of the Cross



For people living in the southern hemisphere the Southern Cross is a familiar sight. Formed by the four brightest stars in the constellation of Crux (The Cross), the asterism of a cross is easy to see. Somewhat less familiar though is a dark patch of the night sky next to the Cross, which can be seen in less light polluted skies. This large “hole” in the Milky Way is actually a dark nebula referred to as the Coalsack. This region is a cloud of light absorbing dust and gas about 600 ly distant with a radius of about 30 to 35 ly. Because of its apparent proximity to the Southern Cross, it is sometimes aptly referred to as the “Shadow of the Cross”.

This image was taken on May 26, 2014 at 9:50 p.m. (local time) while visiting the private Indaba Observatory, of East Lismore, New South Wales, Australia, using a modified Canon EOS 50D and 50mm lens at ISO 2000, 60 second exposure. This was positioned on a tripod with an iOptron Skytracker mount. This image was posted as the “Picture of the Day” by Astronomy Magazine Aug. 29th to Sept. 1st and on NASA’s “Earth Science Picture of the Day”, September 24th, 2014.

Rick Stankiewicz

Weird Misconceptions About Astronomy



ASTROLOGY WHEEL. Astronomy had its roots in the courts of the royalty and the rich. The astrologers kept accurate records of the star motions and other celestial events in order to predict future events. Later, men like Copernicus, Kepler, Galileo and Newton turned astrology into the science known as astronomy. Creator of image unknown.

JOHN CROSSEN

AFTER TWELVE YEARS OF running Buckhorn Observatory I thought I'd heard all the wrong ideas people could have about astronomy. Apparently not. Here are the top five on my list.

For starters a lot of visitors think that astronomy and astrology are the same. While they sound somewhat the alike, nothing could be farther from the truth.

While astronomy grew from the roots of astrology, thanks to the Chinese astrologers who kept records of the stars, the two practices went in separate directions about 2,500 years ago. Astronomy became a science dealing with provable concepts and repeatable results.

Astrology is totally the opposite. Different alignments of planets and stars have been going on for the last 13.7 billion years. They

See "Misconceptions" on page 12

M42 & M43

The Great Orion Nebula

Taken with a Canon 6D



THE ORION NEBULA IS the stellar nursery the closest to Earth. This star birth region is 1,344 ly away and about 24 ly across.

The Orion Nebula is one of the most scrutinized and photographed objects in the night sky.

This image is my first test of photographing an emission nebula with my unmodified Canon 6D DSLR at the prime focus on my home-built 16" diameter f/4.5 Newtonian telescope at my Observatory in JBSPO in Yellow Springs, Ohio.

This is a quick 97 second exposure, actually two separate shots layer masked, to prevent over exposure at the central Trapezium, which often overwhelms the image.

A 7 second exposure for the centre Trapezium region and a 90 second exposure for the full nebula is all it took to record this.

ISO was set at 3200. The Canon 6D tends to be a little more blue/green sensitive ... very little noise in this image at 70°F, but it does the trick if you need a quick image before the clouds roll in.

Transparency was not the best Friday night ... but now I know the Canon 6D (full-frame hhip) is easily capable of recording bright red emission nebulae quickly!

Pretty impressive for 97 seconds as well as very clean and sensitive for an unmodified DSLR.

see "DLSR Astrophotography" on page 13

*continued from page 7***The Sun**

seem right when dear old Sol is one million times larger than planet Earth. To me calling the Sun a yellow dwarf is like referring to Donald Trump as middle class.

Many cults have worshipped the Sun as a god for centuries — and rightly so. Were it not for the Sun, Earth wouldn't exist, nor would any of the other planets orbiting it. This is because the planets are composed of the material left over from the Sun's formation.

Through the ages it has warmed us and thanks to photosynthesis, given us food and nourishment. The Sun also warms our oceans which in turn control our weather systems. So how much energy does the Sun produce? At its core the Sun has fused about 620 million metric tons of hydrogen every second of every day for the last 4 billion years.

That's the energy output of 400 trillion, trillion 100-watt light bulbs or 19 billion hydrogen bombs. Anyone for solar power? It's plentiful and it's free.

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natalie.graham@live.ca
Email for a free quote.

*continued from page 10***Misconceptions**

have nothing to do with day-to-day life and are entirely open to the whims of those who insist on making sense out of nonsense.

Go out and pickup three different newspapers on the same day. See if your horoscope is the same in each of them. Unless the same column is syndicated in each of the papers you'll have three different readings to choose from. In that way astrology is more like a religion or superstition than anything dealing with hard, provable fact.

Another popular myth is that the North Star, also known as Polaris, is the brightest star in the night sky. Again the "wrong gong" bongs.

Polaris is about as average as a star can be. It shines at magnitude 3.3. Its distinction is that it marks the direction north for those of us in the Northern Hemisphere and is the first star in the handle of the Little Dipper or Ursa Minor. The brightest star in our night sky is Sirius, which we can only see during the winter months.

Where is Orion in July? A lot of people ask this because it's the only constellation they know of besides the Big Dipper. My answer is to come back in February when Orion will be directly south and high in the sky.

Unlike the Big Dipper, the Little Dipper, Cepheus, Cassiopeia and Draco the Dragon, Orion is a seasonal constellation who prefers the chilly winds of winter. The aforementioned are all circumpolar constellations which those of us above the 44 degrees of latitude can see all year around.

Why does the sky move? Well, that's how it looks to us. It's actually the Earth that is doing the moving. We are rotating from the west to the east at the rate of 1,600 km/h. That's what makes the constellations appear to rise in the east and set in the west.

And here's the last and most amazing on my list. Where do the stars go in the daytime? My tactful answer was that the bright sky during the daytime masked out the stars' glow. I was thinking something different, like wow this person can vote!

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*continued from page 6***Moon**

ues to orbit Earth, the Sun gradually illuminates more and more of its surface.

Eventually the Moon reaches the Full Moon phase in which it is directly opposite the Sun and fully lit, face on. The alignment for this phase is Sun – Earth – Moon. From here on the Moon rises later each night and a smaller portion of its surface is lit until the Moon returns to the New Moon or “No Moon” phase.

So what major planets have the most moons? Here they are in descending order: Jupiter – 69 moons, Saturn – 62 moons, Uranus – 27 moons, Neptune – 13 moons, Mars 2 moons, Earth – 1 moon, Venus and Mercury – 0 moons. Despite being a dwarf planet, Pluto has 5 moons. One of which was discovered so recently it has yet to be named.

[to next article](#)*continued from page 11***DSLR Astrophotography**

This was just a test under poor sky conditions, so the next clear night I will go back and do a longer exposure under dark skies and get a fully glory shot!

One thing is for sure the newer DSLR's are getting better for astrophotography ... they seem to be getting the typical noise issues under control!

**Best Regards,
John Chumack**

www.galacticimages.com

[to 'The Sky this Month'](#)*continued from page 4***Hadfield**

But Chris Hadfield isn't the only person advocating cooperation with the Chinese. Iain Christie, executive vice-president of the Aerospace Industries Association of Canada, says China's presence in space cannot be ignored. “I think China is back where we were in North America 50 years ago.” “They're excited about space, they're not spending their time justifying why they're in space, they're spending their time justifying why they're not doing more.”

Hadfield and Christie are joined by Ron Holdway, an independent space consultant. Says Holdway, “I think that's the way we're inevitably headed because space is so expensive and the Chinese are proving to be quite good at it and willing to share the cost.”

Necessity being the mother of invention, she may also be the mother of cooperation when it comes to exploring outer space. I think it's time to take one more giant step for mankind and welcome the Chinese aboard our international space programs.

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Durham Skies
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The Sky this Month

Mercury vanishes into evening twilight early in the month. At inferior conjunction on the 16th. Re-emerges in the morning twilight last week of the month.

Venus is in superior conjunction and not easily visible until early December as it becomes an “evening star”.

Mars is low in the south western evening sky. Moving eastward from Ophiuchus into Sagittarius on the 21st. Passes 0.5° south of the Lagoon Nebula (M8) on the 27th.

Jupiter rises in the ENE after midnight and moves into Cancer mid-month.

Saturn vanishes into evening twilight late in the month.

Zodiacal Light in the E before morning twilight from the 20th for the next two weeks.

Draconid Meteors peak at noon on the 8th.

Orionid Meteors peak at 1 PM on the 21st.

Total Lunar Eclipse visible at dawn on the 8th. Eclipse begins at 6:25 AM and reaches totality at 6:54 AM and leaves at 7:24 AM before setting from our area at 7:29 AM.

Moon Phases

First Quarter	3:33 PM	October 1
Full Moon	6:51 AM	October 8
Last Quarter	3:12 PM	October 15
New Moon	5:57 PM	October 23

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Family Wishes

descend upon us. Thanks to club members Fran and Frank Farrell, Rodger Forsyth, Sean Dunne, Dave Mills, Pat and Jean Crebar and Rob Flindall with his son Adam, we had a good selection of telescopes and binoculars to show the participants the two-day old waxing crescent Moon, Saturn, Mars, Uranus, M13, M31 and the double cluster of Perseus, just to name a few items visible from our vantage point that night. Without the involvement of these PAA members we could not have succeeded, as once the crowd of over 250 children and parents finished with making “star frames”, wishing on a star, singing and having milk and cookies, the sparkler lit parade of youngsters headed up the hill to our location. There were line-ups at every piece of equipment we had and we were able to amaze and thrill everyone with close-up views of our solar system, the Milky Way Galaxy and beyond. Everyone was through by 9:00 p.m. and with such a great night at our disposal some of us stayed for another couple hours just connecting with passersby.

Event organizer/coordinator, Kim Sargent, was thrilled with the PAA participation and the reaction by the crowds that showed up at this event, not to mention the general public that happened upon us on their way up Armour Hill. She commented that, “... there wasn’t a single person who left anything less than inspired. More than anything, I adored the curiosity the experience created in those lovely little people standing perched upon your step stools to see the real world!”, Kim said.

It would be hard to believe that some young people were not bitten by the “astronomy bug” on this evening under the stars and that some of their wishes didn’t come true as they were shown some of the wonders of our Universe first hand.

Who knows where this event may take us in the future, but maybe a new partnership has been established with another community minded organization in the Peterborough area.

This would be my wish.

Rick Stankiewicz,
Publicity Director

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KW *Telescope*
P E R C E P T O R



continued from page 1

Mira

into our Sun's likely future. In general, the cores of stars burn through their fuel in a very consistent fashion, but in the case of pulsating variable stars the outer layers of stellar atmospheres vary. Initially heating up and expanding, they overshoot equilibrium, reach a maximum size, cool, then often forming neutral molecules that behave as light-blocking dust, with the dust then falling back to the star, ionizing and starting the whole process over again. This temporarily neutral dust absorbs the visible light from the star and re-emits it, but as infrared radiation, which is invisible to our eyes. In the case of Mira (and many red giants), it's titanium monoxide (TiO) that causes it to dim so severely, from a maximum magnitude of +2 or +3 (clearly visible to the naked eye) to a minimum of +9 or +10, requiring a telescope (and an experienced observer) to find!

Visible in the constellation of Cetus during the fall-and-winter from the Northern Hemisphere, Mira is presently at magnitude +7 and headed towards its minimum, but will reach its maximum brightness again in May of next year and every 332 days thereafter. Shockingly, Mira contains a huge, 13 light-year-long tail—visible only in the UV—that it leaves as it rockets through the interstellar medium at 130 km/sec! Look for it in your skies all winter long, and contribute your results to the AAVSO (American Association of Variable Star Observers) International Database to help study its long-term behavior!

Check out some cool images and simulated animations of Mira here: http://www.nasa.gov/mission_pages/galex/20070815/v.html.

Kids can learn all about Mira at NASA's Space Place: <http://spaceplace.nasa.gov/mira/en/>.

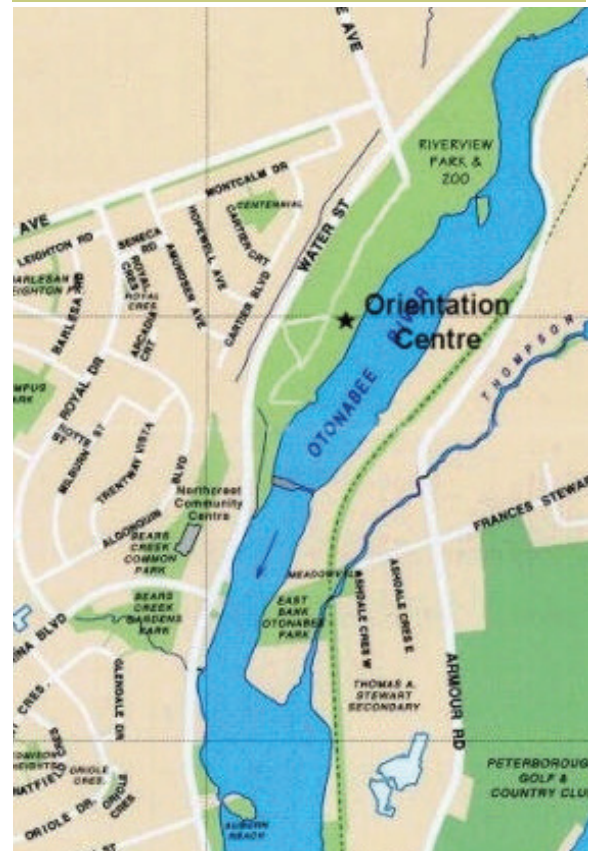
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Articles

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 photos 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:
October 27, 2014**



Meetings

The Peterborough Astronomical Association meets every first Friday of each month, except July and August, at the **Peterborough Zoo Orientation Centre** (Next to the PUC Water Treatment Plant) at 7 p.m. P.A.A. general announcements will begin each meeting with the guest speaker starting at 7:30 p.m.