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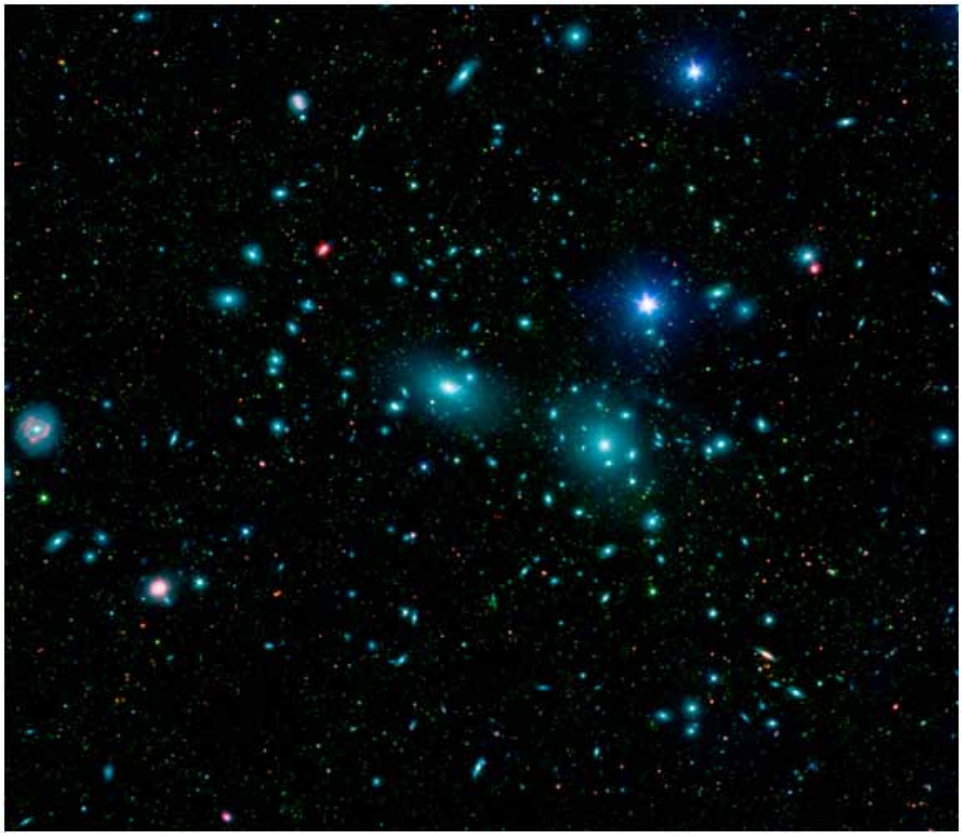
The Reflector

Newsletter of the Peterborough Astronomical Association

Size Does Matter, But So Does Dark Energy

by Dr. Ethan Siegel



Digital mosaic of infrared light (courtesy of Spitzer) and visible light (SDSS) of the Coma Cluster, the largest member of the Coma Supercluster. Image credit: NASA / JPL-Caltech / Goddard Space Flight Center / Sloan Digital Sky Survey.

Here in our own galactic backyard, the Milky Way contains some 200-400 billion stars, and that's not even the biggest galaxy in our own local group. Andromeda (M31) is even bigger and more massive than we are, made up of around a trillion stars! When you throw in the Triangulum Galaxy (M33), the Large and Small Magellanic Clouds, and the dozens of dwarf galaxies and hundreds of globular clusters gravitationally bound to us and our nearest neighbors, our local group sure does seem impressive.

Yet that's just chicken feed compared to the largest structures in the universe. Giant clusters and superclusters of galaxies, containing thousands of times the mass of our entire local group, can be found omnidirectionally with telescope surveys. Perhaps the two most famous examples are the nearby Virgo Cluster and the somewhat more distant Coma Supercluster, the latter containing more than 3,000 galaxies. There are millions of giant clusters like this in our observable universe, and the gravitational forces at play are absolutely tremendous: there are literally quadrillions of times the mass of our Sun in these systems.

The largest superclusters line up along filaments, forming a great cosmic web of structure with huge intergalactic voids in between the galaxy-rich regions. These galaxy filaments span anywhere from hundreds of millions of light-years all the way up to more than a billion light years in length. The CfA2 Great Wall, the Sloan Great Wall, and most recently, the Huge-LGQ

see "Superclusters" on page 16

President's Message

Busy Summer for PAA Members

June 7 was our last meeting before our summer break and although this ended the formal process of getting together as a club many members were kept busy as PAA representatives. The day after our meeting on June 8, three of us set up telescopes for the Girl Guides at Beavermeade Park. This assisted them in getting their Astronomy Badges. On June 14, we had a very good observing night at the Robinson Road Observatory site followed by another one at Cedar Knoll on July 12th. While the weather wasn't as cooperative, that night was highlighted by a very large meteor that stayed visible in beautiful blues, greens and reds for 5 seconds or more. It basically went right overhead. On July 24, a few members set up telescopes for the Peterborough Public Housing organization. August 9, saw a bunch of us at the Buckhorn Observatory, always a treat with John's very dark sky. On August 12, we set up for the publicized viewing of the Perseids Meteor shower. If that was a shower I think the well has run dry. Finally on August 24, we had a good member turnout at Emily Provincial Park where a large number of campers and visitors showed up to "see the wonders of the night sky."

I thank all the members that participated in some or all of these activities. We are getting noticed.

On a serious note we must start thinking about the election of a new executive for the next two years. The entire suite of executive positions is up for grabs. With this in mind I will plead with the attendees at the September meeting for a volunteer to act as "Election Chair" to start the process.

Rodger Forsyth
PAA President

Letter from the Editor

Fall has abruptly arrived less than three weeks early as it is rather cool tonight as I write this introduction. But cool doesn't begin to describe the celestial targets for September and beyond for stargazing.

The Andromeda Galaxy is rising early in the eastern evening sky and will present well for the next few months. The Summer Triangle is setting in the north-west with the Milky Way still looking fabulous. Of course in a couple of months we will greet the arrival of Comet ISON, but let's not get ahead of ourselves.

This month John Crossen and Rick Stankiewicz provide the majority of the content, but it is always a pleasure to read. Rick details his trip to the Ontario Science Centre to hear David H. Levy, comet hunter extraordinaire.

In our gallery Rick forwarded us John Chumak's latest and greatest image: the nova in Delphinus. Spectacular.

So, enjoy this month's read and we will return in October.

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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The PAA Meets David Levy

PAA members pose with David Levy. L-R: John Cameron, Sean McMurray, David Levy and Rick Stankiewicz.

Rick Stankiewicz

On the night of June 5th three members of the PAA capitalized on a unique opportunity to listen to and meet one of the greatest observers and comet hunters of all time. This spring David H. Levy was giving an eight-stop speaking tour in Quebec and through southern Ontario and June 5th was the Toronto stop of the tour. The venue was the Ontario Science Centre (OSC) and this event was co-hosted by the Toronto Centre of the RASC and the OSC. They did a great job of welcoming all in attendance with exhibits, demonstrations and refreshments. The main theatre comfortably held the hundreds of people that attended. Incredibly this was all free.

For those of you that might be new to the hobby and don't know David H. Levy, he is a world renowned observer/comet hunter and author who has currently discovered 22 comets (third most of anyone in recorded history) and along the way has discovered 41 asteroids and written 35 books! How is that for a patient, prolific observer?

Levy is an animated, articulate and interesting speaker who gave his presentation for almost 1 ½ hours and it was amply illustrated with images, videos and music clips. His love of Shakespeare was evident as he interjected readings with astronomical references. He talked about his boyhood memories and how he became interested in astronomy at an early age. Using a video clip from the classic television series "Bonanza", to music from a moonlight sonata, it was clear that the beauty of the Moon had taken hold of him.

See "The Comet Hunter" on page 15

Sweet September

Andromeda Galaxy. The Andromeda Galaxy (in the constellation Andromeda) is one of September's favourite targets. It can just be seen by the naked eye from a dark rural location. That's amazing when you consider the fact that it is 2.5 million light years distant! A low-power view in a telescope will also reveal two satellite galaxies along side it. Photo by Peterborough Astronomical Association member Brian McGaffney.

John Crossen

For the Backyard astronomer September has it all. It gets dark earlier and the nights are longer. The temperature is cooler and the bugs are all but gone. Plus you still have the Milky Way overhead and summer's abundant harvest of star clusters and galaxies. Add in the fact that we insomniacs can stay up and ogle a sneak-peek of autumn's sky show, and what's not to like? Planet fans are the only folks who will find the month a bit disappointing.

Venus will continue to hug the western horizon so it will be a difficult target unless you have an unobstructed view to your west. On September 8 the waxing Crescent Moon will be just 2 degrees from Venus which will make a beautiful pairing.

Jupiter won't peep over the eastern horizon until 2:00 a.m., so unless it's Friday or Saturday night, most people won't be up to see it.

Mars rises in the eastern predawn sky, but unfortunately it will still be too distant to reveal much surface detail. On the flip side of the coin, Mars will be higher in the sky this year, so despite its diminutive disc observers should be rewarded with some details.

Uranus will be up as will Neptune, but because both are below the vision

See "September" on page 13

The Perseids of 2013

Rick Stankiewicz

This year's Perseid Meteor Shower was better than you might think. If you waited for the peak on the night of August 12th to have a peek, you were probably disappointed, but if you had been watching the skies in the nights leading up to the peak, you should have been treated to a nice display of meteors.

The evening of our public Perseid Meteor Shower Show on Armour Hill was pretty much a washout. The clouds made up for the lack of lunar light pollution and prevented us from showing members of the public anything much until about 11:00 p.m. and then we had a bit of a break until close to 1:00 a.m., but by then most of the public had dwindled. I didn't see any meteors the whole evening and I heard very few comments from the public that would indicate they were in the same boat. The clouds were just too effective in keeping all but the brightest meteors from view. Our members made up for the lack of meteors with quick views of Saturn, star clusters and a few nebulas. I managed to find Uranus and Neptune for a few visitors too, but this was close to closing time.

However, the nights leading up to 12th were quite clear and enjoyable to be out given the cool temperatures, low humidity and bug count. Not wanting to put all my eggs in one basket on the 12th, I made the effort to get out under the Milky Way and see what I could see. I also tried to catch a "falling star" while I was at it and after many hours of trying, I managed to do just that. The attached

See "Perseids" on page 15

Take a Space Walk on the Wild Side

John Crossen

Outer space can be as wild as the outer limits. Take a neutron star for example.

A neutron star was at one time a red giant star that was millions of kilometres in diameter. But it wasn't quite big enough to become a black hole when it ran out of fuel. Instead it collapsed down into a very dense ball just a few kilometres across. It is so heavy that just a thimble full would flatten the scales at 100 million tons.

While we're squishing things down, let's talk about atoms. An atom is 99.9999999999999% empty space. Given that we humans are composed of atoms, you could squish the entire human race down into a lump the size of a sugar cube. Does this mean that the old chestnut: "Will that be one lump or two?" takes on a new meaning at a cannibal tea party?

Still want to tumble some numbers? Try this on for size. The world population of ants is approximately equal in weight to the human population. Who ever came up with that one had a lot of time on their hands and nothing on their minds!

Here's another one from that same group of folks. There are more bacteria in your stomach right now than there have been people in the history of the human race. So is this before or after my Big Mac?

I always thought the universe was a virtually endless ocean of stars. But according to the experts, the human brain contains

see "Wild Side" on page 14

It is estimated that there are about 100 billion stars in the Milky Way Galaxy and 400 billion galaxies in the known universe. Yet there are still more synapses in the human brain than there are stars in the universe. Photo by Ron Brecher.

Rare Gathering in May

Planetary Alignment. Jupiter (left), Mercury (top) and Venus (bottom-right) formed a nearly equilateral triangle on May 26, 2013.
Photo by Rick Stankiewicz.

Rick Stankiewicz

On the early evening of May 26th, 2013, while on a fishing trip to Big Rideau Lake, south of Perth, Ontario, for the opening of lake trout season, I was hoping for a clear night to witness a fairly rare celestial conjunction. Low in the western horizon, Mercury, Jupiter and Venus formed a nice tight two degree wide "equilateral triangle" in the sky. Rarely are there such nice neat "packages" of so many planets to be seen. However, it was so low in the sky that when they were at their highest above the tree line at my location, it was too bright a sky to see them easily or to record a decent image. They were too close to the Sun, so I had to wait them out and change my game plan if I was to capture anything worth sharing.

My Plan "B" was to have my friend Gary take me out on the water with his pontoon boat to get a better/lower horizon and buy so time as the twilight sky darkened, but all the while the planetary triangle continually sank toward the tree line. We were blessed with clear skies that evening, but the twilight was not the most colourful on record. You have to take the cards you are dealt in cases like this and I felt lucky to have had the view and opportunity I did. The next hurdle was to try and get an image of these planets in a darkening sky with a lower shutter speed, on water. A tripod and pontoon boat helped, but with the planets sinking so fast and having to maneuver the boat away from shore to keep the planets above the tree line as I kept shooting, it was a challenge to say the least. If it had been windy, I would not have stood a chance.

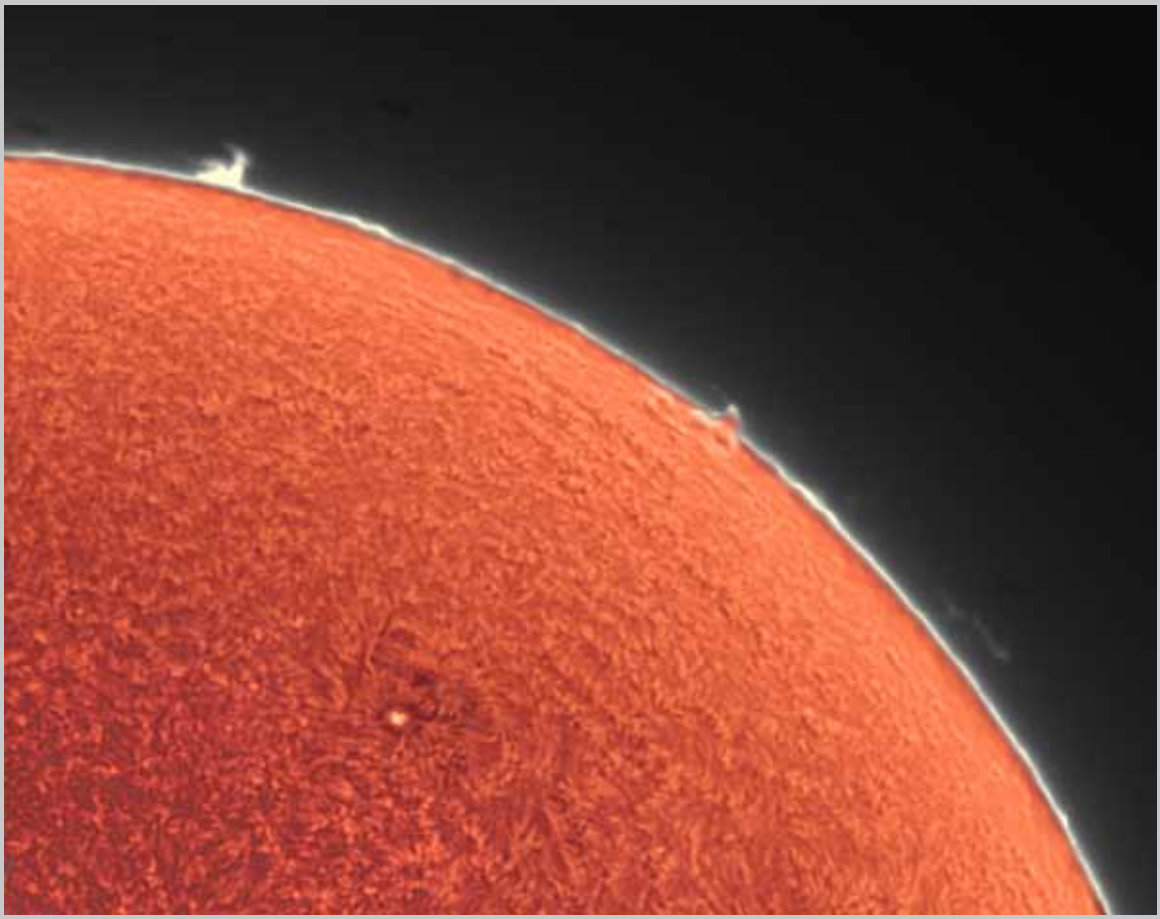
In the end, the attached image was one of only two that were acceptable for my purposes.

This cropped image from the original taken with a tripod mounted Canon 400D, 18-200mm Canon lens at 200mm, ISO 400, f/5.6, and 1/6 second exposure, shows (in descending order) Mercury, Jupiter and Venus just seconds before Venus disappeared from view.

How rare was this event? Let's just say it doesn't happen regularly. They were about this close on May 11, 2011, but the next time they will be this close and observable, will be February 26, 2058. Now you can see why going to great lengths are worth the effort in cases like this.

PHOTO GALLERY

The Sun, August 15, 2013



New hi-res image of Sun taken at the Nutwood Observatory. Taken with Solarscope 100 and imaged over 4 hours of processing.

Brian McGaffney

Nova in Delphinus

Here is a nice image of the New Nova in Delphinus, visible in binoculars ... hard to see naked eye unless you are in a very dark sky ... and know exactly where to look, but this is a very bright Nova ... most don't get above 8th magnitude.

Nova in Delphinus-PNV J20233073+2046041 at Mag. 6.1

QHY8 Cooled Color CCD Camera + Homemade 16" Newtonian scope. 30 minute exposure

At my observatories at JBSPO in Yellow Springs , Ohio USA

Best Regards,

John Chumack
www.galacticimages.com

How Big? How Fast? How Far Away?

John Crossen

Those are the top three questions that accompany any visitor to Buckhorn Observatory. So, here are some answers. Let's start close to home, with Earth.

Our home planet rotates at 1,600 kilometres per hour. Even at that brisk clip it still takes 24 hours to make one complete rotation from Sunrise to Sunset. But that's slow compared to how fast we orbit the Sun.

To lap the Sun in one year we zip along at 107,000 kilometres per hour. At that speed we could journey to the Moon in just 4 hours instead of the 4 days it took the Apollo Astronauts.

Yet that too, is a snail's pace compared to the speed at which we orbit the core of our Milky Way Galaxy as it cartwheels through space. At Earth's 28,000-light-year distance from the galaxy's centre we are clipping along at a breezy 965,600 kilometres per hour. But before moving on, let's clarify a few things.

For starters a light-year is the distance a beam of light would travel in one year. Light travels at 300,000 kilometres per second. That's fast enough to circle the Earth 10 times in one second. But let that beam of light fly through space for a year and a light-year works out to 10 billion kilometres. On a dark, clear, moonless night during the late summer you and I can see the Andromeda Galaxy with our naked eyes. This gigantic star city is 2.5 million light years away. This

See "Questions" on page 13

Starburst Galaxy. The Starburst Galaxy is 22 million light years away. But that's just spittin' distance compared most of our cosmic neighbours. Image by Ron Bretcher.

PAA Observing Session

Buckhorn Observatory

John Crossen

August's PAA Observing Session got off to a great start. My two weather sources both gave us clear skies straight through until the wee morning hours. So the turnout of PAA observers was good.

Jeanne and Pat Crebar brought their 9.25-inch scope along and Brett Hardy gave them a hand setting up. Club President Rodger Forsyth had his 8-incher along as did Paul Ward. Boyd Wood's 10-inch Dobsonian was on hand along with Harold Briggs' William Optics 110mm refractor and Ken Sunderland's 80mm pea shooter. So all told we had a great cross-section of scopes for viewing.

The night started out great with everyone dancing through the Messier Objects.

Saturn was available early on. The Andromeda Galaxy was rising in the east while the Dumbbell Nebula and the Wild Duck Cluster took charge of viewing to the southeast.

Overhead the Ring Nebula had a few necks arched and to the west M51, the colliding galaxy pair, were visible. Then disaster struck.

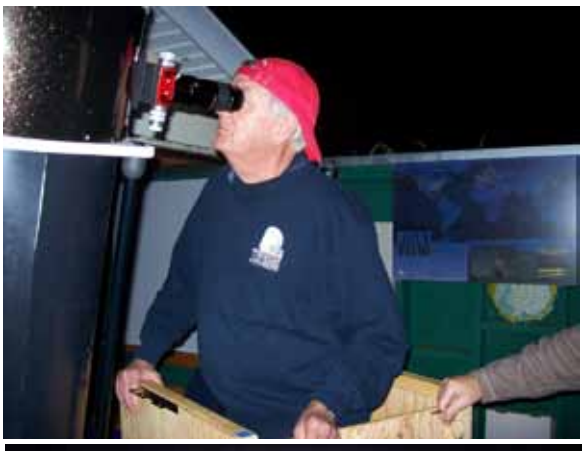
Like the lid on a roll-top desk slamming shut, a blanket of clouds rolled in. Within 3 minutes the sky was clouded over from horizon to horizon. After twiddling thumbs and idle conversation the members started packing their gear.

The stalwarts, Boyd and Rodger, hung in for an extra coffee and Tim Bits in the observatory warm room. After a half-hour of scope chatter we stepped back into the observing area. The clouds were gone—and unfortunately most of the members.

Not wanting to miss the opportunity we cranked the 16-incher up and dropped in an eyepiece that boosted the power up to 200×. I swung the scope over to the Hercules Globular Cluster. Both Boyd and Rodger were a tad gaa-gaa at the sight.

We also took in M92, the other globular in Hercules. Once again, the sight was riveting—even to me, and I should be used to it by now.

The clock was striking midnight, so Rodger and Boyd hit the road. I'm really sorry the others left because the balance of the night was incredible. But that's astronomer's luck.



Buckhorn Observatory PAA Observing Session. Left: Paul Ward. Right: Club President, Rodger Forsyth. Photos by John Crossen.

The Sturgeon Moon of August

Rick Stankiewicz

The full Moon of August occurred on the 20th and marked the Full Sturgeon Moon. According to the Farmer's Almanac the fishing tribes of indigenous people are given credit for the naming of this Moon, since sturgeon, a large fish of the Great Lakes and other major bodies of water, were most readily caught during this month. A few tribes knew it also as the Full Red Moon possibly because it can appear reddish through the summer haze near the horizon. The Moon does not have to be full to take on a colour as it rises or sets at anytime of the year, but the summer months definitely increase the odds of this occurrence, as there are warmer air masses that hold more aerosols, smog and particulates in the atmosphere and these can tint or colour the light reflected from the Moon. I did not find this last month's moon to be particularly colourful, but some of you might have. Some people also say that the Full Moon this August was a 'seasonal Blue Moon,' because it is the third of four full moons in a single season. This is an older definition of a Blue Moon compared to the more modern adaptation of two full moons in the same month definition. Which is correct? According to the August 21st NASA Spaceweather.com website, both and neither. It's all folklore. The only true-Blue Moon is a Moon that actually turns blue and yes, that can happen. Under certain circumstances volcanic dust and ash from forest fires can scatter the reds out of moonlight, leaving a blue tinted Moon. This only happens, "once in a Blue Moon" though. Whatever you want to call it, I always find it a wonderful sight.

Sturgeon Moon. Tripod mounted Canon 400d and Sigma 70-300mm lens @ 168mm; iso 100, f/5.6, 1/20 exposure. Photo by Rick Stankiewicz.

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Questions

means the light we see from the galaxy left it about the time our earliest ancestors were learning to stand upright.

How big is the Andromeda Galaxy? At 200,000 light years in diameter it is nearly twice the size of our Milky Way. That means the light from the far side of Andromeda is 200,000 years older than the light from the near side.

But let's go straight to the big one. How fast is the universe expanding? In a recent study published in the Astrophysical Journal the newly refined calculation goes like this. The universe is expanding at 73.8 kilometres per second per 3.26 million light-years or per one megaparsec. Since Edwin Hubble discovered space is expanding at a faster rate the further one goes from the Milky Way, astronomers have been trying to refine the rate.

So, according to the above equation, a galaxy 3.26 million light-years away — or one megaparsec — is moving away from us at around 73.8 kilometres per second. A galaxy two megaparsecs away would be travelling twice as quickly. Three megaparsecs distant would increase its speed by three times or 234.9 kilometres per second. Given that the universe is, or perhaps I should say was, 13.7 billion light years across the ultimate speed could exceed that of light.

Until we meet again by the backyard telescope, keep your outdoor lights aimed and dimmed down. You'll save money and our dark Kawartha night sky.

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September

threshold of most people, a computerized telescope or some good star charts are recommended if you want to catch a view of them.

As the month progresses the constellation Andromeda will rise higher in the eastern sky. Almost overhead are her mom and pop, Queen Cassiopeia and King Cepheus. To complete the story, her boyfriend Perseus will be well up in the eastern sky and his gallant steed, Pegasus the Flying Horse will dominate the south-eastern sky. If this sounds oddly like The Clash of the Titans, you're right. Hollywood copied a 2,500 year-old Greek myth and made a million.

As the night progresses our cast of characters grows. The bright star Capella announces the arrival of Auriga, the Charioteer. Accompanying Auriga, but farther to the right you will find the Seven Sisters of the Pleiades, followed shortly thereafter by Taurus the Bull. The Sisters are just a fuzzy patch to the eye, but burst into a glorious dipper-like formation in binoculars.

That's what's up for September. Until we meet again by the backyard telescope, keep your outdoor lights dimmed down and pointed down. You'll save money and our dark Kawartha night sky.

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Wild Side

more synapses than the universe has stars. My wife isn't so sure about that, at least not where my brain is concerned.

If you're looking for an anti-aging formula, look no further. Physics says that if you travel at the speed of light, time stops. Experiments with exceedingly precise clocks have shown that time does run slower for objects in orbit around Earth. So when cosmonauts and astronauts return to Earth they are a tiny bit younger than they would have been if they had remained Earthbound.

Here's one to ruffle the feathers of you Pluto fans. Russia is larger than Pluto in surface area. However, when it comes to moons, Pluto has the lead, 5 to zip over Russia. Yes, as of last year Pluto's moon count jumped to five.

According to astronomers the new plutonian moon isn't much to write home about. It's only 5 to 6 kilometres across and goes by the mind-numbing name of P-5.

If there wasn't life on Mars, there probably is now. We're back to bacteria again, but ever since man-made craft have landed on and crawled across the Martian surface, they have more than likely left bacteria behind.

NASA makes every effort to assure that any craft that lands on another planet or moon is as free of unintended Earthly passengers as possible. But nobody is perfect. Bacteria have been known to make the trip from Earth to the Moon and return unscathed.

The Sky this Month

Mercury is obscured in the west-south-west evening twilight for most of the month in the Northern Hemisphere.

Venus is low in the evening sky in the west-south-west. On the 8th the waxing crescent Moon passes 0.4° south near Spica.

Mars in the morning sky in Cancer and moving into Leo later in the month. On the 8th and 9th Mars passes in front of the Beehive Cluster (M44).

Jupiter rises after midnight in Gemini. The waning crescent Moon passes 5° S on the 28th.

Saturn low in the west-south-west twilight. From the 16th to 20th passes a few degrees north of Venus.

Autumn Equinox arrives on the 22nd at 4:20 p.m.

Zodiacal Light visible before morning twilight in the east from the 3rd for the next two weeks.

Moon Phases

New Moon	7:36 AM	September 5
First Quarter	1:08 PM	September 12
Full Moon	7:13 AM	September 19
Last Quarter	11:55 PM	September 26

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The Comet Hunter

It was in 1965 at an Adirondack Science Camp that the seed for his life long passion germinated. Levy's "life long science project" was to discover a comet. His records indicate that he started searching on December 17, 1965 and almost nineteen years later, on November 14, 1984, he was a co-discoverer of Comet Levy-Rudenko (C/1984 V1). He went on to discover eight more comets "visually" with backyard telescopes and another thirteen comets "photographically" with the famous team of Eugene and Carolyn Shoemaker. It was with them that he co-discovered Comet Shoemaker-Levy 9 (D/1993 F2). This comet ended its journey into our inner solar system after being pulled apart by the gravity of Jupiter and then crashing into the gas giant in 1994. This is one of the greatest astronomical events in modern times. His last comet (P/2006 T1) was discovered in 2006. After this discovery he asked his wife if he should stop his search for comets and she asked him if he was having fun and he answered "You bet" and she responded with, "Then why stop now?"

From being raised in Montreal to now living the dream under Arizona skies, David Levy rarely does speaking tours and you normally have to see him at some large convention or conference around the world. So, when an opportunity like June 5th came along in our own backyard (relatively speaking) it was a dream come true for me and I have my autographed book to prove it. However, our experience was not complete that night until John Cameron, Sean McMurray and I had our picture taken with an astronomical legend and this we did.

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Perseids

image show some of the fruits of my labour. These are cropped from frames that show some brighter meteors as many of the fainter ones I expected to be there, just failed to register.

I used a Canon 50D camera and Sigma 10-20mm lens at 10mm tripod mounted with ISO 2000, f/4.5 for 50 seconds.

It can be tricky at the best of times because invariably the meteors will always fall outside your field of view. I had this happen lots, but patience pays off. The best stretch I saw was seven meteors in one minute, but they were faint and none were where my camera was pointed.

I spent a couple hours from midnight on the 11th until 2:00 a.m. and from 2:00 to 4:00 a.m. on the 12th. The neat thing to observe is that almost every streak of a meteor I saw all appeared to radiate from the constellation of Perseus, but I saw maybe two that didn't. This would indicate that their origin was other than Comet Swift-Tuttle.

Over all, the Perseids of 2013 might not have performed up to everyone's expectations, but I did prove that "good things come to those that wait."

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Superclusters

(Large Quasar Group) are the largest known ones, with the Huge-LGQ—a group of at least 73 quasars—apparently stretching nearly 4 billion light-years in its longest direction: more than 5% of the observable universe! With more mass than a million Milky Way galaxies in there, this structure is a puzzle for cosmology.

You see, with the normal matter, dark matter, and dark energy in our universe, there's an upper limit to the size of gravitationally bound filaments that should form. The Huge-LGQ, if real, is more than double the size of that largest predicted structure, and this could cast doubts on the core principle of cosmology: that on the largest scales, the universe is roughly uniform everywhere. But this might not pose a problem at all, thanks to an unlikely culprit: dark energy. Just as the local group is part of the Virgo Supercluster but recedes from it, and the Leo Cluster—a large member of the Coma Supercluster—is accelerating away from Coma, it's conceivable that the Huge-LGQ isn't a single, bound structure at all, but will eventually be driven apart by dark energy. Either way, we're just a tiny drop in the vast cosmic ocean, on the outskirts of its rich, yet barely fathomable depths.

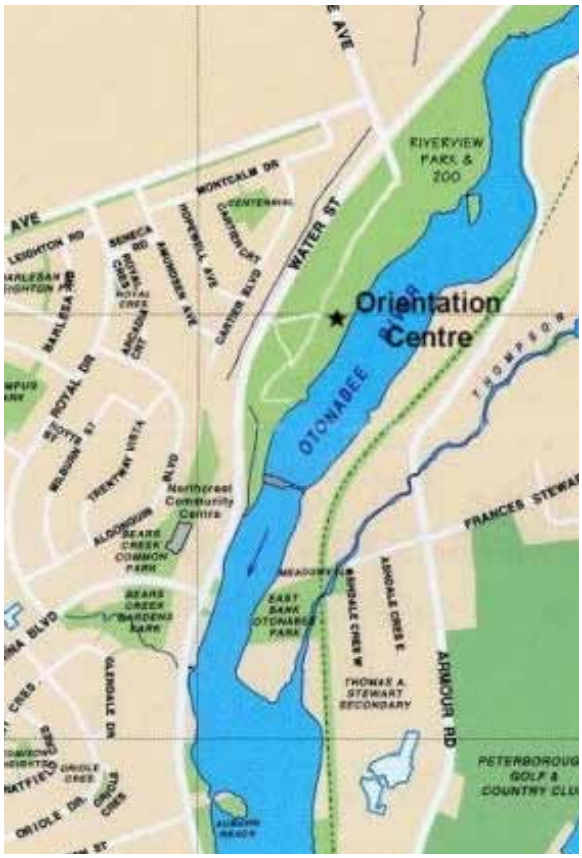
Learn about the many ways in which NASA strives to uncover the mysteries of the universe: **http://science.nasa.gov/astrophysics/**. Kids can make their own clusters of galaxies by checking out The Space Place's fun galactic mobile activity: **http://spaceplace.nasa.gov/galactic-mobile/**

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:
September 27, 2013



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.