

# The Reflector

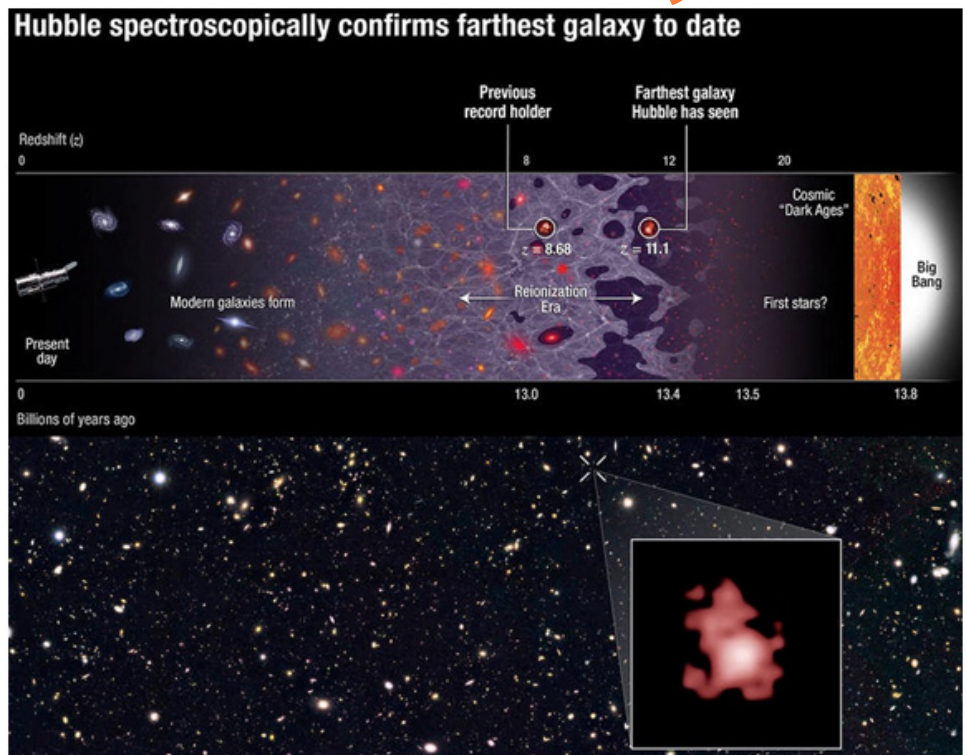
Newsletter of the Peterborough Astronomical Association

## Hubble Shatters The Cosmic Record For Most Distant Galaxy

ETHAN SEIGEL

**T**HE FARTHER AWAY you look in the distant universe, the harder it is to see what's out there. This isn't simply because more distant objects appear fainter, although that's true. It isn't because the universe is expanding, and so the light has farther to go before it reaches you, although that's true, too. The reality is that if you built the largest optical telescope you could imagine—even one that was the size of an entire planet—you still wouldn't see the new cosmic record-holder that Hubble just discovered: galaxy GN-z11, whose light traveled for 13.4 billion years, or 97% the age of the universe, before finally reaching our eyes.

There were two special coincidences that had to line up for Hubble to find this: one was a remarkable technical achievement, while the other was pure luck. By extending Hubble's vision away from the ultraviolet and optical and into the infrared, past 800 nanometres all the way out to 1.6 microns, Hubble became sensitive to light that was severely stretched and redshifted by the expansion of the universe. The most energetic light that hot, young, newly forming stars produce is the Lyman- $\alpha$  line, which is



Images credit: (top); NASA, ESA, P. Oesch (Yale University), G. Brammer (STScI), P. van Dokkum (Yale University), and G. Illingworth (University of California, Santa Cruz) (bottom), of the galaxy GN-z11, the most distant and highest-redshifted galaxy ever discovered and spectroscopically confirmed thus far.

produced at an ultraviolet wavelength of just 121.567 nanometres. But at high redshifts, that line passed not just into the visible but all the way through to the infrared, and for the newly discovered galaxy, GN-z11, its whopping redshift of 11.1 pushed that line all the way out to 1471 nanometres, more than double the limit of visible light!

Hubble itself did the follow-up spectroscopic observations to confirm the existence of this galaxy,

but it also got lucky: the only reason this light was visible is because the region of space between this galaxy and our eyes is mostly ionized, which isn't true of most locations in the universe at this early time! A redshift of 11.1 corresponds to just 400 million years after the Big Bang, and the hot radiation from young stars doesn't ionize the majority of the universe until 550 million years have passed.

See "Hubble" on page 16

## President's Message

# PAA Financial Summary

I want to take a moment and thank you for being a PAA member! Being a PAA member has its perks, the most important in my opinion is to be part of this amazing group of individuals that share something in common, a love for astronomy.

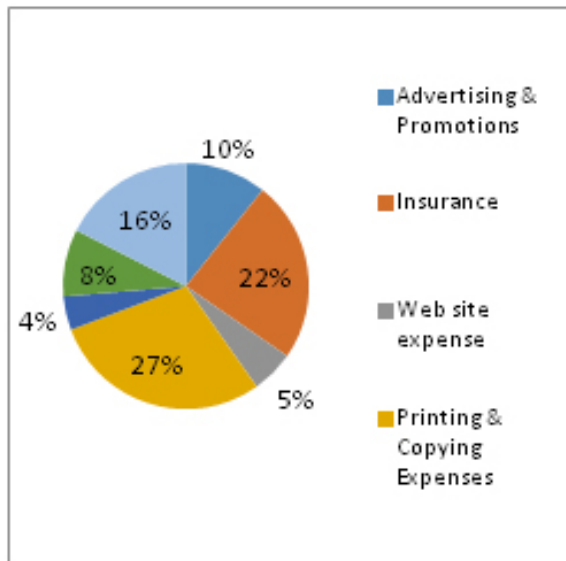
Among other member benefits, we can borrow a loaner telescope, free of charge. This will allow you to have hands on experience with different telescopes. You can also attend our monthly meeting to get/share some knowledge. I find our monthly meetings extremely informative. As a member, you also help PAA to continue with its noble objective, the dissemination of astronomy.

In the last annual meeting, the executive presented how PAA allocates its financial resources. Our budget is very small, but efficiently used. Below you will find two pie charts that will give you an idea of how we use our financial resources. As you can see, insurance and printing use 47% of our revenues. On the revenue side, as you can expect, our membership payments are the most important source of money.

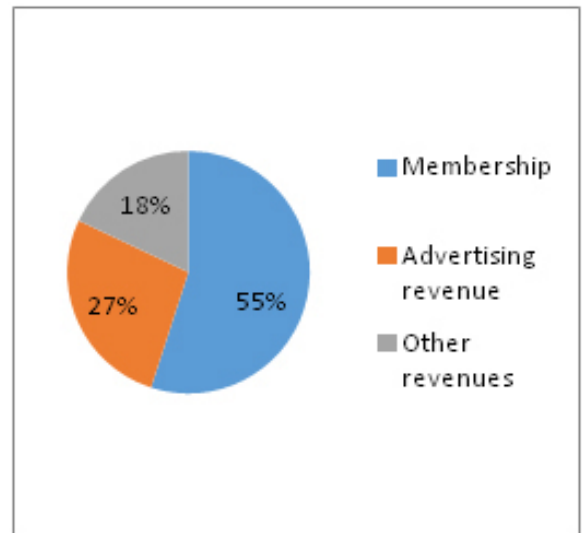
I hope these charts give you a better understanding of how the PAA operates. I hope you are enjoying your membership!

**Jaime Morales**  
**PAA President**

Breakdown of 2015 Expenses (Percent)



Breakdown of 2015 Revenues (Percent)



## 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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# Are You Ready For the Transit of Mercury?



RICK STANKIEWICZ

**B**Y THE TIME YOU read this article I trust you have given some thought as to how you plan to witness the next big solar event on May 9th. For those of you who were around and witnessed the Transits of Venus in 2004 and 2012, the idea of the an inner planet crossing in front of the disk of the Sun (transitting) is nothing new, but this time it will be Mercury.

I suspect there will be less media hype around this transit because it admittedly is less rare an event then when Venus does the same thing, but only twice roughly every 120 years. Mercury has about 13 tries a century, but the gig is the same, just smaller. When Mercury takes centre stage on the morning of May 9th and crosses in front of the Sun there will be lots of people watching and some of those will hopefully include you. If you have a solar filter for your gear this is a great opportunity to use

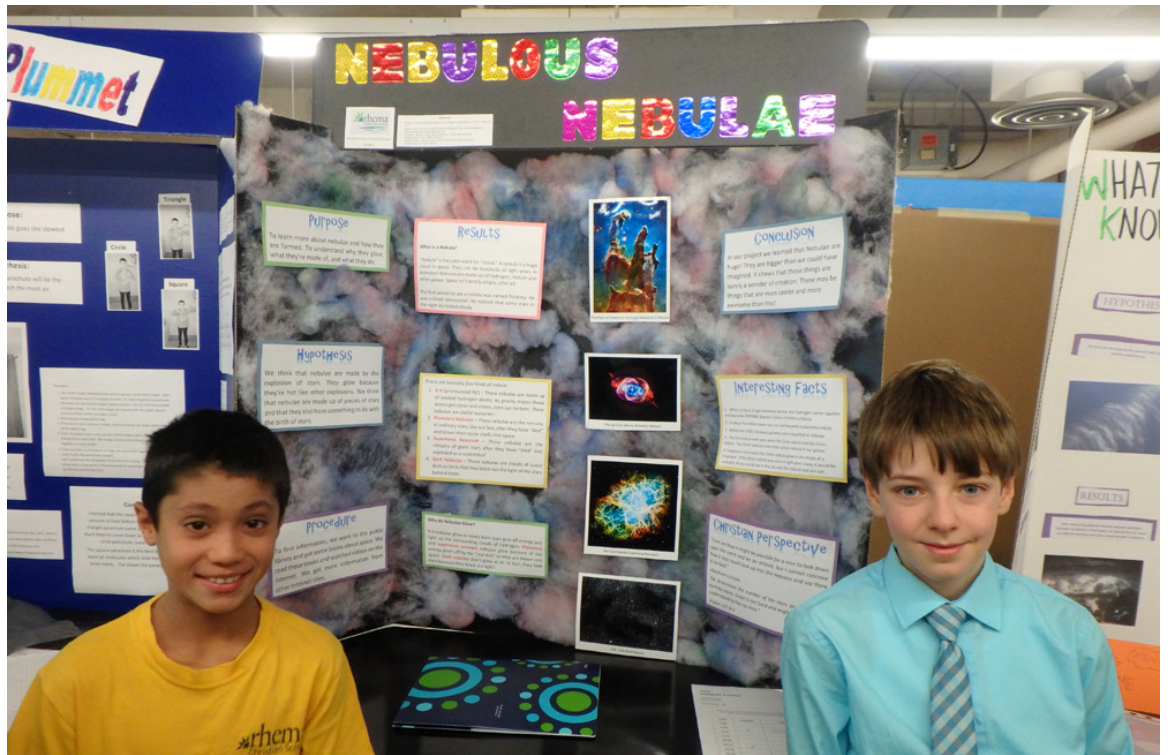
it. For those that don't have the solar gear, plan on meeting many of us up on Armour Hill by 7:00 a.m. and take in the event while helping those members (like me) that have more equipment than they can handle by themselves. The actual transit will take place between 7:12 a.m. to 2:42 p.m. so there is plenty of time to take it in.

In preparation of the big day, I have been out with all my gear making sure that everything is in working order. To get you in the right frame of mind, here are a few images from the last few weeks that are related to the upcoming transit day.

Firstly, is a twilight shot of Mercury from April 17th, just one day prior to the inner most planet reaching its greatest distance from the Sun in the evening sky this season (20 degrees). From this point on, the planet slipped toward the horizon each night as it

See ["Mercury Transit"](#) on page 15

# The 47<sup>th</sup> Regional Science Fair



## RICK STANKIEWICZ

**T**HIS YEAR'S REGIONAL Science Fair was one of the best when it came to a selection of astronomy related projects. Given that some years have had none, one or maybe two projects to choose from, it has often not been much of a competition because we offer at least two prizes every year. This year was different and your two PAA judges were run ragged trying to get all eight projects in the time we had to work with. Director-at-large, Sean Dunne and I were tasked with deciding who would win the \$100.00 Frank Hancock Memorial Award for the best astronomy related project in the Fair and who would be the Runner-up winning a one-year family membership to the PAA.

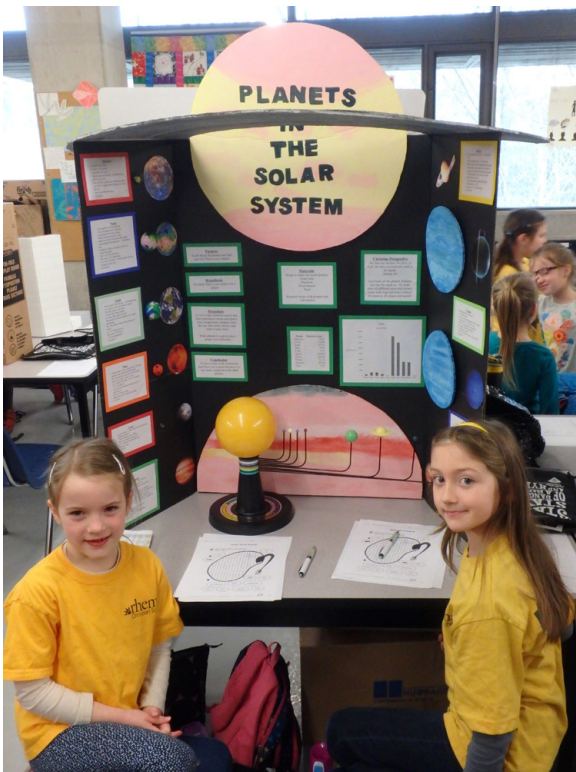
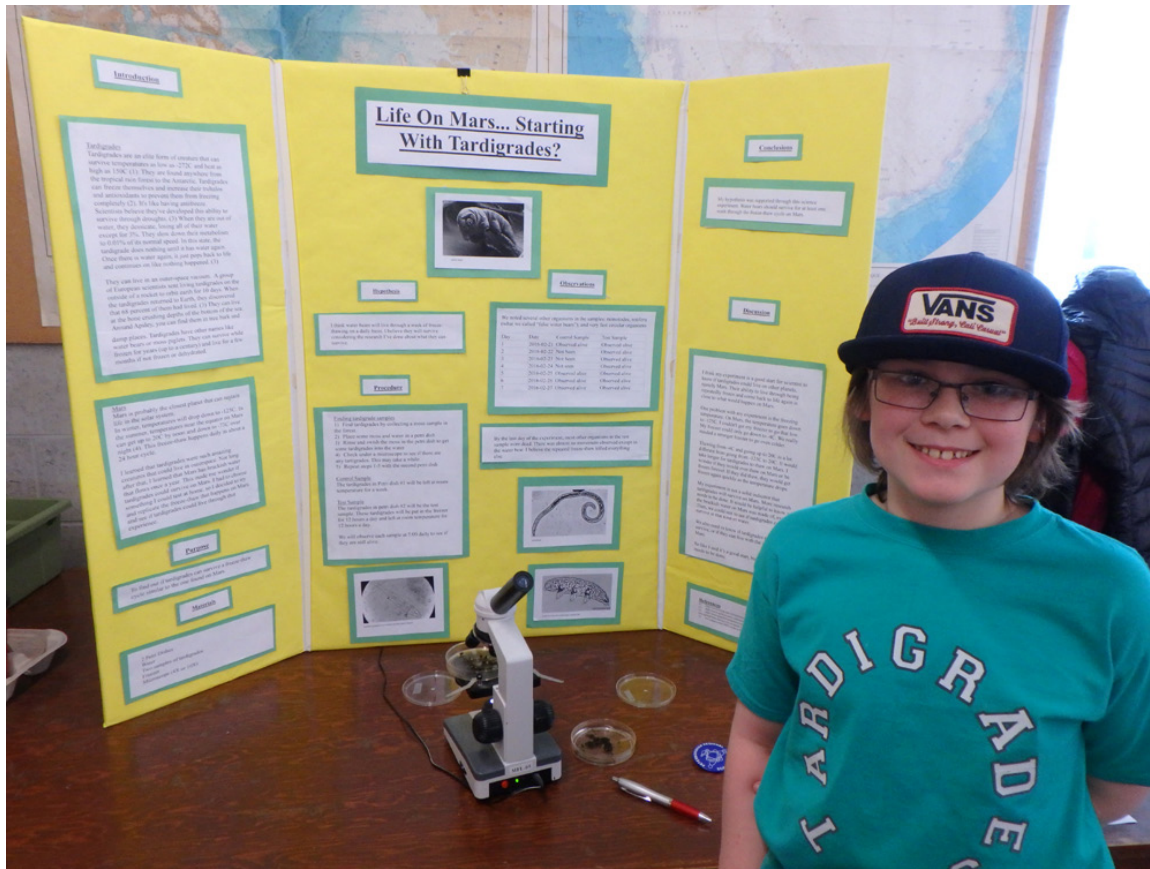
The young science minds from around the region were in full gear this year. From seven year-old Grade 2 students to 14 year-old Grade 8 students, there was an obvious interest in space and things astronomical. To show you what I mean, here is the list of projects, **Planets in the Solar System; Life of a Star; When Will the Sun Explode?;**

**Tardigrades on Mars?; Nebulous Nebulae; Black Holes; Spines in Space and Altered Gravity Growth.** Admittedly, some of these students bit off a little more than they could chew, but you had to give them all points for gumption.

There were many ingenious ideas and presentations, but the one that stood out for the judges was a pair of Grade 5 students from the Rhema Christian School. Isaac Chandra and Atticus Sikma chose to look at various types of nebulae. They did not have every type illustrated, but what they had, they knew and could answer questions about the subject matter and not just read what they had on their story boards. They were able to also explain some of the nebulae they didn't have on display. This put them head and shoulders above many of the other participants in the Fair. Given the work and effort these young scientists put into their project (and who doesn't like a good looking nebulae), they were our winner of the 2016 Frank Hancock Award.

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It does not pay as well as a Nobel Prize, but maybe we have helped encourage these young minds to go on to bigger and better things.

The Runners-up was 11 year old Cael Osborne's "Life on Mars...Starting With Tardigrades?". Cael is a Grade 5 student from Apsley Central School and his interest in biological sciences was infectious (not that you could catch something). I knew a little bit about Tardigrades from recent articles I had read, but I had no idea where or how you could get them for experimentation. Cael explained that you go into the woods and gather moss, soak it in distilled water and start checking your petri-dish with a microscope and if you are lucky you will have specimens to work with. He was able to collect enough to conduct his freezing/thawing experiments and write-up his results. I was not able to see one of these little creatures for myself, but he had lots of Rotifera specimens moving around his

See "Science Fair" on page 13

# Buckhorn Observing Site a Clear Winner

JOHN CROSSEN

**S**ATURDAY NIGHT, APRIL 9, PAA observers gathered in Buckhorn for the first clear night at our northernmost observing site. The sky was dark and clear to the horizon with a 360-degree open area encircling us from the zenith to the distant tree tops.

Setup began at just after 7:30 as the Sun slid below the horizon. All told there were six PAA members and four visitors — Barb and Dan plus Zen and Brandy. Zen and Brandy brought their new go-to scope along, while Barb and Dan opted to scope hop for the evening.

The first targets of twilight were bright Jupiter and the Thin Crescent Moon. It wasn't long before Orion and the famous Orion Nebula popped out of the ever-darkening sky. Soon a host of Messier objects were available for viewing. Nebulae, star clusters, and double stars were all on the menu of celestial treats.



Rodger and Boyd setting up. Photo by John Crossen



Brandy and Zen with their GoTo scope. Photo by John Crossen

Once total darkness had settled in, Sean Dunne took a sky quality reading and the site rendered a 21.3 rating. That's impressive for being just 31km north of Peterpuddle. I was equally impressed because this was the first time in two previously planned sessions that the weather was clear.

On the downside, it was cold, especially for this time of year. But a trunk filled with hot coffee and homemade chocolate chip cookies made things a tad more tolerable. So all told, it was a very successful session. Marvelous, dark skies for being so close to a major city. And well attended given the nippy temperature. I'll give this one a warmly-gloved thumbs up.

# 2016 Membership Report

KEN SUNDERLAND

**W**ITH THE APRIL 1ST membership renewal date now past, let's take a snapshot. Of course, all numbers are subject to change going forward.

The club offers several membership options; single (\$30/yr), family (\$45/yr), student (\$15/yr) and lifetime (\$500/yr). The 2016 roster presently consists of 55 memberships and considerably more members due to family memberships. With the exception of two Honourable Life Members (HLM's), all memberships are annual subscriptions; paid, sponsored or prizes.

Current membership profile;

Single	: 38
Family	: 7
Student	: 0
Lifetime	: 0
Sponsors	: 8
Prizes	: 0
HLM	: 2

Obviously the single membership is our most important category and the club should be most responsive to the needs of this group. While our sponsors automatically become PAA members, some choose to give away their membership rather than keep it for themselves. This generosity allows the club to support a number of sponsored memberships. The sponsors, whose logos you see at our website, in *The Reflector*, and other print materials deserve our patronage. Prize memberships are given yearly at the local science fair and at our annual "Astronomy on the Hill" event.

Last year at this time we had 54 memberships and so we are in a state of equilibrium. This is not to suggest that the membership is static. Indeed, people are coming and going all the time, but we gain

a new member for every loss. We lost about 10 memberships going forward into 2016 from 2015. A 20-25% loss is consistent with the previous two years, suggesting it may be typical of special interest groups like ours.

Total membership may be static, but attendance at monthly meetings has definitely increased. By my count, we now regularly get more than 30 members out to meetings. One reason must surely be the vastly improved meeting room conditions; spaciousness, washrooms, comfortable chairs and a reliable projection system. All good stuff!

An analysis of the membership portfolio suggests consideration of the following actions;

a. Our modest rate schedule (including sponsorships) has remained unchanged for a number of years. A review prior to 2017 is recommended.

b. Everyone agrees that family memberships are important, partly because this in an entry point for youth into the hobby. The club needs to consider ways to become more attractive to families.

c. The roster has no \$500 lifetime subscriptions. This category should be re-examined. Why have a category that has never been subscribed?

d. We presently have no paid student members; i.e. high school, college, university. Why not? If part of the club mission is outreach, we should be reaching at least some of these youth. How?

e. Prizes and sponsored memberships are generally not used. (At least, that is my experience as Membership Director for 3 years.) We need to consider more effective ways of gifting memberships to people who will actually use them.

f. The club should implement an invoicing system for our sponsors who want a

**See "Membership" on page 12**

# Mercury

## The Incredible Shrinking Planet and More

JOHN CROSSEN

**M**ERCURY HOLDS THE honour of being the smallest planet in our solar system. It is also closest to the Sun. And it is the least understood. For years the little guy was overlooked while the public and scientific attention focused on Mars, Jupiter and Saturn.

Then the Messenger spacecraft blasted off. Up until June 30 it has been orbiting little Mercury gathering data on the planet's mineral composition and magnetic fields, all while and imaging Mercury in high resolution. Prior to NASA's Messenger mission only a few images were available from a previous fly-by mission. Now Messenger

has imaged the entire planet in high resolution. It is hoped that the data gathered will help us understand how the planet formed so close to the Sun

One question puzzling scientists about our smallest solar system member is the question as to whether Mercury is shrinking. By closely observing surface images

many have come to the conclusion that Mercury is shrinking due to internal cooling. There are numerous high walls adjacent to much lower flat plains. This is taken to prove that internally the planet is cooling thereby causing the surface plates to buckle.

Keeping in mind the fact that Mercury is such a small planet, it appears to have had an incredibly violent past. Its surface

appears to be as pockmarked as that of our Moon. Craters are packed on top of one another with some covering huge areas. Obviously being a small target didn't help when our solar system was storming with huge asteroids and smaller meteors.

Also like our Moon, Mercury was home to many volcanoes. Again, the

high-resolution images showed that what appeared to be impact craters were actually ancient volcanoes. They are now dormant, but have left their mark on Mercury.

So, could such a small, hot planet have an atmosphere? For years scientists said "no". But they were wrong. Our tiny neighbour

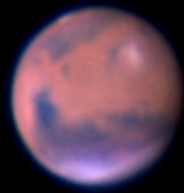
**See "Mercury" on page 12**



**MERCURY SURFACE DETAIL.** A close up of Mercury looks just like a tight shot of our Moon. Craters abound as do fracture lines. Messenger began orbiting Mercury in 2011 and during that time made more than 4,000 orbits taking over 2,500 images. The craft was de-orbited and crashed into mercury on June 30, 2015.



## Mars At Opposition



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My best Mars so far this opposition, I captured it on the early morning of 18 April 2016 from my backyard observatory in Dayton. We finally had above average seeing.

Every 26 months Mars gets close to Earth and provides awesome views of its surface through small telescopes. Thirty days from now Mars reaches opposition on Sunday May 22, 2016 at 07:10 EDT, or 11:10 UTC, and it will be at its largest (18.4") across for this opposition.

This is why I love to view and image Mars. It is the only planet that you can see the surface details in a telescope. All other planets you would be looking at cloud tops, except Mercury, no clouds, but is a real challenge as it never gets far from the Sun or high enough off the horizon to get decent surface details from small telescopes on Earth. At the top or North end you see a large darker area this is Utopia Planitia, and the little dark island just south of it is Utopia Rupes.

Mars' current Axis tilt in relationship to Earth is barely showing the Martian Northern Ice Cap as a little white spot at the top. To the far right is a small patch of clouds over Elysium Mons, one of the Martian volcanoes. Clouds tend to gather around these high volcanoes. Near centre are Libya Montes and Nepenthes Mensae.

On the South end Syrtis Major Planum is clearly visible and as the largest dark feature on the bottom left. Bottom middle and right are Tyrrhena Terra, and Hesperia Planum. The Southern Pole a ice cap at the bottom is shrouded in clouds as well.

Captured on 18 April 2016 at 08:34 UTC from my backyard observatory in Dayton, Ohio. C8 (2000mm) Telescope and QHY5III CCD camera, 3 × Barlow, 900 frames RGB, stacked in Astrostackert, Registax 6, Maxim DL, and Adobe CS 2015.

Best Regards,  
John Chumack [www.galacticimages.com](http://www.galacticimages.com)

# Mars

JAIME MORALES

On April 5, *Astronomy Magazine* published an article titled “Early Mars bombardment likely enhanced life-supporting habitat” by the University of Colorado, Boulder. In this article Professor Mojzsis argues that “ancient bombardments of Mars by comets and asteroids would have been greatly beneficial to life there, if life was present”. What Professor Mojzsis is arguing is that those ancient impacts could have increased the atmospheric pressure of Mars, creating a warmer planet that could bring back the sleeping water under the surface. This article has important pieces of information: the presence of water on Mars and the possibility that life could have existed there in the past. Let’s explore two of them.

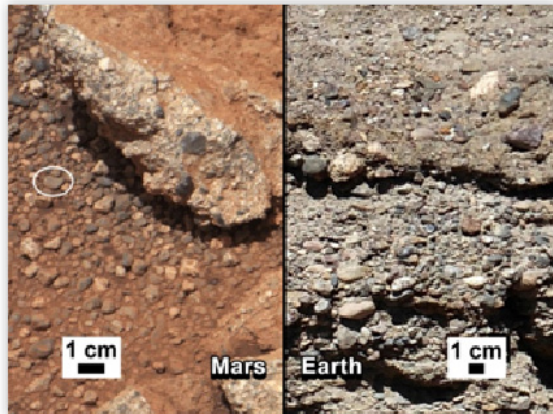


FIGURE 1. Picture from Mars taken by Curiosity  
[https://en.wikipedia.org/wiki/Water\\_on\\_Mars](https://en.wikipedia.org/wiki/Water_on_Mars)

On Mars there is strong evidence of the presence of water in the past. When comparing the pictures from Mars and Earth (Figure 1), we can see how similar the pebbles are in both pictures. This provides evidence that the pebbles on Mars were rounded by running water.

Regarding life on Mars, we have the technology to explore our neighbouring planet, and bit by bit, our scientists are trying to put together this puzzle. The only “evidence” we had from Mars past life was ALH84001 (Figure 2). In 1996, David McKay from NASA claimed that ALH84001 might contain evidence of past life on Mars. ALH85001 is a rock from Mars found in Antarctica by Allan Hills in 1984. After McKay’s claim, scientists have devoted years analysing this rock, concluding that effectively, this rock is from Mars, but they have not concluded that this rock has evidence of life on Mars.

On the other hand, scientists have uncovered the history of Meteorite ALH84001, which is fascinating. Just to quickly illustrate: This rock is 4.1 billion old; 16 million years ago it was sent out into space by impacts on Mars where it stayed for 16 million years until landing on Earth, 13,000 years ago. It was discovered in 1984 and in 1993 it was identified as Martian meteorite. This rock, rocks!

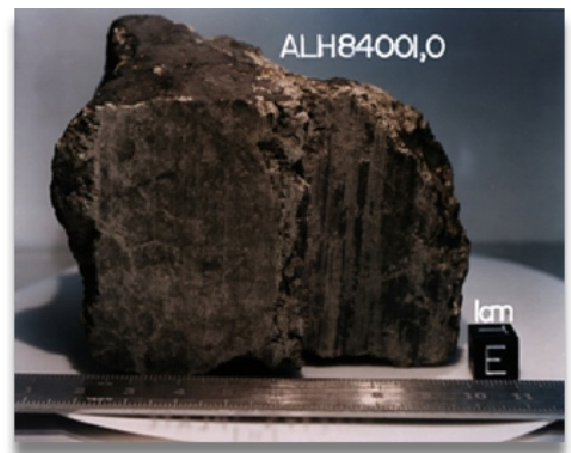


FIGURE 2. ALH84001  
[http://www.nasa.gov/images/content/652610main\\_pia00289-43\\_full.jpg](http://www.nasa.gov/images/content/652610main_pia00289-43_full.jpg)

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Currently, we know that Mars looks a lot like a desert on Earth (see Figure 3, Curiosity) but Mars is still friendlier than our Moon. On Mars the average surface pressure is 0.007 bar, equivalent to less than 1% on Earth. This means if you and I went to Mars, we would need pressurized spacesuits to survive. The average temperature is -50C, this is because Mar's atmosphere is weak and it can not create a strong greenhouse effect. Mars lacks oxygen and ozone, as a result, the thin atmosphere permits the sun's ultraviolet radiation to reach Mar's surface.



FIGURE 3. [http://photojournal.jpl.nasa.gov/jpegMod/PIA16239\\_modest.jpg](http://photojournal.jpl.nasa.gov/jpegMod/PIA16239_modest.jpg)

NASA and the European Space Agency and Russia have their eye on Mars. NASA and the European Space Agency have announced their missions. NASA's InSight, using sophisticated geophysical instruments will explore the depth of Mars, detecting signs of planet formation, and some "vital signs": "pulse" (seismology), "temperature" (heat flow probe), and "reflex" (precision tracking) - information taken from NASA web site. In 2018, the European Space Agency will send a second ExoMars mission; it will deliver a European rover and a Russian surface platform to the surface of Mars.



Now we are in the position to explore Mars. *Still from The Martian film.* If we are able to send our astronauts to Mars, we may be able to confirm the existence of past or present life there. Moreover, we can create "Martians" and populate Mars.

*continued from page 7***Membership**

more business-like approach. This can be done in coordination with the club treasurer on a yearly billing cycle.

Finally, be aware that the PAA Bylaws describe the duties of the Membership Director as follows: “shall be responsible for maintaining an accurate list of the membership of the PAA. The Membership Director shall issue a membership certificate to each member in good standing.” In lieu of issuing a separate membership certificate, your nametag on a PAA lanyard serves this purpose, in addition to identifying you to fellow members. Please wear it to all club meetings and outreach events.



## Ontario Telescope and Accessories

*continued from page 8***Mercury**

has a very tenuous sheet of hydrogen and helium hovering close to its surface. The planet’s small mass means that gravity can’t hold the atmosphere to the planet, so it drifts away. But for some unknown reason, it is replenished again.

Scientists think this may be due to the solar wind drawing it back to Mercury. But currently they are sifting through more data to validate their conclusion. Either way, we couldn’t breathe it.

Mercury is a planet of extremes. The temperature on the side facing the Sun is a blistering 427°C. Meanwhile on the side of Mercury facing away from the Sun, the temperature reaches a numbing -183°C. Throw in the fact that there is no thick atmosphere to screen astronauts from the Sun’s intense radiation and you won’t find any Super 8 Motels or me on this planetary odd ball.

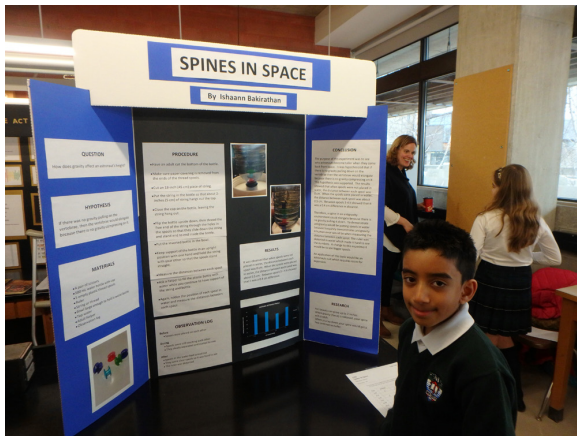
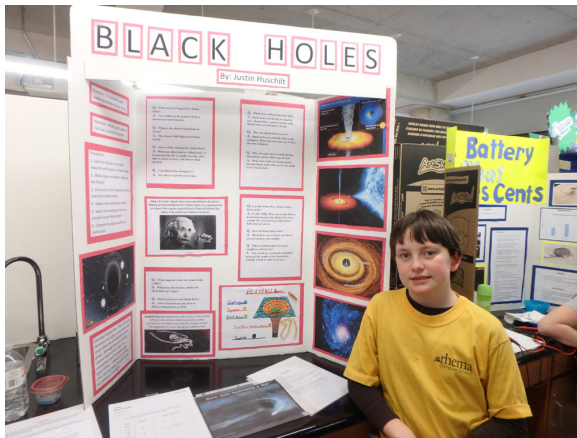
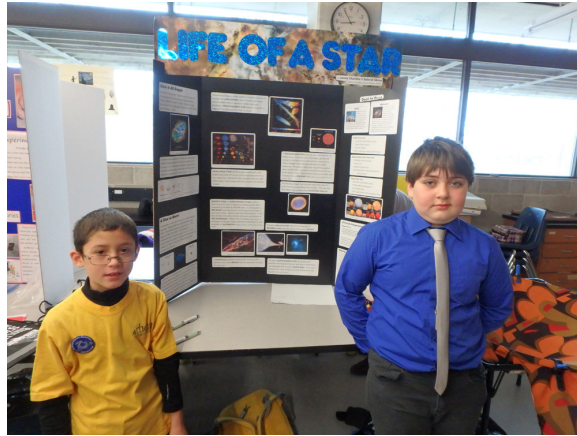
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Science Fair

dishes. It was so cool to see something alive and not just from a book or off the internet.

Tardigrades are tough little critters, also known as Water Bear or Moss Piglets, these segmented mirco-organisms look like an 8-legged mole with no hair, but picture this at only 0.5mm long! This young scientist tried to prove just how tough these organisms are by freezing and thawing them over 7 days. Other organisms in the samples perished during the course of the experiment, but not the Tardigrades, it “bearly” fazed them. He could hardly replicate the Martian environment, but he had the right idea. Let’s hope he puts his free one-year memberships for the PAA to good use.

That’s a wrap for the 2016 Regional Science Fair. Let’s hope there is even more astronomical interest stimulated for next year’s Fair and then all we’ll need will be more PAA judges!





**THE UK SHOPPE**

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## The Sky this Month

**Mercury** is well placed in the morning sky from the 19th to the 31st. At inferior conjunction on the 9th. Transits the Sun on the 9th.

**Venus** is too close to the Sun to be observed.

**Mars** at opposition on the 22nd and rises around sunset in Scorpius and visible all night.

**Jupiter** is well placed in the mid-evening sky in Leo and ends retrograde motion on the 9th. In close conjunction with the Moon on the 18th.

**Saturn** is retrograding in Ophiuchus and rises in the late evening.

**Mercury Transit** begins at Contact I at 7:12:19 AM. Transit of sun at Contact II 7:15:31 AM. Reaches Greatest Transit at 10:57:26 AM. Transit reaches edge of Sun at Contact III at 2:39:14 PM. Ends at Contact IV 2:42:26 PM.

## Moon Phases

New Moon	3:30 PM	May 6
First Quarter	1:02 PM	May 13
Full Moon	5:14 PM	May 21
Last Quarter	8:12 AM	May 29

*continued from page 3*

### Mercury Transit

closed in on its May 9th rendezvous with the Sun.

Secondly, are images of the largest sunspot or active region in recent weeks. This shot of AR#2529, was about 5 times the size of Earth and was visible from April 8th to 20th, as it appeared to cross the face of the Sun. With any luck, there will be some sunspot activity on transit day to show scale and perspective to the black round silhouette of Mercury. Mercury will also be much smaller in the eyepiece than AR#2529, but just as unmistakable and much shorter lived, with its 7½ hour duration. Fingers crossed and eyes heavenward on May 9th. Are you ready for Transit of Mercury?



Peterborough Local 590

*continued from page 1*

## Hubble

In most directions, this galaxy would be invisible, as the neutral gas would block this light, the same way the light from the center of our galaxy is blocked by the dust lanes in the galactic plane. To see farther back, to the universe's first true galaxies, it will take the James Webb Space Telescope. Webb's infrared eyes are much less sensitive to the light-extinction caused by neutral gas than instruments like Hubble. Webb may reach back to a redshift of 15 or even 20 or more, and discover the true answer to one of the universe's greatest mysteries: when the first galaxies came into existence!

This article is provided by NASA Space Place.

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# Articles

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

[phillip.chee@gmail.com](mailto:phillip.chee@gmail.com)

**Next submission deadline:**  
**May 27, 2016**



## Meetings

The Peterborough Astronomical Association meets every first Friday of each month, except July and August, at the **Peterborough Zoo Guest Services and Rotary Education Centre** (inside the main entrance at the north end of the Zoo) at 7 p.m. P.A.A. general announcements will begin each meeting with the guest speaker starting at 7:30 p.m.