Peterborough Astronomical Association
The Reflector
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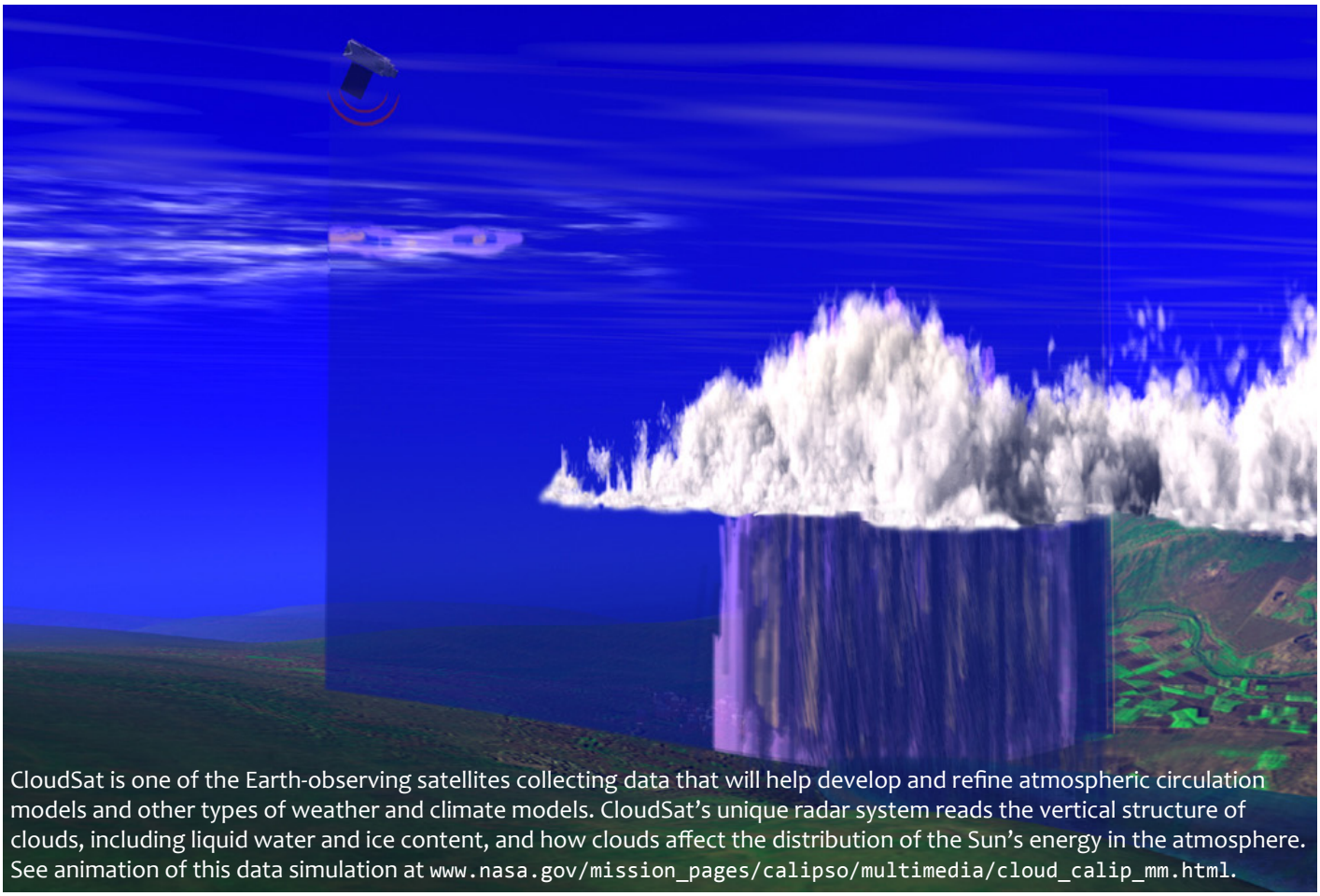
The Planet in the Machine



CloudSat is one of the Earth-observing satellites collecting data that will help develop and refine atmospheric circulation models and other types of weather and climate models. CloudSat's unique radar system reads the vertical structure of clouds, including liquid water and ice content, and how clouds affect the distribution of the Sun's energy in the atmosphere. See animation of this data simulation at www.nasa.gov/mission_pages/calipso/multimedia/cloud_calip_mm.html.

by Diane K. Fisher and Tony Phillips

The story goes that a butterfly flapping its wings in Brazil can, over time, cause a tornado in Kansas. The "butterfly effect" is a common term to evoke the complexity of interdependent variables affecting weather around the globe. It alludes to the notion that small changes in initial conditions can cause wildly varying outcomes.

Now imagine millions of butterflies flapping their wings. And flies and crickets and birds. Now you understand why weather is so complex.

All kidding aside, insects are not in control. The real "butterfly effect" is driven by, for example, global winds and ocean currents, polar ice (melting and freezing), clouds and rain, and blowing desert dust. All these things interact with one another in bewilderingly complicated ways.

And then there's the human race. If a butterfly can cause a tornado, what can humans cause with their boundlessly reckless disturbances of initial conditions?

see "System Science" on page 16

President's Message

Good-bye Winter

Here we are in one of two best times of year for observing. Spring and fall. Some great skies, no mosquitoes and you don't have to wait until 11:00 p.m. to start your journey across the Galaxy.

As I write this we are one week away from our first publicized event for this year, "Earth Hour on the Hill." We can only hope the skies are clear so that we can introduce members of the public to the delights above. Please come out and give us a hand with this activity. If you have a portable telescope by all means bring it along. If you don't have observing equipment we can always use your help whether it be talking to the public, answering questions or keeping the president company down the hill at Checkpoint Charlie.

April once again means the annual Peterborough Regional Science Fair is upon us. I'm happy to say we expect to have five judges this year at Trent University. A record I believe and helps raise awareness of the PAA. Of course the Frank Hancock Award will once again be presented to the student with the best astronomy related exhibit.

Looking ahead we need to focus on "Astronomy on the Hill" in May. I've include a copy of the poster for this year's event. It's basically a re-arrangement of last year's poster.

Rodger Forsyth
PAA President

Good Fortune

Letter from the Editor

As this newsletter is being edited in March during Canadian Music Week I thought it *à propos* to bring to light the affinity many Canadian musicians have with things astronomical. I have been meaning to write up an essay on this very topic but have put it off. But listening to Neil deGrasse Tyson on CBC Radio's Q (http://www.cbc.ca/video/news/audioplayer.html?clipid=2216393889) reminded me of this connection between Space and the Arts.

There's the obvious David Bowie (*Space Oddity*, *Ziggy Stardust*, *Life on Mars?*), Elton John (*Rocket Man*), and Queen (*Bohemian Rhapsody*). Then there's the Canadian artists. The most celebrated astronomical musicians would be Rush, of course, with *Cygnus X-1*. In recent years there have been a number of Canadian bands with names like Young Galaxy, Stars, or have songs with that reference astronomy. Here I can think of Metric's *Twilight Galaxy* and *Eclipse* (from the Twilight movie *Eclipse*), Great Lake Swimmer's *Still*, The Tragically Hip's *Bobcaygeon*, or Sarah Harmer's lyrics from her Weeping Tile-era song *Good Fortune*:

And now I'm leaning back against your warm coat
Under a setting galaxy
Orion's belt with all I felt
It was a wonder I could see
There in that clearing where the treeline's shadows
Impose on the blacker sky

Good Fortune, indeed.

Phillip Chee
Editor, The Reflector

Peterborough Astronomical Association

The Reflector is a publication of the Peterborough Astronomical Association (P.A.A.) Founded in 1970, the P.A.A. is your local group for astronomy in Peterborough and the Kawarthas.
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Astronomy on the '12 Hill

May 12 8:00pm to 12:00am
Night viewing on Armour Hill.

May 13 12:00pm to 4:30pm
Activities at the Museum -
Enjoy solar viewing, a planetarium and displays.

FREE ADMISSION

The Museum and Armour Hill are located at 300 Hunter Street, East in Peterborough.

PETERBOROUGH ASTRONOMICAL ASSOCIATION
WWW.PETERBOROUGHASTRONOMY.COM

Peterborough Museum & Archives

Buckhorn Observatory

for more information
705-743-5180
www.peterboroughastronomy.com
www.peterboroughmuseumandarchives.ca
www.buckhornobservatory.com

PAA Visits Clarington Museums and Archives

John Crossen with David Cox, David`s wife Anne and their two kids at the Clarington Museums and Archives on March 9, 2012.

Boyd Wood

The Peterborough Astronomical Association was at the Clarington Museums and Archives in Bowmanville on March 9th and 16th to give presentations and do some observing. Things started off a little slow on the 9th but ended with a larger crowd on the 16th.

On March 9th, John Crossen and I went to the Clarington Museums and Archives in Bowmanville. There we were met by David Cox, Clarington Museums and Archives Programme Co-ordinator, David's wife, Anne, and their two children. David gave us a quick tour of the museum and his space/astronomy themed displays. He had done a great job with such things as a floor model demonstration of a black hole and a huge poster of earth-rise as seen from the Moon.

Being the first day of March Break, we had a very small turnout, just David and his family and John Crossen and myself. While we waited for more people to arrive, we decided to watch John's presentation. After the presentation we had a tour of the dome that was on loan from the ROM. Amazingly, it looked a lot like our's. John and David took us on a tour of the night skies. After the tour we went outside to do some observing. Alas, after all the waiting for more sky tourists, we had missed the best skies of the night as clouds had moved in.

Venus was still well up but was peeking in and out of cloud cover. However it still

See "Clarington" on page 15

Winter's Constellations are Heading West For Spring

Spring Constellation Chart. Each season brings a new cast of constellation characters to meet. Cancer, Leo and Virgo are the prime players in the spring. Hydra, Corvus and Crater are the supporting cast.

John Crossen

It's time to say farewell to Orion, Gemini and Canis Major as the big three winter constellations prepare to dip below the western horizon for another year. But looking to the east, we have a whole new cast of characters to greet, plus the parade of planets continues with Saturn added to the mix.

Leo the Lion is high in the southern sky with Mars marching close to the bright star Regulus. Just in front of the lion's nose is the dim constellation Cancer the Crab. The binocular brigade can spot the open star cluster M44, also known as the Beehive, at the centre of Cancer. It appears to the unaided eye as a very faint misty patch, but bursts into full glory in binoculars.

Following Leo is the constellation Virgo. It will be home to the ringed planet Saturn for the next few months. Saturn's rings will be favourably tilted towards us so that those with telescopes will be able to see the Cassini division and the ring shadow across the planet. They will also have the famous Virgo Galaxy Cluster to muddle through. Representing the tuft of the lion's tail is Coma Berenices. It's an interesting target to the naked eye as well as binoculars.

Beneath Leo, Hydra the Water Snakes stretches across the sky, almost touching the southern horizon. Riding the back of the snake are Crater the Goblet and Corvus the Crow.

See "Spring Constellations" on page 15

Winter Beacons

The brightness of Venus and Jupiter on a clear night this past month has been spellbinding! I stopped on my way home from a meeting this evening (March 13th) and caught the reflection of this celestial pairing in a patch of open water south of Peterborough, along Cty. Rd. #35. Not even the light pollution of the city could take away from this brilliant pair. I just used a tripod mounted digital camera and 28mm lens setting. These two planets (Venus at Mag. -4.5 and Jupiter at Mag. -2.7) were about 3 degrees apart for the next few nights. That is just about a thumb width apart, at arms length.

The very next evening the skies continued clear and I was ready and captured the next twilight shot with a lone "wolf tree" along the Crowley Line south of Peterborough.

This is the closest you will see these two for sometime, as Jupiter has quickly started to dive for the western horizon each evening. These two brightest planets are still putting on a nice show and have been true winter beacons that has led us into spring. Enjoy it while you can and keep looking up!

Guided by the light,
Rick Stankiewicz

The Moon Has Stretch Marks and Shows Us its Backside

Farside of the Moon. Here's the picture you've waited a lifetime to see. To see the whole video visit www.youtube.com and call up "MoonKAM" for the launch video and "dark side of the Moon 2/2" for a video tour of the Moon's backside.

John Crossen

Ever since Apollo astronaut Buzz Aldrin described the Moon as a "magnificent desolation" we've all thought of our celestial neighbour as dead. No atmosphere means there's no weather or winds, no tectonic plates spell no surface tension or shifts and any volcanic activity ceased a billion or so years ago. But wait, NASA's Lunar Reconnaissance Orbiter (LRO) has images that show the Moon's crust is being stretched.

At 4.5 billion years old, the Moon might just be ready for a face lift. The high-resolution images the LRO has taken show some stretch marks. Scientists estimate that they occurred less than 50 million years ago. That's recent history for the Moon.

The stretch marks — narrow trenches in the lunar surface — are evidence that the lunar crust is being pulled apart forming narrow valleys called graben. These formations occur when the Moon's surface is stretched between two adjoining faults. The result of the stretch causes the surface to break and ultimately drop to form a graben. While rare, grabens have been found in a few other spots across the Moon's aging face.

Their cause has been attributed to the fact that the Moon is slowly contracting because its interior is still cooling and growing smaller. Discoveries like this can help scientists better understand how the Moon formed and what is still taking

See "Farside" on page 14

PHOTO GALLERY

Rosette Nebula

Rosette Nebula. NGC 2237. Taken March 14, 15 and 16 from the Nutwood Observatory. Using a Williams Optics 132mm f/4.5 telescope, on an ME mount with an SBIG 6303e. This large object (80 × 80 arc min.) is in the constellation Monoceros. Total acquisition time about 16 hrs.
Thanks
Brian McGaffney

March Moon-Planets Conjunction

On February 25 and 26, 2012, the crescent Moon took a path between Jupiter and Venus, paying a "neighbourly" visit to each planet on subsequent nights. The left image shows the Moon a few degrees north of the Jovian planet. The right image, taken the following night has the Moon stopping by Venus. Both photos were taken towards the end of nautical twilight with a Nikon D200 DSLR. The lens used on the 25th was a Nikkor 35mm f/2D set to f/4 aperture and exposed for 5 seconds at ISO 400. The lens used on the 26th was a Nikkor 17-55mm f/2.8G set to 38mm. The ISO was 800 and the aperture was f/4 with an exposure of 1 second.

Phillip Chee

Canada's Grand Old Lady of the Night is Still Looking Up

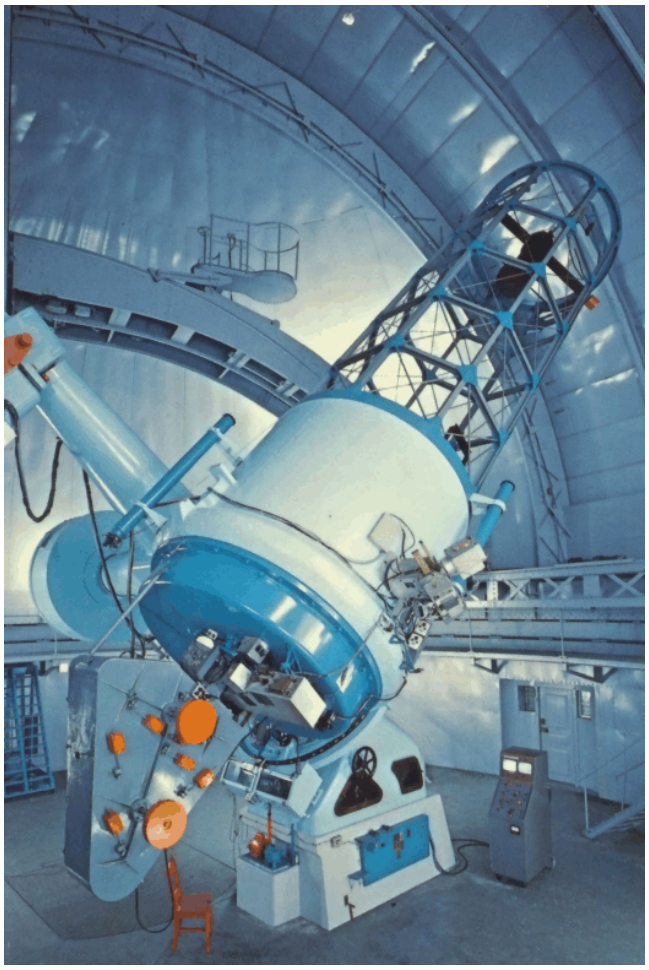
John Crossen

Recently two newspaper clippings were given to me by a student who thought they would be of interest. Indeed they were, so I'll pass the information on to you.

The first article dealt with the David Dunlap Observatory (DDO) in Richmond Hill. A number of people seem to think that it is closed because the University of Toronto sold the land to a real estate developer. The fact is that the dust hasn't settled yet.

Visitors to Buckhorn Observatory frequently ask about the DDO and I've been happy to tell them that the observatory is still up and running. The same goes for the adjoining class/office/lecture building. It's all thanks to a devoted group of volunteers from the Toronto Chapter of the Royal Astronomical Society of Canada (RASC).

These devoted men and women have invested their time and considerable talents in repairing, maintaining and operating the huge scope. With a mirror diameter of 2-metres it is one of the largest telescopes in Canada or North America for that matter. Since it opened in 1935 the DDO and has been used for research, training and public outreach. The fate of the massive instrument — it weighs in at 23 tons — is still uncertain while the developers, local residents and the Town of Richmond Hill wrangle out the details. But one thing is for sure — the David Dunlap Observatory is still open to the public.



David Dunlap Observatory Telescope. Seventy-four feet tall, weighing 23 tons and sporting a 2 ton mirror, the David Dunlap Observatory telescope is well worth the trip just to look at. Thanks to the Royal Astronomical Society of Canada volunteers you can also look through it if the night is clear.

To say that the telescope is impressive is an understatement. Standing next to it will give you as distinct case of "the punies," Visit www.theddo.ca for more DDO historical information, public observing nights and lectures. Thank-you to the RASC for keeping Canada's grand old lady of the night looking up.

The other article was about the discovery of water on yet another exoplanet. Since 1995 nearly 1,000 of these far-flung worlds have been dis-

see "Dunap Observatory" on page 13

Jupiter Has 66 Moons

The largest planet in our solar system has always had bragging rights, but it just "upped the anti". It has always reigned supreme in size and having the most moons (natural satellites) at 64, for years, with Saturn a close second at 62 moons, but on February 9th, 2012, it was reported that another 2 moons were added to Jupiter's total. The latest discovery brings the gas giants total to 66. I guess this means we have just been "mooned" again? Wow, will it ever end. The newest little satellites are only about 1 km in size and have huge slow orbits that take from 1.6 to 2 years to complete. This is really slow given that Io (the closest satellite of Jupiter's), takes only 1.8 days to complete its orbit! The new moons were discovered on Sept.27th, 2011 by the optical Magellan Telescope in Chile.

It is amazing what we continue to learn about the universe just about everyday, but even our own backyard (cosmologically speaking) still continues to yield secrets. That is one neat thing about astronomy, it is never static for long.

Factoid finder,

Rick Stankiewicz

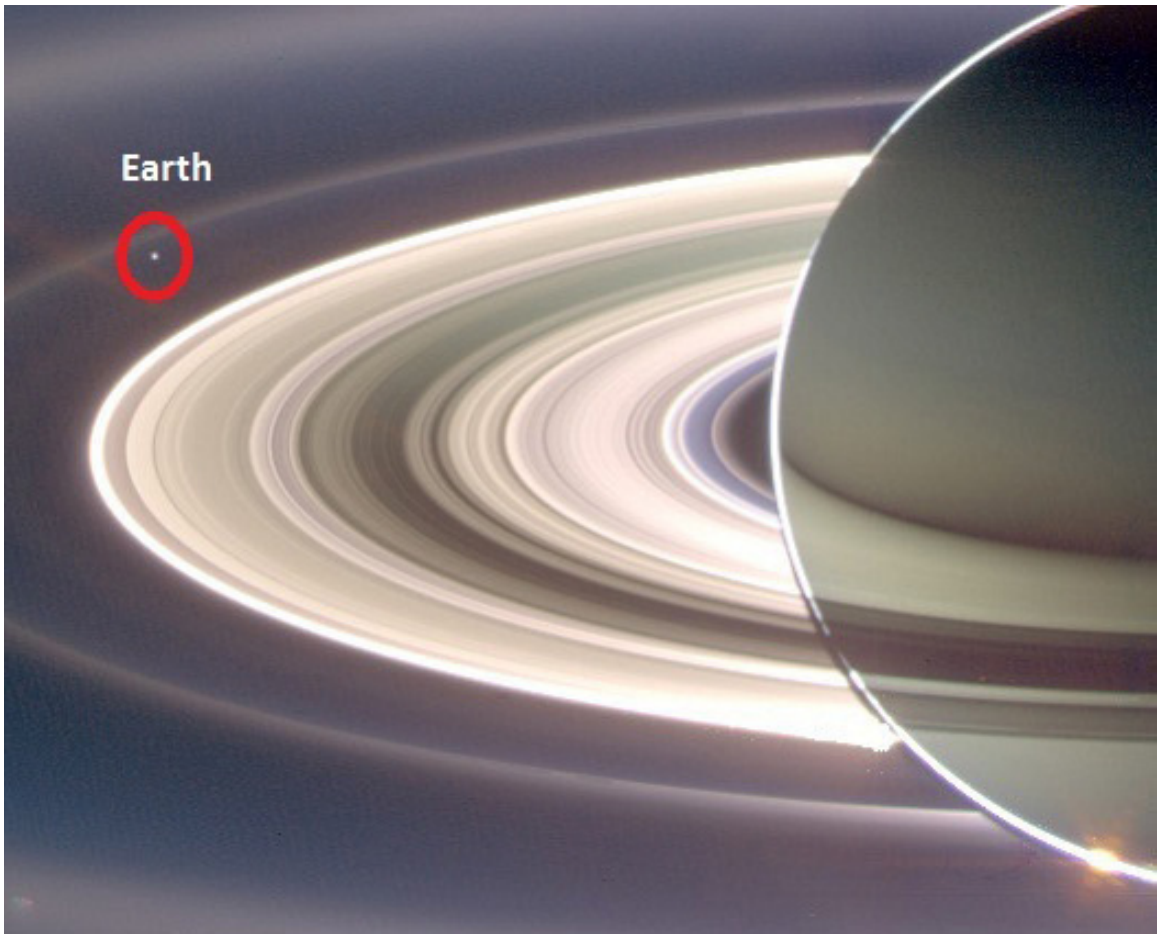
Closer to the Equator

During a recent visit to Mexico on the Mayan Riviera, I tried to get a shot at our resort of a little different looking night sky. There was still the usual cast of characters like Orion and Canis Major, but there was this bright star, Canopus well below Sirius. It was nice to be able and compare the two in the same sky given that they are the two brightest stars in the entire night sky (magnitude –0.72 and –1.46 respectively). Then I realized that if I could see Canopus I should be able to see Puppis and Pyxis and there they were in my images, dim, but still there. Sure there was lots of light pollution at the resort, but it never stopped me from enjoying a little different view a little closer to the equator (20 degrees latitude, to be exact).

Keep looking up (even on vacation)!

Rick Stankiewicz

Saturn is Back Big and Beautiful



CLOSE-UP OF THE RINGS. This Cassini Mission image shows Saturn's ring system and planet Earth in the background. Courtesy NASA.

JOHN CROSSEN

AFTER A COUPLE OF MONTHS struggling to make out bits of detail on the surface of tiny Mars, Saturn pops above the horizon as a welcome target. Unlike Mars, which is half the size of Earth, Saturn is about eight hundred times larger than terra firma. So despite its greater distance, it appears much larger in a telescope.

This year the planet's rings are tilted towards us. That makes a refreshing change from a few years ago when we viewed them edge on. While it was an unusual sight, the "wow factor" was barely above zot. For 2012, Earth-bound viewers have a ring-side seat.

This year Saturn can be found in the constellation Virgo near the bright star Spica. The planet itself is classified as a Gas Giant due to the fact that any solid or liquid core that it has is buried thousands of kilometres beneath clouds of hydrogen and methane gas. This seemingly "endless atmosphere" is very active and is responsible for winds at the planet's equator of 1,800 km/h. It's a great place to fly a kite, if you can hold on.

see "Saturn" on next page

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Saturn

Saturn's beautiful rings are what set it apart from the other planets. Unlike the rings of Jupiter, Uranus and Neptune, Saturn's rings are highly visible. Galileo could actually see them through his telescope in 1610. Due to the poor optical quality of his gear Saturn appeared as a ball with "big ears" on either side. Later on an astronomer named Cassini was able to see that the "big ears" were rings that encircled the planet.

The rings are a multi-ring system with slight gaps between them. The largest gap now bares the name of its discoverer. It is called the Cassini Division. Cassini is also the name of the current exploratory mission orbiting Saturn. Discovering how the rings originated has been a mandate for the Cassini mission.

Planetary scientist Robin Canup has been analysing the data sent back by Cassini and has a unique theory as to how the rings came to be based on their composition. At one time it was thought that Saturn had moons which collided with each other and thereby shattered into bits that eventually came to orbit the planet. If that had been the case, they would have been composed of both ice and rocky materials. But that is not the case. The millions of chunks are nearly 95% water ice. How come?

Canup theorizes that 4.5 billion years ago as the solar system was forming, Saturn was surrounded by numerous icy moons that slowly succumbed to the giant planets gravitational pull and plummeted beneath the Saturnian clouds. But before they plunged to their doom, they were stretched and pulled so that their outer layers of ice were stripped off. Any remaining moons would have collected the ice as they continued to orbit Saturn. But they too, would eventually fall prey to the stretch/pull of Saturn's gravity. Thus what is called tidal stretching is the culprit.

During the ensuing billons of years the ice chunks have bumped and ground their way into distinct pathways around the planet. Some even have small shepherd moons that create some of the wider ring divisions.

Now that I understand a bit more about how Saturn's rings came to be, each time that I view them will have a bit more meaning to me beyond "wow they're gorgeous."

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Dunlap Observatory

covered thanks to improved technology and more precise observing techniques. Scientists now have the capability to analyse the atmospheres of the exoplanets. It isn't an exact science yet, but they can arrive at some well-educated guesses.

The latest find is called GJ1214b. Also known as "Kevin" after Kevin Costner the star of Waterworld the sci-fi flick, the planet appears to have an abundance of water.

The exoplanets discoverer, Zachory Berta says that the distant dot is like no other that we know of. "It's hot and has a lot of water. But these are initial findings and need to stand the test of time and independent analysis."

What excites me about these discoveries isn't so much finding a potential Earth twin, but the technological advances that allow us to learn so much about them by analysing little more than the dim light we can capture. I think it's far too early to claim "Earth-like" or "a second Earth". That's media hype. Besides getting to GJ1214b will be another thing. Travelling at the speed of light — 300,000 kilometres per second — it will take forty years to arrive.

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Farside

place on and within it. At present only about half of the Moon's surface has been imaged in high resolution so scientists can expect to learn more and make further new discoveries.

As long as we're on the Moon, have you ever wondered why we can't see the far side of dear old Luna? NASA has the video and you can watch it on YouTube. But first, here's why we never see the far side of the Moon.

The pull of Earth's gravity has been slowly slowing the Moon's rotation down since the Moon was created in a giant impact between Earth and another smaller planet at a time when the solar system was still forming. Originally both the Earth and the Moon were spinning faster than today. The gravitational interaction between the two bodies gradually slowed both down. But Earth was bigger and had a great deal more "tug" on the Moon than it did on us. So eventually the Moon's rotation ceased, leaving us with a view of its near side only. But all that has changed now thanks to NASA's Gravity Recovery and Interior Laboratory (GRAIL).

The two orbiters, called **Ebb** and **Flow** each have a MoonKAM attached and will eventually drop to an altitude of about 55 kilometres performing a series of experiments analysing the magnetic abnormalities and the Moon's interior.

But the MoonKAMs aren't part of the GRAIL study. They are part of a program designed to interest and excite students from grades four through eight in the sciences. The project is overseen by Sally Ride, America's first woman astronaut, and allows the students to choose different areas on the Moon's surface to video. Very cool!

The Sky this Month

Mercury in the dawn sky all month. Reaches greatest elongation west (27°) on the 18th.

Venus in western evening sky. Reaches brightest magnitude (-4.7) near the end of the month. Crescent Moon sits 6° S on the 24th.

Mars begins to dim as Earth leaves it behind. Ends retrograde motion on the 15th.

Jupiter disappearing into evening twilight by month's end. Crescent Moon passes 2° N on the 22nd.

Saturn up most of the evening in Virgo sitting 5° NE of Spica.

Lyrid Meteor Shower peaks at 1 am on the 22nd.

Moon Phases

Full Moon	1:19 PM	April 6
Last Quarter	6:50 AM	April 13
New Moon	3:18 AM	April 21
First Quarter	5:57 AM	April 29

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Clarington

gave us some good views and impressed all viewers. The view of Jupiter was not as good. Even when you could see it, the hazy cloud cover and the local light pollution obscured all of the detail. Mars even put in an appearance. Again, it too was peeking in and out of cloud cover but less so than Venus.

The event was enjoyed by those that were there that evening and we all hoped that the following week would be better.

On March 16th Rick Stankiewicz and I made a return trip to Bowmanville. This time the skies where with us so we setup our scopes as soon as we arrived. While we waited for Venus and Jupiter to make an appearance the public was arriving. We had twenty-five people out on this night. David took them on a night sky tour in the ROM dome while Rick and I waited. Just as Rick was about to set up and give his presentation, the two celestial guests arrived, David was able to find the light switch and turn off the security light pollution and the viewing began.

This night Venus and Jupiter where magnificent. Venus was at quarter phase and everyone was intrigued by how much it looked like the moon. They could not believe how bright the planet was even thought it was only lit up on one side. The details on Jupiter were excellent with its major bands and all four of its Galilean Moons visible. Mars too was visible and put on a good red show.

We even managed to spend some time on the Orion nebula. It was not as awesome as it can be because of the local light pollution but it was still impressive.

As the evening was drawing to a close, the clouds began to move in. This time we had timed it perfectly. From the comments of our guests, I believe everyone enjoyed themselves and David has invited us back.

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Spring Constellations

If you're looking for the Big Dipper, look up — way up. During the spring it is nearly straight overhead. Those with keen eyes will notice that the second star in from the end of the Dipper's handle is actually a naked-eye double. If you're like me, a pair of binoculars will make the twosome of Alcor and Mizar easier to spot.

Mark April 3 on your calendars and keep your fingers crossed for clear skies that night. That's when brilliant Venus will be crossing in front of the Seven Sisters of the Pleiades. The event will make for a beautiful sight in binoculars and also presents a photo opportunity for chroniclers of the night sky.

Venus will reach its brightest on the night of April 30. It will shine at magnitude -4.7. By comparison Sirius, the brightest star in the winter night sky shines at magnitude -1.46. So if you miss Venus, you need an eye examination and in the interest of public safety, have a friend do the driving.

That's what's up for the month of April. Until we meet again in the merry month of May, keep your outdoor lights dimmed down and the stars up big and bright. You'll save energy, money and the night sky.

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System Science

Understanding how it all fits together is a relatively new field called Earth system science. Earth system scientists work on building and fine-tuning mathematical models (computer programs) that describe the complex inter-relationships of Earth's carbon, water, energy, and trace gases as they are exchanged between the terrestrial biosphere and the atmosphere. Ultimately, they hope to understand Earth as an integrated system, and model changes in climate over the next 50-100 years. The better the models, the more accurate and detailed will be the image in the crystal ball.

NASA's Earth System Science program provides real-world data for these models via a swarm of Earth-observing satellites. The satellites, which go by names like Terra and Aqua, keep an eye on Earth's land, biosphere, atmosphere, clouds, ice, and oceans. The data they collect are crucial to the modeling efforts.

Some models aim to predict short-term effects — in other words, weather. They may become part of severe weather warning systems and actually save lives. Other models aim to predict long-term effects — or climate. But, long-term predictions are much more difficult and much less likely to be believed by the general population, since only time can actually prove or disprove their validity. After all, small errors become large errors as the model is left to run into the future. However, as the models are further validated with near- and longer-term data, and as different models converge on a common scenario, they become more and more trustworthy to show us the future while we can still do something about it — we hope.

For a listing and more information on each of NASA's (and their partners') Earth data-gathering missions, visit http://science.nasa.gov/earth-science/missions/. Kids can get an easy introduction to Earth system science and play Earthy word games at http://spaceplace.nasa.gov/ecosphere.

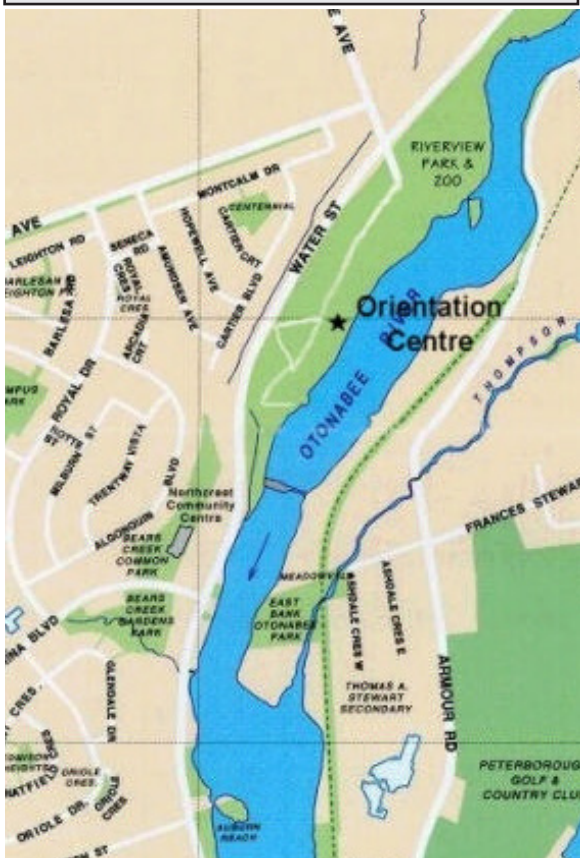
This article was provided courtesy of the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.

Articles

Submissions for *The Reflector* must be received by the date listed below. E-mail submissions are preferred (Microsoft Word, OpenDoc, ASCII and most common graphic formats are acceptable). If your article contains photso or graphics, please provide a separate file for each. Typed or hand-written submissions are acceptable provided they are legible (and not too long.) Copyrighted materials will not be published without written permission from the copyright holder. Submissions may be edited for grammar, brevity, or clarity. Submissions will be published at the editor's sole discretion. Depending on the volume of submissions, some articles may be published at a later date. Please submit any articles, thoughts, or ideas to:

phillip.chee@gmail.com

NEXT SUBMISSION DEADLINE:
APRIL 27, 2012



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.