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The Reflector

Newsletter of the Peterborough Astronomical Association

Where the Heavenliest of Showers Come From

Dr. Ethan Siegel

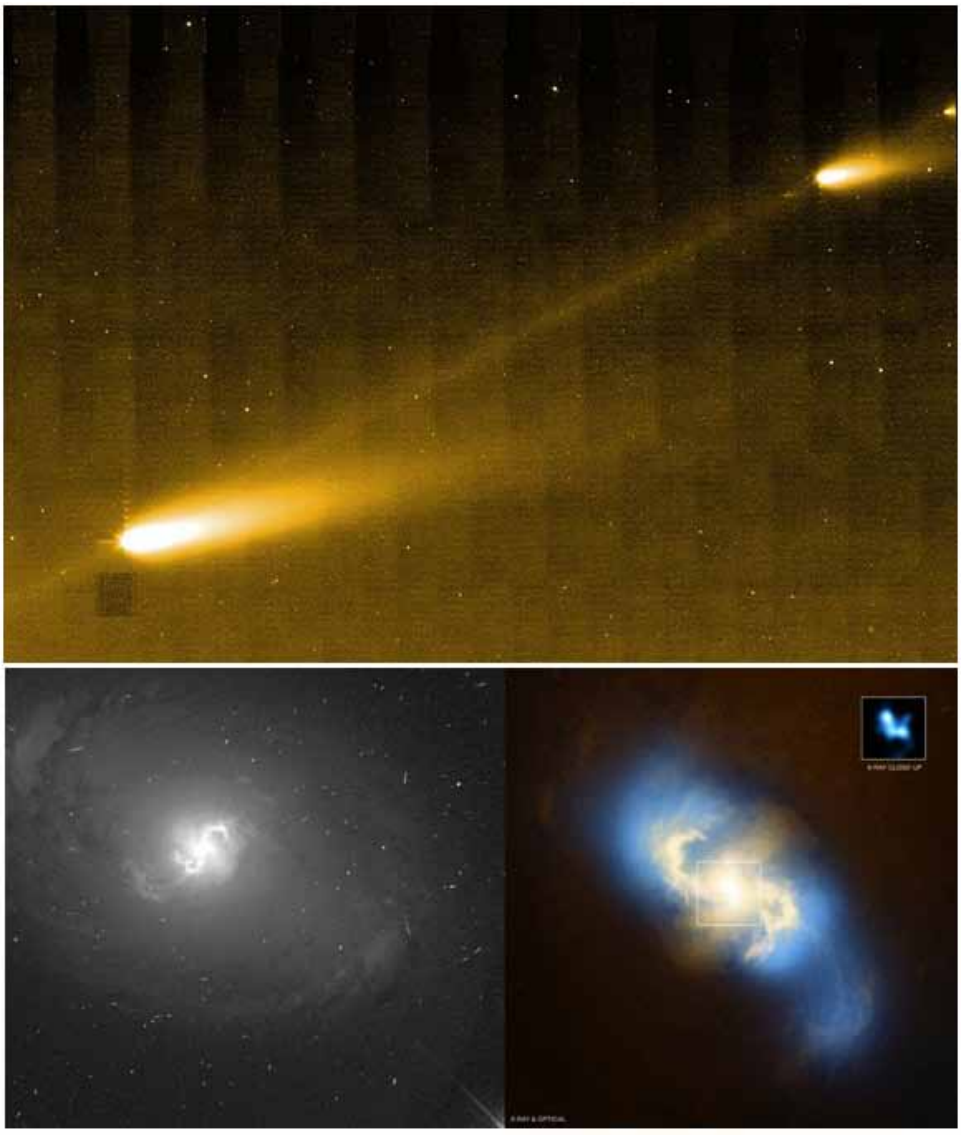

Image credit: NASA / JPL-Caltech / W. Reach (SSC/Caltech), of Comet 73P/Schwassman-Wachmann 3, via NASA's Spitzer Space Telescope, 2006.

You might think that, so long as Earth can successfully dodge the paths of rogue asteroids and comets that hurtle our way, it's going to be smooth, unimpeded sailing in our annual orbit around the sun. But the meteor showers that illuminate the night sky periodically throughout the year not only put on spectacular shows for us, they're direct evidence that interplanetary space isn't so empty after all!

When comets (or even asteroids) enter the inner solar system, they heat up, develop tails, and experience much larger tidal forces than they usually experience. Small pieces of the original object—often multiple kilometers in diameter—break off with each pass near the sun, continuing in an almost identical orbit, either slightly ahead-or-behind the object's main nucleus. While both the dust and ion tails are blown well off of the main orbit, the small pieces that break off are stretched, over time, into a diffuse ellipse following the same orbit as the comet or asteroid it arose from. And each time the Earth crosses the path of that orbit, the potential for a meteor shower is there, even after the parent comet or asteroid is completely gone!

This relationship was first uncovered by the British astronomer John Couch Adams, who found that the Leonid dust trail must have an orbital period of 33.25 years, and that the contemporaneously discovered comet Tempel-Tuttle shared its orbit. The most famous meteor showers in the night sky all have parent bodies identified with them, including the Lyrids (comet Thatcher), the Perseids (comet Swift-Tuttle), and

see "Geminids" on page 16

President's Message

End of an Era

John Crossen has announced the closing of Buckhorn Observatory. This is sad news for many people, the public and PAA members alike. John has brought a refreshing approach to astronomy over the years and has delighted many with his tours of the night sky. No doubt that when John and Deb are settled into new digs the SkyShed POD will pop up complete with John's favourite C11. We look forward to visiting John in the future as he delights us with more astronomy tales and knowledge albeit on a smaller scale.

It's election time again and once again Sean Dunne has done a great job as election chair. Sean will be centre stage at the December meeting and will enlighten us with the results of the polling and nomination process.

The permits for the use of Ashburnham Park and the Heritage Pavilion have been sent to city hall with our planned schedule of events for 2015. In order will be Earth Hour on Saturday March 28th, Astronomy on the Hill Saturday May 16th and Sunday May 17th and finally the Perseids Meteor Shower on August 12th. Our Astronomy on the Hill is on the Victoria Day weekend in 2015 instead of the Mother's Day weekend.

It's time for our "Annual General Meeting & Christmas Social." This meeting will see the election of directors for the club and our Christmas Social. You are invited to bring "goodies" in the form of cookies, cakes, tarts etc. to share during the social. We will also hear from Mark Coady on the Fall 'n' Stars annual star party. I hope we have a good turnout.

I would like to take this opportunity to wish everyone a Merry Christmas and a safe and Happy New Year. Thanks for your support over the last three years.

Reminder. It's membership renewal time.

Rodger Forsyth
PAA President

Letter from the Editor

Trish McCloskey

Winter stargazing is soon upon us with more cloudy nights the norm. Hopefully the Geminids will be a fine show as explained by our monthly NASA Space Place cover story.

Ken Sunderland has a review of the "other" H.A. Rey astronomy book if you are looking for a Christmas gift for the wee ones. He also dons the cap of film critic with his review of Christopher Nolan's *Interstellar*.

Rick Stankiewicz has written a great summary of his trip Down Under the southern skies. His photos just make you want to book your flight to Australia, no?

And not to be forgotten, John Crossen previews the December skies.

Perhaps we should wish for clear skies from Santa. Till next year!

Phillip Chee
Editor, The Reflector

PETERBOROUGH ASTRONOMICAL ASSOCIATION

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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Fill the Trish Bowl was an Astronomical Success

John Crossen

The November 7 PAA meeting brought together two people with divergent needs. Our Observing Director was clearing out his observatory's "Stuff Bins" and PAA member Trish McCloskey, who has just been diagnosed with A.L.S., will need some money to help defray upcoming transportation and medical costs.

So a table was set up at the meeting and piled with everything from books and binoculars to eyepiece cases and telescope collimation gear. The table was dedicated to Trish, and members could pick out what they wanted and pay what they wanted. It was a novice astronomer's dream and combined with some generous individual donations, raised a substantial amount for Trish's care.

Club President, Rodger Forsyth and his wife, Louise (the original Ninja Bookkeeper) will be administering the funds and making sure that Trish has transportation to wherever she needs to be. They are currently in the process of purchasing a GPS device that Trish will wear and can activate at the push of a button should she ever require assistance. It should bring her a feeling of added security as she goes about her daily routine.

To everyone who chipped in and went home with a bargain, thank you. A big thank you also goes to John Cameron who was not only a great customer at the table, but poured his winnings from the 50/50 draw into the Trish Bowl as well. PAA Vice-President, Dean Shewring, also earned a pat on the back for his generous envelope of care.

Well done everyone!

The Upside of Down Under

I HAVE HAD SOME TIME now to reflect on my recent trip this year to The Land Down Under (Australia) and I have been asked a number of times, "How were the skies?" I can say that on a clear night down there the skies are amazing, to say the least. I loved the southern hemisphere skies and viewed them from everywhere I travelled around the country and it did not matter where I was, it was magical. I did most of my observing and imaging around the border between Queensland and New South Wales (Brisbane area), near the eastern coast between March and May of this year. Yes, it is a long way to the Land of Oz (typically 21 hours of travel), but there is an up side, the night skies. We have some nice things to look at from where we live in this part of the northern hemisphere, but compared to what I could see while I was Down Under, there was no contest. The following are just a few examples of how I saw things and although I was fortunate to have shared some telescopes with astronomers that were up to 20" (50.8 cm) in diameter, however much of my observing was with a pair of 10 × 50 binoculars. Most of the following images were taken using 10 to 70mm lenses on a modified Canon EOS 50D camera and an iOpteron SkyTracker mount with up to 60 second exposures at ISO 2000. A few images have been cropped from the original format to improve the view. I have also both named and numbered the objects in this article. Messier Objects (M) and Caldwell Objects (C) are similar in nature and purpose. Most of you will be familiar with French astronomer Charles Messier's list of objects he identified centuries ago that were not comets, while the Caldwell list was compiled by Sir Patrick (Caldwell) Moore in 1995 to compliment Messier's list by covering objects in the southern sky that Messier could not have seen and some interesting things Messier appeared

Eta Carinea Nebula. Rick Stankiewicz

LMC, SMC and 47 Tuncanae. Rick Stankiewicz

continued on next page

continued from previous page

to have missed in the north. The following is my comparison of some of the more impressive objects I saw relative to what we normally can see here at home.

Omega Centauri. Rick Stankiewicz

We have the Great Orion Nebula (M42), that with decent skies you can see the faint smudge of where you need to focus in the "sword" of Orion, but they have the Eta Carina Nebula (C92) which is so obvious there is no mistaking this knot of dust and gas in the constellation of the Keel. I could not believe my eyes when first saw it.

We have the Pleiades (M45) and they are lovely sisters, but they have the Southern Pleiades (C102), the Jewel Box (C94) and many other dazzling open clusters to rival the Seven Sisters, not so much in size as in gorgeous coloured stars.

We have the Andromeda Galaxy (M31), which is the most distant object you can see with your naked eye (2.5 mly), given you have dark skies and your eyes are sharp enough to see the faint smudge in Andromeda. But they have the Large and Small Magellanic Clouds (LMC/SMC), which are so close (200,000 and 160,000 ly respectively) and loom so large in the sky, that you think they are clouds hanging in the sky as you stare at them in wonder. You would need the end of your finger held at arms-length to cover either of these beautiful irregular galaxies.

We have the Hercules Cluster (M13), but they have Omega Centauri (C80) and 47 Tucanae (C106) which outshine M13 to be naked eye object even without pristine dark skies. M13 may have 300,000 stars at 25,000ly, but C80 has close to a million stars only 17,000ly away!

We have Sirius, the brightest star (mag. -1.46) in the night sky and they have Canopus, the second brightest star at magnitude -0.72. They are both pretty impressive, but Canopus rarely sets below the southern horizon, so it is visible during most observing sessions throughout the year. Unlike Sirius, which is in the "dog house" half the time.

We have the Milky Way and so do they, but they have a "bird" in theirs, The Emu. The head is formed by the famous Coalsack Nebula (C99) that I found was visible even in the light polluted skies of suburban Brisbane. Try seeing any part of our Milky Way under similar conditions and you will be looking in vain.

LMC and Canopus. Rick Stankiewicz

They have one of the closest star(s) to us (4.37 ly), with the famous Alpha Centauri

See "Down Under" on page 15

Giant Jupiter Dominates December's Night Sky

John Crossen

By the month's end Jupiter will be joined in the night sky by Mercury, Venus and Saturn. Mars is also visible in the sunset if you have a clear view of the western horizon. So if you stay up from dusk until dawn the next day you'll see all of the naked-eye planets. Uranus, Neptune and dwarf planet Pluto are also up, but the trio can only be seen in binoculars or in the case of Pluto, a telescope. That's because they are all too far away from Earth to be seen without optical aid.

By mid-month Jupiter will be rising in the eastern sky prior to midnight. It may not appear much larger to the eye than a yellowish dot of light, but rest assured the gargantuan gas giant can swallow planet Earth more than 1,000 times over. Being humungous isn't the only jaw-dropper about Jupiter. All you need is a pair of 7×50 hand-held binoculars to watch four of Jupiters largest moons trade places from night to night as they orbit the planet. Jupiter's moon dance is popular with a lot of amateur astronomers.

Earlier in the evening Venus will be scaling the western sky, followed by the mini-me of the planet world, Mercury. Both these planets are inside Earth's orbital path around the Sun, so binocular gazers can observe as they go through phases, somewhat like our Moon.

As dawn approaches Saturn rises in the east. To make out its rings you'll need a small telescope at about 30 power. Even a junk scope from Cheap Bobs Bargain Bonanza will show them to you. But first buy

See "December" on page 13

Group Stargazing with Binoculars. A set of 7 power binoculars with a 50mm aperture (7X50) are the only option you'll need once you have a good book on stargazing. They're light weight, easy to hold and not so powerful that the stars bounce around a lot as you hold the binocs up to your eyes. Photo by John Crossen.

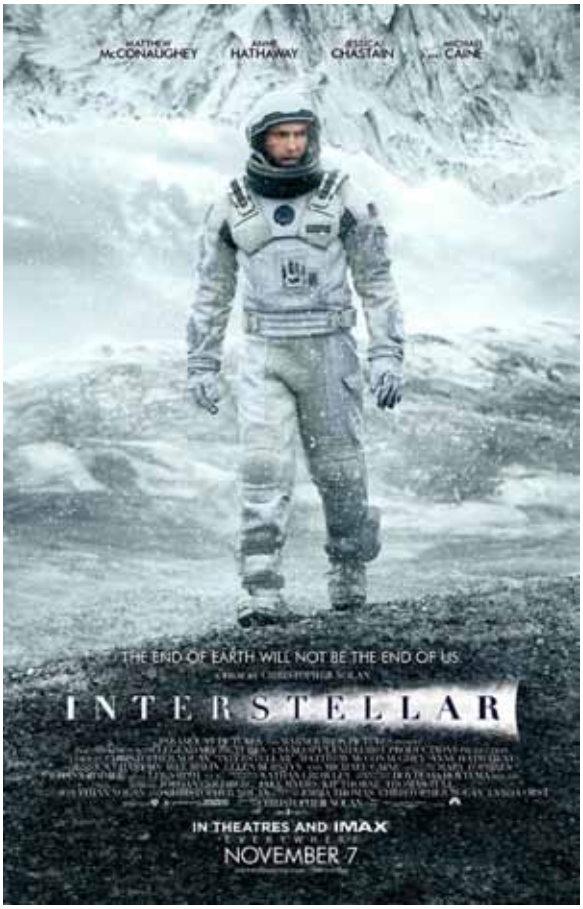
MOVIE REVIEW

Ken Sunderland

Take 1

As we filed out of the movie theatre a man asked "Did you understand what just happened?" "Not really," I lied. Then he said "I'm going to have to see it a second time." I kept it to myself, but I thought: Are you joking?

A film can only ever be as good as the story it tells. Lacking good narrative glue, this film is an irritating sequence of special effects and stunts. Let's begin at the beginning and follow along. Earth is an apocalyptic Dust Bowl calling forth Steinbeck's *Grapes of Wrath*. The required chase scene, in a late model pickup truck, is across a cornfield. I can almost hear the director saying to his screen writer, "OK. Check-off chase scene". What does it add to the development of the story? Nothing. What's next? The director continues ... "Hey, Americans love conspiracy theories. Let's play the 'NASA-faked-the-Moon-missions' card. OK, what's next? Well, we need a top secret base ... the whole Area 51, Roswell, thing. Yes, and that's where we'll launch our heroes (looked like a Saturn V to me) toward a wormhole in the vicinity of Saturn. Wormholes permit intersteller travel and so our heroes can find a new planet for mankind because Earth is beyond saving, you see. Let's get a nice black hole CGI sequence in there, and extra dimensions too. The science geeks are going to love it. But, what about the average movie goer? They don't even like science. We'll give them poetry. *Do Not Go Gentle into that Good Night* by Dylan Thomas would be good because we're raging here, we're raging against the dying of the light we're fighting to save humanity. Of course, we'll have a chance for some emotional scenes when it's time to split-up the family—that sort of thing. Listen, I know we've got Matthew McConaughey but Matt Damon can bring'em to the box office too. Let's give him a part. We'll have him fight McConaughey on an ice planet with their space suit on! Every film needs a fist fight and that reminds me that we should



let McConaughey actually fly the spaceship. Forget computer controls—people feel good when man out-smarts machine."

And on it goes with this mash-up of mandatory Hollywood motifs, conventions, and special effects that pass for cinema these days. This film is a waste of time.

Ok, ok, perhaps I'm being unfair...

Take 2

As we filed out of the movie theatre a man blurted-out "Did you understand what just happened?" "Sure, that was fun!" I replied. Then he said "I'm going to have to see it a second time." "Me too, the CGI was amazing, especially the wormhole and the extra dimensions. Time travel stories are the best!"

Let's acknowledge it right away ... *Interstellar* has ghosts, with none looming larger than *2001: A Space Odyssey*. The debt is obvious; running time, crescendo pipe organ, a mysterious anomaly, an alien "they", and so

See "Interstellar" on page 12

PHOTO GALLERY

Lagoon Nebula

A wide field view of a Great Nebula region near the center of our galaxy. M8, the Lagoon Emission Nebula Complex, this Great Nebula is visible to the unaided eye from a dark location, but looks much better in binoculars or a small telescope.

The Lagoon Nebula M8 is a massive and very active stellar nursery (star formation region) with embedded bright star cluster NGC-6523. It is located 5,000 light years from Earth in the constellation of Sagittarius in the direction of the centre of the Milky Way.

The glowing gas and dust cloud spans well over 60 light-years across (348 trillion miles). Above M8 the Lagoon is the beautiful Trifid emission/blue reflection nebula known as M20, along with open star cluster M21, and below the Lagoon Nebula is 7.5 magnitude NGC-6544 globular star cluster.

To the left edge of the Lagoon you will see several fainter blue reflection Nebulae IC-4681, IC1275, IC-4685 and NGC-6559.

I captured this image with my modified Canon Rebel XSi DSLR & Canon 200mm lens from the Vacation Cabin in Northern, Michigan on July 21, 2014. It is a 21 minute exposure (7 x 3 minutes subs), ISO1600, f/5.0, tracking on a CG-4 mount.

I left it high enough res to zoom in a little bit ... Enjoy!

Best Regards,

John Chumack www.galacticimages.com

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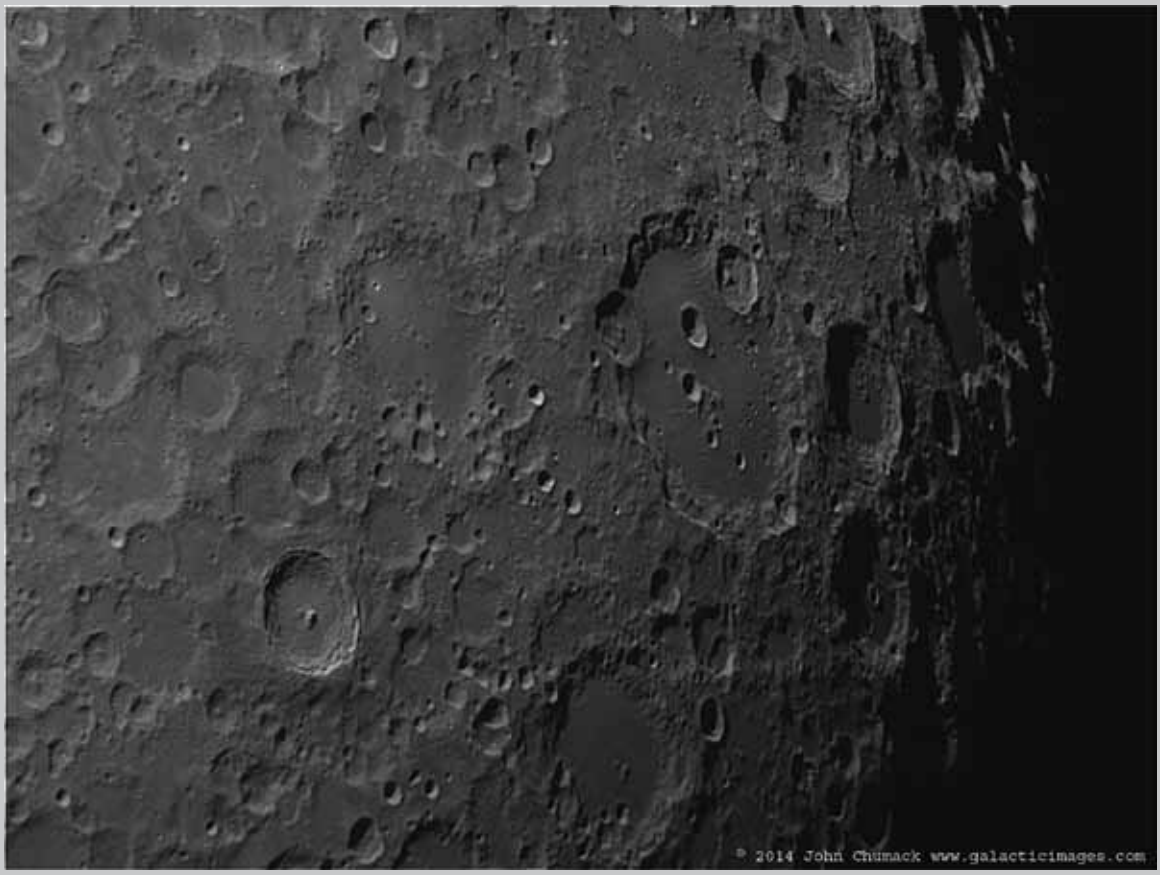


The "Chumack Observatory Lunar Orbiter" ... LOL!!! Okay not really an orbiter, but when seeing is good, I can get very close-up detailed shots!

My backyard observatory telescope has made another pass over the lunar terrain, this time closing in on Tycho and Clavius!

I'm always looking for nights were I can improve on the resolution from the previous shots!

This week I will be posting some of my sharpest images of the lunar surface taken just this past Sunday evening from my backyard observatory in Dayton, Ohio!

Dodging contrails and high cirrus clouds ... shooting in the clear spots.

Details:

Lunar impact crater Tycho (left) and Clavius (right with multiple impacts in its basin) on November 2, 2014 at 18:56.21 EST.

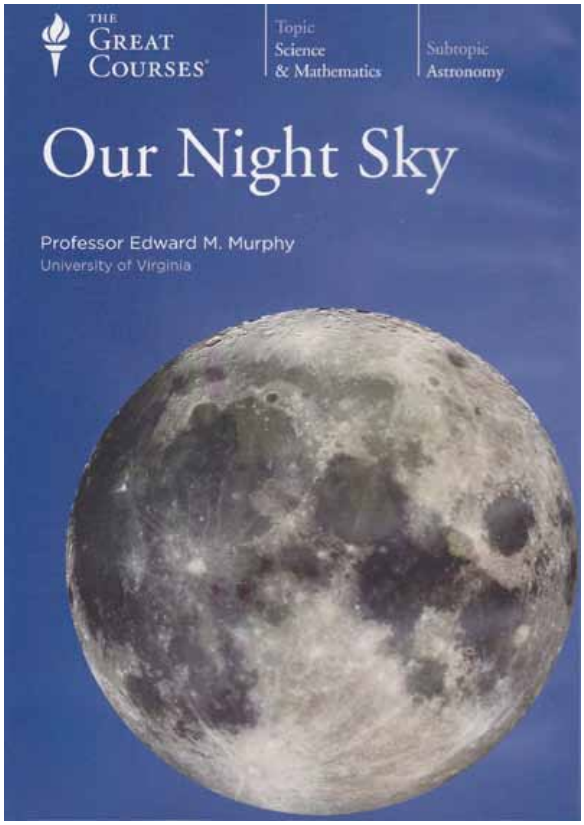
QHY5IIL Camera, prime focus at *f*6.3, 10" SCT scope, 5.6 ms exposures/15 FPS full-resolution 1280x960 (3.7micron pixels). Best 65% of 400 frames Stacked in Registax 6.

I am posting these in a little bit higher res than I normally do so you can zoom in a little to look at the tiny craterlets!!!

John Chumack www.galacticimages.com

Our Night Sky (The Great Courses)

Professor Edward M. Murphy Ph.D. of University of Virginia
Transcript Book, 250 pages
Course Guide Book. 88 pages



Rick Stankiewicz

Our club purchased this set of DVDs a few months ago and I don't think that most club members are aware they are available for their use just by contacting our club librarian, Mike McCarthy. I have previewed this set when they arrived and they are a "Big Bang" for the buck. There are twelve lectures given by award winning and NASA researcher, Professor Murphy, that are a great primer for a novice astronomer or a good refresher for any of us. Each lecture is about 30 minutes long which makes for a nice length to sit and learn (the length of your average sitcom) in these upcoming cold winter months. Start by learning about the constellations and their stars and then learn to navigate the night sky using the stars by using binoculars and telescopes. Then learn about observing the Sun and our Moon and move on to the planets in our solar system. There is even coverage of phenomena like meteor showers, eclipses, auroras and comets, so there is a little something for anyone learning to explore the wonders of the night sky.

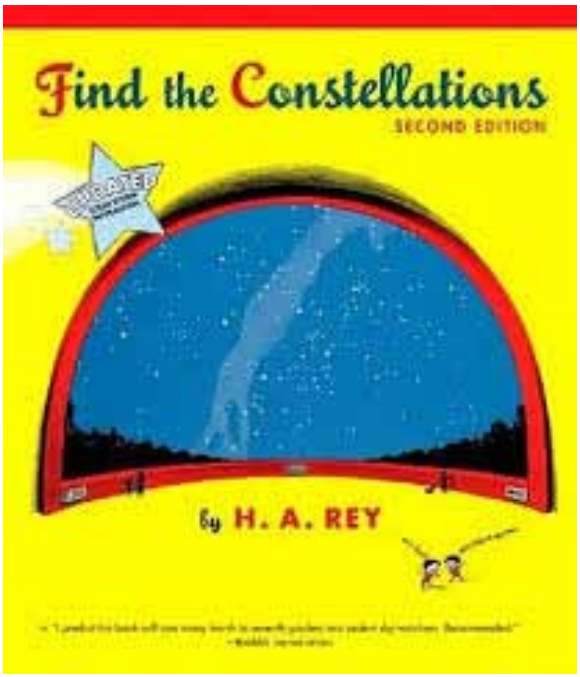
The second half of the course lectures deal with the night sky firstly and mostly in the northern hemisphere with the circumpolar constellations and their relationship to the North Star (Polaris). Then there are lectures that deal with the four seasons and their major constellations and how to star hop around the sky throughout the year. This is all valuable information to have for when the power source in your Go-To telescope packs it in for the night. Don't be left high and dry while cruising down the Milky Way. This all wraps up with a quick look at the southern hemisphere and the wonders it has to offer and believe me there are lots to whet your appetite.

If you are not yet convinced that this "course" is for you, it is made easier to digest as there is a Guidebook that makes navigating a breeze. The real bonus is that we purchased the Transcript Book for the each lecture, so following along is easy and if you are like me, learning is made easier because you can read about the course content instead of just looking and listening. It comes complete with a planisphere and how to use it, as this was a bonus when the course was ordered.

Imagine, all this for the price of your annual PAA membership. Why not get your monies worth and contact our club librarian today to reserve your private viewing of this visually rich course. You will not be disappointed that you invested your time in this condensed course on our wonder-filled hobby of astronomy.

BOOK REVIEW

Kenneth Sunderland



Find the Constellations (2nd Ed.)
H.A. Rey
Houghton Mifflin Harcourt 2008, 72 pages
ISBN 978-0-547-13178-8, $12.99, Trade Paperback

"At night time, when the stars are out, the sky all of a sudden becomes a huge picture book." So begins H.A. Rey's other famous astronomy book *Find the Constellations*. Following the success of *The Stars - A New Way to See Them*, (reviewed in *The Reflector*, November 2014) Rey released a junior version of his book in 1954. Remarkably, it is still to be found in children's libraries, and for good reason. The opening quote leaves little doubt that *Find the Constellations* is meant for young readers ... 7 or 8 years-old would be about right. Little gremlin figures appear on many pages offering extra comment. Rey reportedly quipped that his book "...was so simple even an adult could understand it."

Star patterns are introduced using Ursa Major, before discussing magnitude and naming prominent stars. Without preamble, Rey uses his unique constellation figures introduced in *The Stars*. All told, a dozen constellations are described in the opening section along with their 15 brightest stars. It's a good start. Simple quizzes reinforce memorization.

In the middle section, the full sky is presented in seasonal "Sky Views" which are drawn as if looking through a picture window. (see accompanying sample) The sky is shown both with, and without, constellation art—first a northern view and then a southern. To break up these repetitive "Sky Views", uncomplicated information is given on a variety of topics, such as, constellation mythology and stargazing tips.

The book finishes by describing the planets and even how to navigate to Mars. We learn that star patterns would look the same from the Moon, and anywhere else. There are lists of the first stars to appear at dusk, organized by

see "Find the Constellations" on page 13

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Interstellar

on, but *Interstellar* is more than a copycat. The screenplay has enough original material to stand on its own.

Much has been made of the fact that Kip Thorne, a leading theoretical physicist, was consultant to the project. There is a claim that exotica from General Relativity, like the wormhole, have been accurately rendered. In fact, Thorne claims there will be a scientific paper resulting from the CGI efforts. Sure, it's a SF story, but no mere fantasy.

The movie's strength and weakness is this: it tries to do too much. There's a little something for everyone. For example, approaching a wormhole, our imaginations soar, having been whiplashed by scenes of environmental degradation on Earth. Is a unified theory of gravitation and love going too far? In trying to channel *The Grapes of Wrath*, *Star Wars*, and *2001: A Space Odyssey* at the same time, this movie doesn't quite know what it is.

Time travel, that SF staple, is at the core of this movie enabling an entertaining story that bites its own tail. The unfolding of time is a function of speed and gravitational field strength—it's true. Mundanely, GPS systems calculate these effects in order to work. If General Relativity turns out to be entirely true, then the things shown in this film are not so much SF as real possibilities. The movie tinkers with the time dimension throughout and at its conclusion, produces a memorable 'twin paradox' scene. It gets you thinking! Go see it. Enjoy the time.

Final Take

As we filed out of the movie theatre a man openly lamented to no one in particular, "Did you understand what just happened?" "Sure ... loved it." I offered. Then he said "I'm going to have to see it a second time." "Not me." I replied. "I watched a Discovery Channel documentary last night on YouTube, *The Science of* Interstellar. It was so good, I'll watch it again." Now, that's time well spent.

Good friends are like stars . . . You don't always see them,

But you know they are always there!

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December

a copy of *SkyNews Magazine* so you'll know where to point it.

At this point in time, all of winter's prime constellations are up. Mighty Orion is in the south east early in the evening. If you imagine his belt as an arrow pointing to your right and follow it you'll come to Taurus the Bull. The bright star Aldebaran marks the bull's eye. Right next to it is the large open star cluster known as the Hyades. It's a beautiful sight in binoculars. But wait, there' another treat in store for you.

Continue moving to your right and you'll come to a hazy spot. It's no bigger than your thumb nail at arm's length to the naked eye. Train your binoculars on it and the Seven Sisters of the Pleiades will burst into song—well, metaphorically speaking. This delightful stellar display is one of my favourite targets when the chilly weather arrives.

Joining Orion are Gemini the Twins, Canis Major his hunting dog, Eridanus the River and Lepus the bunny. A copy of *Night-Watch* by Terence Dickinson will give you the lowdown on what's up in the night sky. So be nice and Santa might just stash a copy in his sack for you.

Have a merry whatever you celebrate and may 2015 be filled with family, friends and fun.

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Find the Constellations

month. This is helpful for the beginning stargazer. An index/glossary is included.

In summary, this is the classic introduction to the celestial sphere for the very young, illustrated with all of H.A. Rey's charm and accurately told. However, be aware that any child will soon outgrow this book. Given a choice, select *The Stars*, which any child can only grow into.

The Sky this Month

Mercury is at superior conjunction and greatest aphelion on the 8th. Not visible because of the solar glare until late in the month reappearing SW of Venus in the evening twilight.

Venus reappears low in the SW evening twilight in early December.

Mars is low in the SW evening sky and crosses from Sagittarius into Capricornus on the 4th.

Jupiter rises in the ENE in mid-evening in western Leo. Begins retrograde motion on the 9th.

Saturn reappears in early morning twilight sky in eastern Libra.

Geminid Meteors peak at 7 AM on the 14th.

Winter Solstice arrives at 6:03 pm on the 21st.

Ursid Meteors peak at 3 PM on the 22nd.

Moon Phases

Full Moon	**7:27 AM**	**December 6**
Last Quarter	**7:51 AM**	**December 14**
New Moon	**8:36 PM**	**December 21**
First Quarter	**1:31 PM**	**December 28**

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Down Under

The Enu. Rick Stankiewicz

(A and B) which is one of the two "pointer stars" next to the Southern Cross. However, knowing that a third star (Proxima Centauri) is circling at 4.25 ly makes this a very special sight indeed and also the third brightest star, next to Canopus. This combination of stars aids in locating the south celestial pole. Look at the head and neck region of The Emu.

Alpha and beta Centauri. Rick Stankiewicz

It is true that everything that we are used to seeing in our skies will be upside down and going in the opposite direction when Down Under. Take the constellation Orion for an example. I did see it while I was well south of the equator, but it was in the northern sky, not the south as we are used too, it revolved in a clockwise direction, not counter-clockwise as it does for us and it was upside down from how I see it at home! I got used to this head changing experience, with a little practice, but it initially sets you on your heels.

Basically, the Aussies have the best of both worlds. They can see most of our gems from the northern sky that we see and they add to that all of the southern circumpolar wonders that we never get a chance to observe from where we live in Ontario. Would I trade observing locations with them, you bet! They have so much more to offer with better, bigger and brighter objects to gaze upon. It is worth the trip to the Land of Oz.

Looking up from Down Under,
Rick Stankiewicz

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Geminids

what promises to be the best meteor shower of 2014: the Geminids (asteroid 3200 Phaethon). With an orbit of only 1.4 years, the Geminids have increased in strength since they first appeared in the mid-1800s, from only 10-to-20 meteors per hour up to more than 100 per hour at their peak today! Your best bet to catch the most is the night of December 13th, when they ought to be at maximum, before the Moon rises at about midnight.

The cometary (or asteroidal) dust density is always greatest around the parent body itself, so whenever it enters the inner solar system and the Earth passes near to it, there's a chance for a meteor storm, where observers at dark sky sites might see thousands of meteors an hour! The Leonids are well known for this, having presented spectacular shows in 1833, 1866, 1966 and a longer-period storm in the years 1998-2002. No meteor storms are anticipated for the immediate future, but the heavenliest of showers will continue to delight skywatchers for all the foreseeable years to come!

What's the best way to see a meteor shower? Check out this article to find out: http://www.nasa.gov/jpl/asteroids/best-meteor-showers.

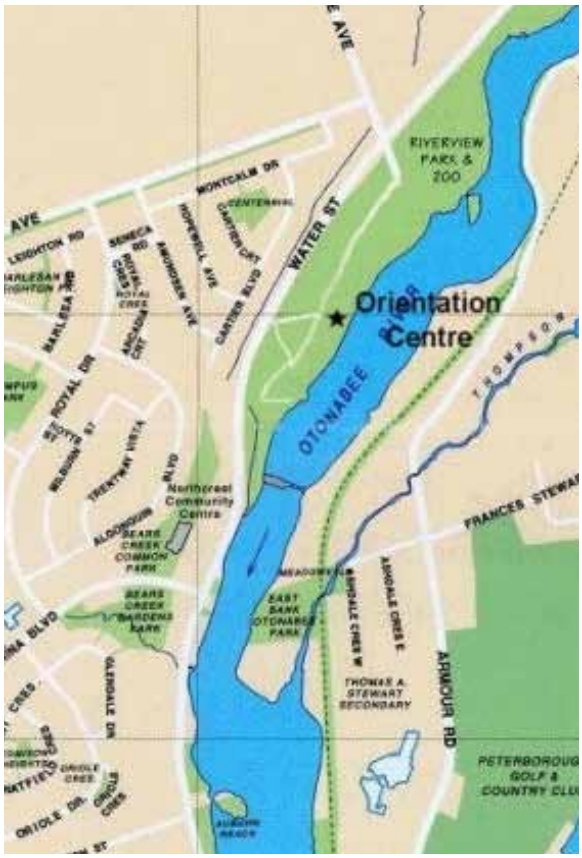
Kids can learn all about meteor showers at NASA's Space Place: http://spaceplace.nasa.gov/meteor-shower.

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:
December 28, 2014



Meetings

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