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The Reflector

Newsletter of the Peterborough Astronomical Association

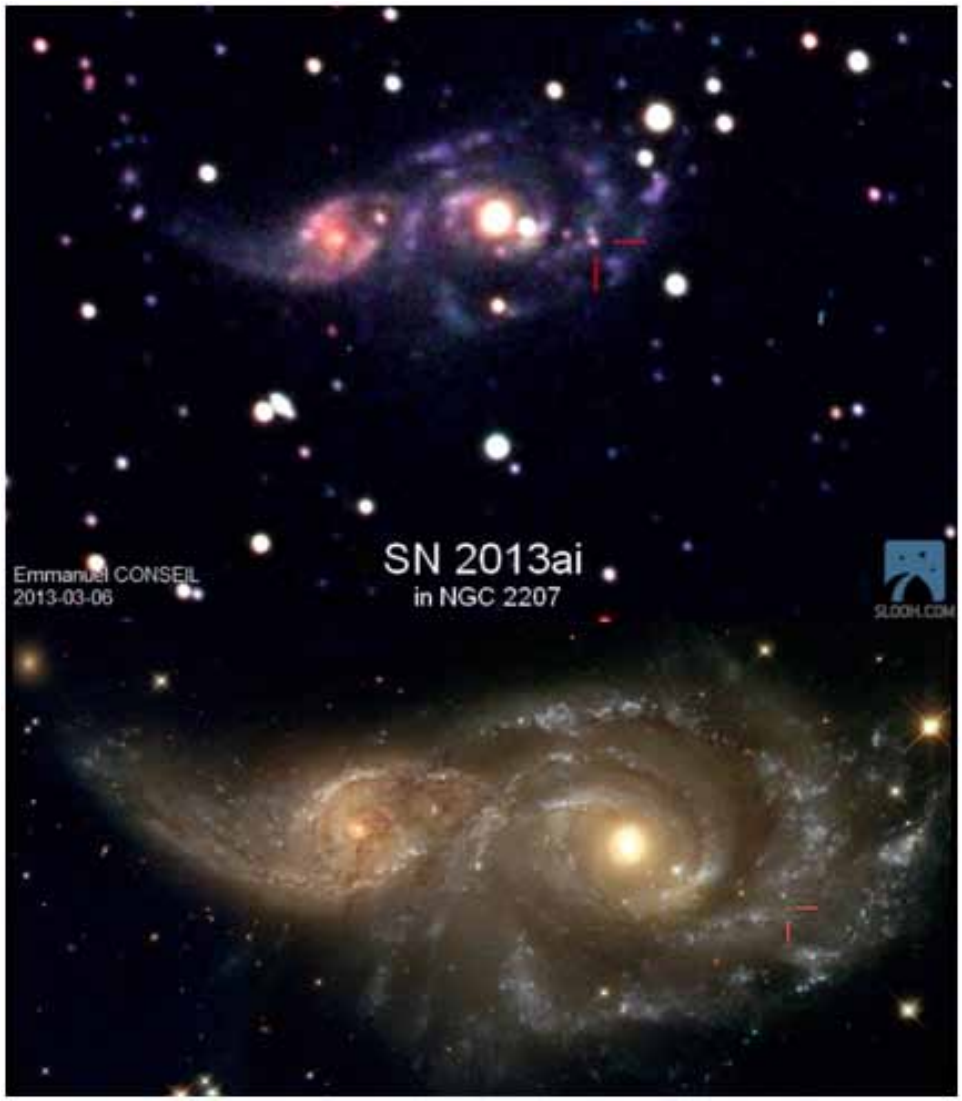
How To Hunt For Your Very Own Supernova

by Dr. Ethan Siegel

In our day-to-day lives, stars seem like the most fixed and unchanging of all the night sky objects. Shining relentlessly and constantly for billions of years, it's only the long-term motion of these individual nuclear furnaces and our own motion through the cosmos that results in the most minute, barely-perceptible changes.

Unless, that is, you're talking about a star reaching the end of its life. A star like our Sun will burn through all the hydrogen in its core after approximately 10 billion years, after which the core contracts and heats up, and the heavier element helium begins to fuse. About a quarter of all stars are massive enough that they'll reach this giant stage, but the most massive ones—only about 0.1% of all stars—will continue to fuse leaner elements past carbon, oxygen, neon, magnesium, silicon, sulphur and all the way up to iron, cobalt, and, nickel in their core. For the rare ultra-massive stars that make it this far, their cores become so massive that they're unstable against gravitational col-

see "Supernova" on page 16



SN 2013ai, via its discoverer, Emmanuel Conseil, taken with the Slooh.com robotic telescope just a few days after its emergence in NGC 2207 (top); NASA, ESA and the Hubble Heritage Team (STScI) of the same interacting galaxies prior to the supernova (bottom).

President's Message

The Fall Skies Return

In the blink of an eye another summer has said goodbye but we can look forward to some fine viewing with clearer skies and no bugs. As I write this comet ISON is 2.2au from us almost directly in line with Mars. Let's hope it survives the trip around the sun and gives us a spectacular show late November, into December and beyond. Comets are notorious for not behaving as predicted but maybe we will be pleasantly surprised.

The election process to define the executive members for the next two years is underway with Sean Dunne assuming the role of "Election Chair." I thank you Sean for volunteering. You may hear from Sean over the next few weeks to see if you're interested in becoming one of the club's directors. Please give it serious thought. It is rewarding and you will get lots of help from previous members. As mentioned before every executive position is up for grabs. The only requirement is that you've been a club member for at least one year except to be president you must have served one term as a member of the executive.

Rodger Forsyth
PAA President

Letter from the Editor

Welcome back to another edition of the Peterborough Astronomical Association newsletter, *The Reflector*.

We seem to have a martian theme this month with three articles referencing the little Red Planet. Additionally, we are pleased to show John Chumak's wonderful three day composite of Mars passing through M44, a.k.a. The Beehive. John Chumak, if you will recall, is an American amateur astronomer and astrophotographer from Ohio. Rick Stankiewicz is in regular contact with him and we can give Rick some thanks for making the connection for us.

Not to be outdone, our own Brian McGaffney of Nutwood Observatory near Aspley is no slouch in the imaging department. He continues to amaze with his wonderfully rendered astro images.

The autumn is a great season to stargaze and Rick Stankiewicz shows us with his lunar/planetary conjunction photos from September.

Don't be scared by the image of the Medusa on page three. John Crossen only wants to scare interest in looking out for the constellations that comprise the "Clash of the Titans".

Till next month!

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.

www.peterboroughastronomy.com • rforsyth@nexicom.net
Phone: 705.292.0729
Club Mailing Address
Rodger Forsyth, President
Peterborough Astronomical Association
536 Robinson Road RR #1
Peterborough, ON K9J 6X2

Autum's Skies in Full Bloom

Medusa's Head. Meet Medusa, not everyone's idea of a dream date. To learn more about the autumn constellations pick up Terry Dickinson's NightWatch. It has easy-to-read constellation charts for all the seasons.

John Crossen

In the east nearly all the cast from "Clash of the Titans" is sky high. To the north, the Big Dipper hugs the treetops. To the south, the faint constellations Aquarius and Capricornus quietly rule their chunk of celestial real estate. And in the west Ophiuchus, Scorpius and Sagittarius are slipping towards the horizon along with the setting Sun.

For the seasoned stargazer, the east is where the action is. In September we had to stay up past midnight to catch the Clash of the Titans cast. Now the constellations representing the major players are all on stage by 10:00 p.m.

High in the eastern sky is the vain Queen Cassiopeia. Nearly overhead is the weak-kneed King Cepheus. Midway up the sky is their lovely daughter Andromeda and to her left is handsome Perseus, our hero. With the cast assembled, our tale of vanity and near disaster goes like this.

Queen Cassiopeia was walking along the beach one morning when she stopped to chat with some mermaids. During the course of the conversation the topic of discussion turned to beauty. That's when Cassiopeia stuck her foot in her mouth.

The vain Queen asserted that not only was she more beautiful than the mermaids, but that she outshone the goddesses, including the wife of Zeus, the king of the gods. That left the mermaids a tad peeved and they immediately snitched to Neptune (methinks it was Poseidon, Neptune being Roman. ***editor***.), the god of the sea, about Cassiopeia's arrogance.

Neptune then recanted the tale to Zeus who blistered with anger. As punishment

See "Titans" on page 15

September Conjunctions

Waxing Crescent Moon and Venus. Photo by Rick Stankiewicz.

Rick Stankiewicz

This past month was an interesting one for eye catching conjunctions. If you are a follower of *SkyNews* or other sources of upcoming celestial events, you would have been forewarned of the attached events. On September 8th the waxing crescent Moon was less than 2 degrees south of Venus. I captured my image while enroute to the Buckhorn Observatory for an observing session. What a striking pairing it was.

The morning of this same day had Mars going through the Beehive Cluster (M44) in the early morning sky, but hazy skies stopped me from recording any images, but I know John Chumack of Ohio had better skies and he was on top of things and did record the event.

Then the very next day, right after sunset, the Moon was south of Saturn and Venus was "sinking" fast toward the western horizon, but shining brightly. I used the same camera settings as above, but had the lens set at 50mm. A thin layer of clouds near the horizon threatened my efforts to get an image, but patience paid off. Saturn was barely visible because of the clouds, so I zoomed in to 150mm and increased the ISO to 400 and I still had to increase the exposure to 3.2 seconds. The Moon shows some "earthshine" and the clouds below it must have had a high uniform moisture level to reflect the iridescence seen here. Saturn shows up nicely though about 5 degrees away.

I hope you had an opportunity to witness these events yourself as they are eye catching to say the least and not a common sight.

See "Conjunctions" on page 13

The PAA is a Twitter

As of the first week in September the PAA now has a Twitter site. Some members may be saying, "That is amazing" while others may be asking, "What is a Twitter?" While many younger people are leaving Facebook for Twitter as a way to communicate and stay in touch, the PAA is jumping right into the cyber-age in which we live. Twitter is a means by which to send small bits (maximum of 140 characters at a time) by way of your electronic devices (phones, tablets, and computers). The user has the option to engage or be a passive onlooker. I see it as a form of cyber-"spoon feeding". I say this because if you were a "follower" of the PAA Twitter site (https://twitter.com/PtbAstronomical), you will automatically be sent little text messages about all PAA events, meetings and astronomy related "happenings". This means you would not have to remember to check the PAA website on a regular basis, instead reminders and astro tidbits will come to you.

This all came about because of a chance meeting between the PAA Publicity Director and a generous, keen young lady with an interest in astronomy, who also happens to be a local graphic designer ("Natalie Graham Designs and Media" at http://nataliegraham.carbonmade.com/). After the Perseid Meteor event on Armour Hill in August, Natalie asked me if the PAA was on Twitter and I told her we were not and she was curious why not, given it is such a popular means of communication and information sharing (at least among the younger crowd). I indicated that likely not many of our members were Twitter followers and did not Tweet (communicating on Twitter) and therefore no one would be willing to set-up and maintain such a site for the club. At this point Natalie said she would volunteer to do this for the PAA. She pointed out she had a keen interest in astronomy and that this would keep her "plugged into" the hobby and the PAA would be able to tap into a market or interest group that it might currently be missing. In other words it is not important whether current members of the PAA are on Twitter, but rather that the PAA could link with those on Twitter to share information and communicate accordingly. Sounded like a perfect match. The executive decided that we should give it a try and it looks like, "the rest is history".

So, if you like, check out the above link to the PAA Twitter site and you can sign up to become a "follower" and who knows, maybe you will become a Tweeter and engage with the PAA in a different way because "the PAA is all a Twitter" these days with all the excitement around it's new Twitter site.

Publicity Director,
Rick Stankiewicz

Martian History is All Wet

John Crossen

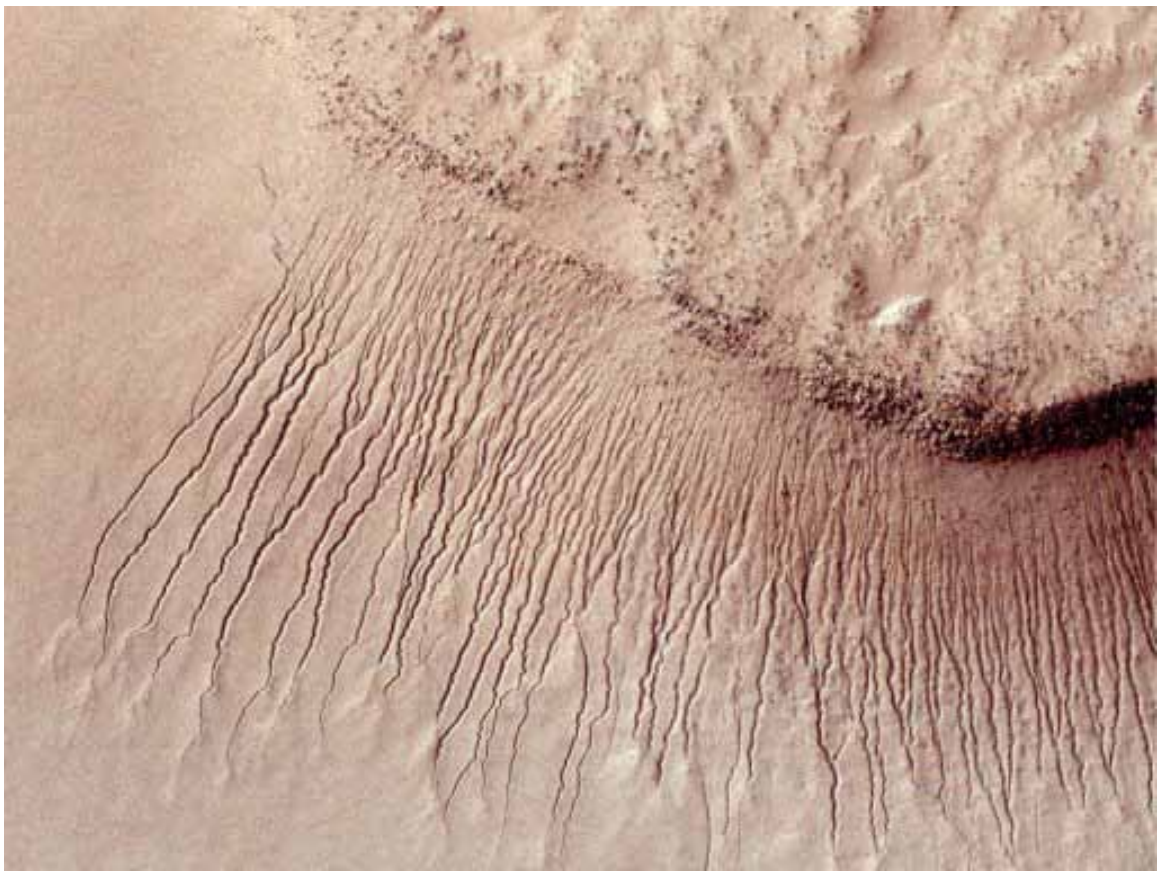
Ten years ago when the Opportunity and Spirit Rovers first set wheels on Mars, Principal Investigator Steve Squires said "follow the water" if you're looking for signs of life on Mars. That's just what happened—with repeated success. But it wasn't just the Rovers' divining rods that twitched as they compiled a raft of evidence for water on ancient Mars. Other eyes were also on the lookout.

In 2007 the European Space Agency's Mars Express's radar bounced off rich layers of water ice around the Red Planet's Polar Regions. A year later NASA's Phoenix Mars Lander dug an 8cm-deep trench and, surprise, surprise, more ice came to light. Most recently NASA's new Curiosity Rover found itself at the bottom of what used to be a stream flowing across the Martian surface. It is a region whose name is sure to warm the hearts of Canadians back here on Earth: Yellowknife Bay.

By analysing the rocks and soil samples scientists could tell that the water in this ancient stream was neither too acidic nor alkaline. It was, in fact, good enough to drink. This is a surprising contrast to the findings of the Spirit and Opportunity Rovers.

Both the earlier rovers landed in areas where the samples tested showed the liquid to be more like sulphuric acid. That's a long way from Curiosity's "good enough to drink" stream. So why is there such a difference between different areas?

see "Water on Mars" on page 14



Water Marks. These trails, which fade during winter and reappear in warmer months, could be evidence of liquid water on the red planet.

Mars One

Proposed Mars One Colony. If you wanted this to be your future dream home, I'm sorry say that you've missed the August 31, 2013 cut off. Still you can always join the NASA astronaut program. Their current Mars lift off date is in 2043.

John Crossen

The $6-billion project is called Mars One and aims to place a permanent colony of Earthlings on Mars in just 10 years. That's just half the time that NASA currently has plans for such a mission.

Originated by Dutch entrepreneur Bas Landorp, the first four settlers will land on Mars in just one decade. They will be followed by more groups of four at 2-year intervals.

The first group of Mars colonists will prep the landing site with a terrarium in which to grow vegetables for their future compatriots. You'd better be a vegetarian because livestock consumes too much feed to be an economical food source. Then there's the matter of finding potable water.

The one-way mission may even fall short of that. There are risks at every point, starting with the launch. If the launch succeeds, there is a lot that can go wrong on the one-year journey to Mars. Sickness and mechanical failures in the myriad systems and subsystems required to keep our traveller's alive top the list.

Assuming that our team withstands the mental rigors of living together in the close confines of a capsule and get to Mars, landing is another phase of major concern. One human, computer or mechanical failure and it's too late for a "Plan B."

Having avoided all the hazards of space travel, there are still problems and dangers involved in setting up a colony on Mars. Solar radiation is a big one. Mars has no thick atmosphere to protect our Martian village people from the harmful rays. This would make sickness from cancer a distinct danger.

see "Mars One" on page 15

PHOTO GALLERY

NGC 7000

A portion of the NGC 7000 region of the Cygnus Cloud. This the lower eastern portion of the region taken in Hα (Hydrogen Alpha 600 Å).

This entire image here covers about a one dgree field of view.

Taken with a Williams Optical 110 with flat .8 field reducer using both Red and Hα Bader filters on a 6303e CCD cooled camera at the dark sky preserve at the Nutwood Observatory, Bancroft Ontario Canada.

Brian McGaffney

Mars in the Bee Hive

While everyone was busy watching Venus and the Crescent Moon the last two nights, I was also following Mars as it visited the Beehive Cluster, M44, visible low in in the Morning Sky just before dawn!

Here are my composite shots from the three mornings of September 7-9 as Mars cruises rapidly from day to day.

Although M44 is a naked eye visible star cluster from a dark location, you don't need dark skies to take a look as city dwellers can still get a fine look at this bright pairing with a pair of binoculars!

Photo details:

Celestron CG-4 Tracking Mount, modified Canon Rebel Xsi DSLR and Canon 70-300mm lens set to 200mm, f/6.3, ISO 800, 1 × 5 minute exposure each day.

Best Regards,

John Chumack
www.galacticimages.com

Diamond's Are an Astronaut's Best Friend

John Crossen

If astronomers are right, there could be an exoplanet made of diamonds out there. But it's 40 light-years away. Before drilling into the subject, let me explain a few terms.

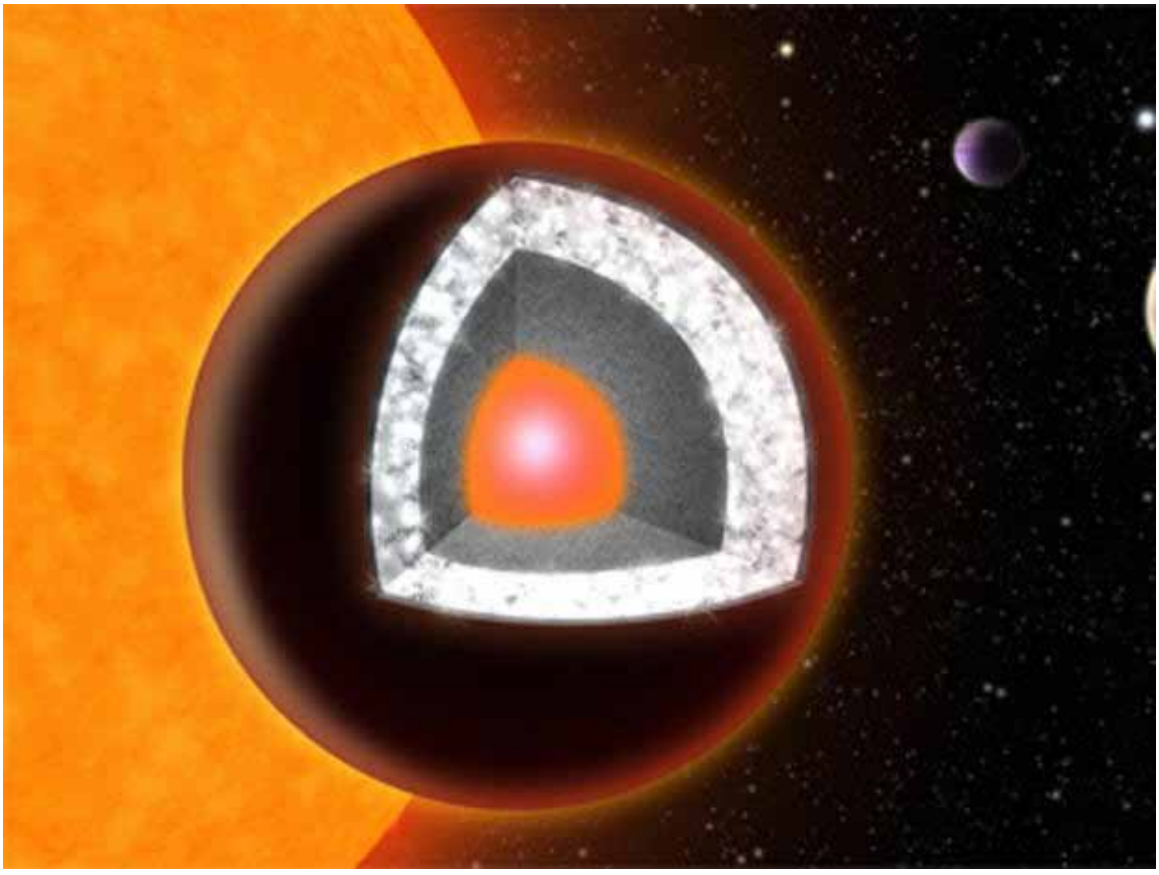
An exoplanet is a planet orbiting a star other than our Sun—yes, our Sun is a star. The closest exoplanet we know of is Alpha Centauri B. It orbits a star known as Proxima Centauri in the southern constellation of Centaurus. It is relatively close in cosmic terms—just 4.3 light-years away. What's a light-year?

It's the distance a beam of light would travel in one year. Light travels at 300 thousand kilometres per second so over the course of a year that distance stretches out to a mind-numbing 10 trillion kilometres. In just one second a beam of light would circle the Earth 7.5 times. That's zippy!

Our exoplanet diamond dream goes by the unromantic title of 55 Canceri e. It is in the constellation Cancer the Crab and is visible to the naked eye. That's good because for the time being you'll only be able to stare at it and drool.

Using the fastest rocket we have today it would take us just under one million years to reach the little gem. So don't forget to pack your toothbrush, fresh undies and those all important immortality pills.

See "Diamond Planet" on page 13



Artist's rendering of 55 Canceri e. To date nearly 1 thousand exoplanets have been discovered and catalogued as they orbit distant suns. Of them 55 Canceri e is the most intriguing. Astronomers think that it may be covered in a layer of graphite, beneath which is a wealth of diamonds. If you have access to a star chart find the star 55 Canceri. That's the home to your celestial diamond mine.

We're Celebrating Anniversaries on Saturn and Mars

John Crossen

Life in outer space is just one hazard after another. That goes for satellites and robots as well as humans. Mankind or machine, you are bombarded by solar radiation constantly. Micrometeors can pierce your thin skin at any time. And the temperatures can plummet to minus 175 degrees Celsius.

As life-spans in space go, the Opportunity Rover, Mars Express Orbiter and the Cassini Mission orbiting Saturn are senior citizens at the ripe old age of ten.

That's not bad considering the fact that the Opportunity Rover was only expected to last 90 days and the European Space Agen-

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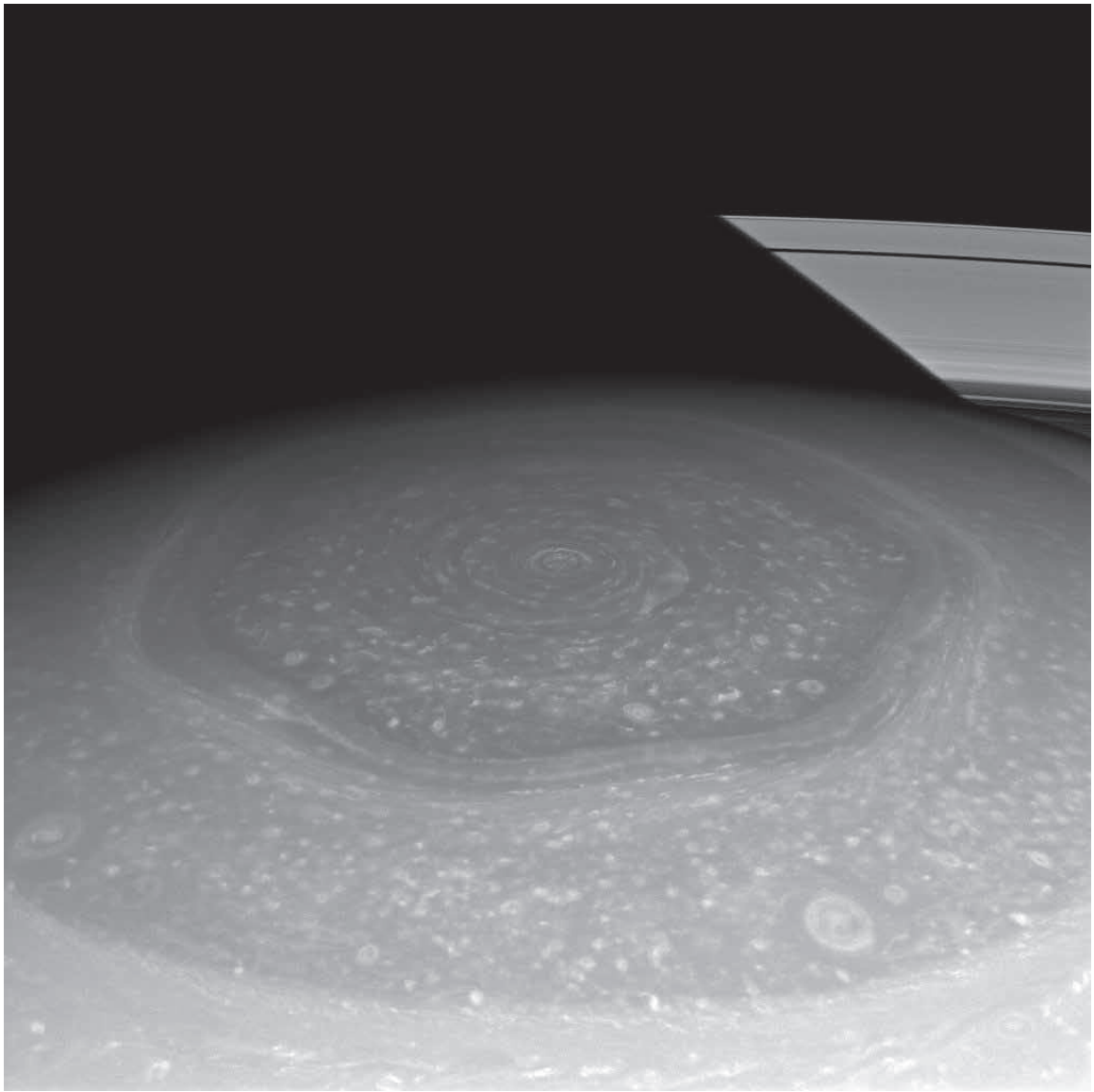

Hexagon on Saturn's Surface. Discovered in 2007, there is a hexagonal shaped formation on top of Saturn that is large enough to hold four Earths and goes 60 kilometres deep into the planet's atmosphere. It hasn't moved since it was discovered. Yet another mystery to be solved!

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Anniversaries

cy's Mars Express warranty was expected to run out in just 24 months. The Cassini spacecraft orbiting Saturn is now approaching its first decade of discovery and has had its mission extended yet again.

So what have we learned from these old timers? Let's start with the youngest of the bunch, Cassini.

Cassini has shown us that Saturn's rings are made mainly of water ice—just like you put in your pop. Some are chunks as big as a house. Others are like pebbles. Cassini even flew through a gap in the rings.

Cassini also packed a second spacecraft onboard, the Huygens Lander. In 2005 the Lander was launched from Cassini and parachuted down to Saturn's moon Titan. Prior to the Huygens Lander all we knew about Titan was that is was the second largest moon in our solar system and that it was shrouded in mist. Huygens changed all that.

Cameras onboard the Lander recorded the drop down through the clouds to an amazing surface below. Huygens discovered a world where methane flows like water and water is frozen as solid as granite. It has similar land formations as Earth with lakes and streams flowing into them. But it wasn't water, it was ethane and methane. One large methane lake looked so familiar it was named Lake Ontario!

The similarities continued as analysis of the red mist turned out that it was similar to Earth's atmospheric pollutants. The large amount of methane on Titan makes the atmosphere seem like L.A. haze on steroids.

Cassini also discovered amazing ice geysers on Saturn's moon Enceladus. These geysers are specific to one region called the Tiger Stripes. The material gushing from them hints that there could be liquid water and perhaps life forms beneath the moon's eerie-looking surface. Analysis also confirmed that Enceladus is also the material source of Saturn's diaphanous E-ring.

We'll review some of the other discoveries that have been made by our intrepid rovers and orbiters in the future. But one thing is certain, the more we know, the more questions we have.

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Diamond Planet

Actually our little gem isn't so demur. Scientists estimate its size at about twice that of Earth and its mass at 8 times greater than terra firma, so it's very tightly packed.

The star that 55 Canceri e orbits is about the size of our Sun. But all similarities end there. 55 Canceri e is so close to its Sun that one orbit around it takes only 18 Earth hours. So as you might guess, it's a real hot spot.

The surface temperature is estimated to be about 1,750 degrees Celsius and the surface is layered in graphite. So a non-melting mining operation will be needed to bore down and extract the diamonds.

But take heart, 55 Canceri e is one of five planets orbiting the same sun, and some are farther out, so they would be cooler. Given that the star which is the progenitor of 55 Canceri e is high in carbon content, perhaps the other exoplanets are also little bags of diamonds waiting to be explored and mined.

Other so called "diamond planets" have been discovered elsewhere in our cosmic neighbourhood, but don't expect to visit them soon either. 55 Canceri e is the closest to home and it is 368 trillion kilometres away.

Until we meet again by the backyard telescope, keep your outdoor lights dimmed down and pointed down. You'll save energy and the diamonds shining in our dark Kawartha night sky.

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Conjunctions

Waxing Crescent Moon and Venus (top) on September 9, 2013. Note Venus is further away. Detail of Venus and Saturn from the same night but using a 150mm focal length lens. Photo by Rick Stankiewicz.

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Water on Mars

Our exploration of Mars is just beginning. To date four Rovers and one fixed Lander have touched down on the Martian surface. While the landing sites have been carefully chosen to yield the best results, the surface area explored is small. At their best the Rovers have limited power, speed and distance. It would be like landing in half a dozen different locations on Earth, running some tests and combining the data to produce an accurate picture of ancient Earth. In short, it would be impossible.

Now we are looking at the possibility of water existing on the surface of Mars today. NASA's Mars Reconnaissance Orbiter has taken several high-resolution images of the Martian surface indicating that water may surface in some areas on a seasonal basis.

They show evidence of running water in the form of ruts and streams that weren't there when the same area was imaged previously. Before you start organizing a surfing party, be forewarned that some of those "water trails" have already turned out to be chunks of dry ice (carbon dioxide). They slid down the sandy surface and sublimated straight into the Martian atmosphere leaving nothing behind but a dent in the sand.

Today it is virtually impossible to find an astronomer who doesn't believe that Mars was once a watery world with oceans, streams and probably life. That's important because water ice can be melted and, if potable, used by future Martian colonists. Plus water is essential in making rocket fuel. There are, after all, more planets to explore.

The Sky this Month

Mercury lies 3° south of waxing crescent Moon on the 6th. Reaches greatest elongation east (25°) on the 9th and passes 5° south of Saturn on the 10th.

Venus is in the south-west evening sky moving eastward into Scorpius. Passes 1.6° north of Antares on the 16th. On the 8th waxing crescent Moon passes 5° north.

Mars in the morning sky in drifting eastward into Leo. Lies 1° north of Regulus on the 15th. Waning crescent Moon passes south a few degrees on the 1st and the 30th.

Jupiter rises in the east-north-east in late evening in Gemini. A triple shadow transit on the 12th begins at 12:32 a.m.

Saturn vanishes into the evening twilight late in the month.

Orionid meteor shower peaks at 7 a.m. on the 21st.

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

Moon Phases

New Moon	8:34 PM	October 4
First Quarter	7:02 PM	October 11
Full Moon	7:38 PM	October 18
Last Quarter	7:40 PM	October 26

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Titans

for such vanity he commanded Neptune to turn the Kraken, a deadly sea monster, loose on the kingdom over which Cassiopeia and King Cepheus reigned.

The destruction wrought by the Kraken was devastating and Cepheus soon sought an audience with Zeus. The two met, and as amends for Queen Cassiopeia's conceit, it was agreed that Cepheus would chain Andromeda to a rock and allow the Kraken to dine on his daughter. I'm sure beautiful young girls are not on the Canada Food Guide, but when in the Acropolis do as the ancient Greeks did.

Happily for Andromeda, Perseus was flying over on his winged horse Pegasus, yet another nearby constellation.

Perseus had just beheaded Medusa the snake-haired Gorgon. He carried her severed noggin in a sack so that none would gaze upon her hideous face and be turned to stone. But when he looked below and saw the Kraken about to snack on Andromeda, he immediately knew what to do.

He and Pegasus swooped down in front of the Kraken. Perseus pulled Medusa's head from the bag and one glance later the Kraken was turned to stone. As the Kraken sank to the bottom of the sea Perseus freed Andromeda from her chains and—you can see this one coming—the two lived happily ever after.

(*Editor's note: The Kraken from the movie is represented by Cetus, the Whale, in our night sky.*)

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Mars One

While there is a near endless list of problems to overcome, that hasn't stopped 160,000 adventurous Earthlings (7,000 of whom are Canadians) from signing on for the one-way trip. They've all explored the down side of their final journey beyond the inherent dangers of getting to Mars alive.

Imagine never seeing your family and friends again—ever. Let's say you meet someone in the Martian colony, marry and start a family. You can't visit the relatives, so all they'll ever see are the pictures you send. You are going to live out the rest of your life and die on Mars.

To some the chance to spread the human race to another planet is worth it all. Others have cited advancing our knowledge and the opportunity to explore distant worlds as their lure. Still more think that eventually Earth will be destroyed by a solar storm, greed and misuse of natural resources or an asteroid. So we have to colonise other worlds so that our species can survive.

Between now and liftoff in 2023 a lot can change. People grow older. They change their minds. They start families they can't leave behind and some will be too old or die. I hope I'm still around to find out how it all goes.

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Supernova

lapse. When they run out of fuel, the core implodes.

The inrushing matter approaches the center of the star, then rebounds and bounces outwards, creating a shockwave that eventually causes what we see as a core-collapse supernova, the most common type of supernova in the Universe! These occur only a few times a century in most galaxies, but because it's the most massive, hottest, shortest-lived stars that create these core-collapse supernovae, we can increase our odds of finding one by watching the most actively star-forming galaxies very closely. Want to maximize your chances of finding one for yourself? Here's how.

Pick a galaxy in the process of a major merger, and get to know it. Learn where the foreground stars are, where the apparent bright spots are, what its distinctive features are. If a supernova occurs, it will appear first as a barely perceptible bright spot that wasn't there before, and it will quickly brighten over a few nights. If you find what appears to be a "new star" in one of these galaxies and it checks out, report it immediately; you just might have discovered a new supernova!

This is one of the few cutting-edge astronomical discoveries well-suited to amateurs; Australian Robert Evans holds the all-time record with 42 (and counting) original supernova discoveries. If you ever find one for yourself, you'll have seen an exploding star whose light traveled millions of light-years across the Universe right to you, and you'll be the very first person who's ever seen it!

Read more about the evolution and ultimate fate of the stars in our universe: http://science.nasa.gov/astrophysics/focus-areas/how-do-stars-form-and-evolve/.

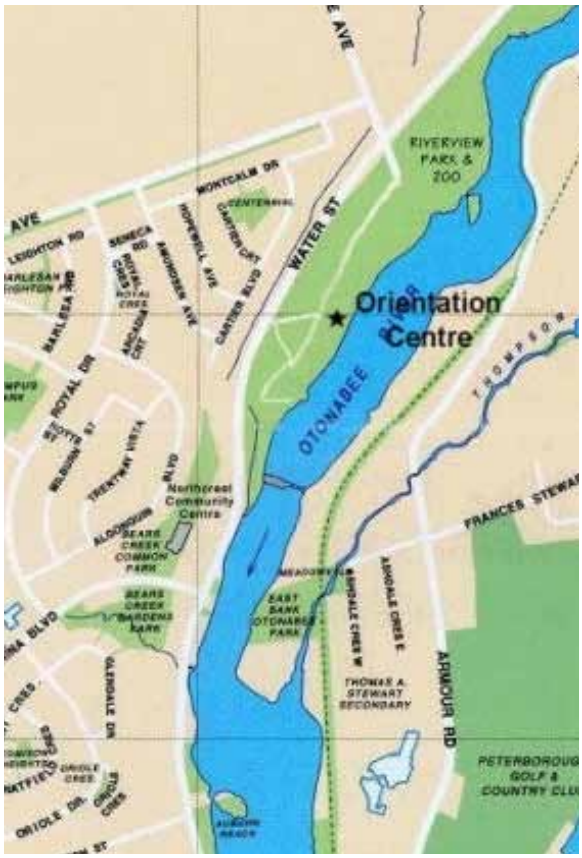
While you are out looking for supernovas, kids can have a blast finding constellations using the Space Place star finder: http://spaceplace.nasa.gov/starfinder/.

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:
October 28, 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.