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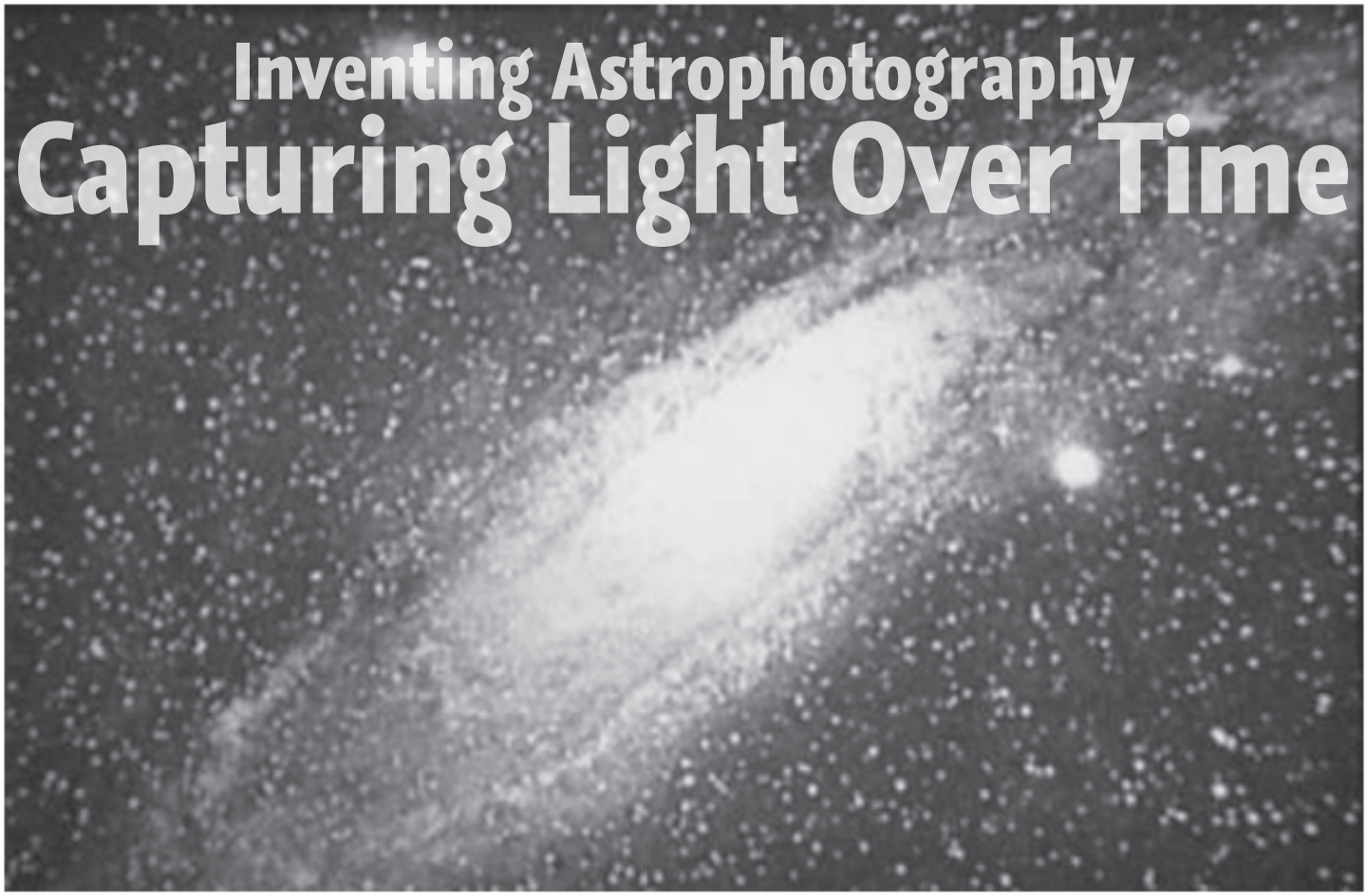
The Reflector

Newsletter of the Peterborough Astronomical Association

Inventing Astrophotography
Capturing Light Over Time



Great Nebula in Andromeda, the first-ever photograph of another galaxy. Image credit: Isaac Roberts, taken December 29, 1888, published in A Selection of Photographs of Stars, Star-clusters and Nebulae, Volume II, The Universal Press, London, 1899.

by Dr. Ethan Siegel

We know that it's a vast Universe out there, with our Milky Way representing just one drop in a cosmic ocean filled with hundreds of billions of galaxies. Yet if you've ever looked through a telescope with your own eyes, unless that telescope was many feet in diameter, you've probably never seen a galaxy's spiral structure for yourself. In fact, the very closest large galaxy to us Andromeda, M31, wasn't discovered to be a spiral until 1888, despite being clearly visible to the naked eye! This crucial discovery wasn't made at one of the world's great observatories, with a world-class telescope, or even by a professional astronomer; it was made by a humble amateur to whom we all owe a great scientific debt.

Beginning in 1845, with the unveiling of Lord Rosse's 6-foot (1.8 m) aperture telescope, several of the nebulae catalogued by Messier, Herschel and others were discovered to contain an internal spiral structure. The extreme light-gathering power afforded by this new telescope allowed us, for the first time, to see these hitherto undiscovered cosmic constructions. But there was another possible path to such a discovery: rather than collecting vast amounts of light through a giant aperture, you could collect it over time, through the newly developed technology of photography. During the latter half of the 19th Century, the application of photography to astronomy allowed us to better understand the Sun's corona, the

see "Great Nebula" on page 16

President's Message

What Happened to the Year?

As one ages the years seem to pass by with ever increasing speed. Here we are with just two months left of 2013. It seems like only yesterday we celebrated the new year. When it comes to observing nights the bad outnumbered the good this year. So far this fall the weather has been disappointing.

As indicated in an e-mail to members I now have the responsibility of storing and maintaining the club's telescopes. I am working through this transition with John Crossen and the process is just about complete. I want to take this opportunity to thank John for the many years of service he has given the club in this role. John's knowledge and skill has been a tremendous asset to this task. Thank you John and I know you will assist me whenever I call.

On the election front Sean Dunne is working his way through the process. I understand a number of positions are expected to be filled. On this note, this will be my second last message as president as I do not plan to stand for re-election. I have enjoyed the last two years and who knows maybe someday I'll throw my hat into the ring again. I'm looking forward to doing more observing and looking after the loaner scopes and less business related matters.

Rodger Forsyth
PAA President

Letter from the Editor

As we veer towards the end of another year within shorter days and colder temperatures, there seems to be fewer nights of good seeing. Hopefully, we'll be rewarded for our paitence this year and Comet ISON will shine.

On that note let us whet your appetite with a couple of John Crossen articles that remind us what the fuss is all about for Comet ISON. Brian McGaffney has a teaser of an image he took on October 12 showing the nice tail sporting from this comet. Hopefully it will brighten at month's end but the latest predictions are not hopeful.

Ken Sunderland is back and in the mode of his Galilean Moons series presents us with a similar analysis of the Moon, our sole companion.

Rick Stankiewicz has a book review of Lynn Hilborn's *Time Machine: Amazing Images Through a Backyard Telescope*. This is a self-published book of Hilborn's astrophotgrapy.

And speaking of astrophotography, our cover story is about the world's first "astrophotograph" of a distant galaxy. Of course, to see the state-of-the-art in amateur astrophotography we present an example of the work of John Chumak's photograph of the Pinwheel Galaxy.

Good skies till next month.

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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Break Out the Binoculars for Comet ISON

Comet Hale-Bopp shown brightly in the light-polluted night sky of Schomberg, Ontario. If Comet ISON is brighter than this, the view will be spectacular. Viewing with binoculars gets you up closer, but naked-eye ogling is just fine. Photo by John Crossen.

John Crossen

November will find many observers bleary eyed and yawning at the office. But it won't be from staying up late. Blame it on Comet ISON which, if some predictions are correct, will utterly dominate the pre-dawn sky.

Depending on how well the big dirty snowball survives its close encounter with the Sun as it orbits our star, ISON has the potential to be the comet of the century. At one extreme there are predictions that it will be as bright as the Full Moon. And at the far end of the scale, the Sun could melt the comet into small chunks that won't be worth rolling over for a peak out the bedroom window.

Having witnessed Comet Hale Bopp in 1997 and Comet Hyakutake the year prior to that, I'm hoping ISON will blow my socks off. Hale-Bopp was so bright that I could see it from downtown Toronto while walking home at night. That's an amazing feat from the light pollution capital of Canada.

But ISON won't be the only celestial treasure in November's sky. Venus will continue to blaze brightly, albeit from low in the western sky. Mighty Jupiter will crest the eastern horizon by around 10:00 and come midnight it should be well above the muck and murk of the horizon for telescopic and binocular viewing.

Another binocular target from our solar system is Uranus which will reach its highest point in the southern sky around 9:00. It will be on the border between the constellations Pisces the Fish and Cetus the Whale.

Those who set their alarm clocks early to catch the comet will also snag a couple of planets as a bonus. Both Mercury and Sat-

See "ISON" on page 15

Comet ISON Arrives After 4.5 Billion Years in the Making

SHOT OF SCOPE, OBSERVATORY AND CO-DISCOVERERS. ISON stands for International Scientific Optical Network, a series of telescopes charged with finding asteroids, space junk and the occasional comet. The comet's co-discoverers are Artyom Novichonok (left) and Vitali Nevski (right). They are shown here with their 16-inch telescope and small observatory.

John Crossen

No matter how brightly it blazes across our sky or how long its tail, a comet has very humble beginnings. Essentially a comet is composed of waste material left over from our solar system's formation. As the heavier materials orbiting our newborn Sun coalesced into planets, the lighter gases and water were left over. Eventually this material drifted on the solar wind to the outskirts of our solar system — far beyond the orbit of Pluto.

Comets form in much the same manner as planets. Gravity pulls the molecules of water, methane, carbon dioxide, oxygen, nitrogen and bits of dust together. It's an over simplification to call comets big dirty snowballs, but that will suffice for our purposes.

Why do comets leave their homes in the distant solar system? Perhaps one big dirty ice ball is bumped by a neighbouring clump of ice and dirt. It's just enough to ease our celestial iceberg in towards the Sun. A passing red dwarf star may have perturbed the comet and sent it into the Sun's gravitational tug. Even a giant planet such as Jupiter can have a gravitational pull on one of these distant balls of ice. Whatever the cause of our "in coming" comet, the show is just beginning.

The closest comet nursery is the Kuiper Belt which is nearly 50 times Earth's distance from the Sun. The furthest comet birthing grounds are in the Oort Cloud, which is still part of our solar

See "Comets" on page 15

Make Way For Mr. Big

John Crossen

Jupiter is the king of the planets no matter how you look at it. In size alone it rules the solar system. The Earth would fit inside Jupiter 1,000 times over. Imagine a marble rolling around inside a basket ball and you've got the idea.

Size brings with it mass, and in Jupiter's case it has 318 times the mass of Earth. The disparity between its mammoth size and middling mass is due to the fact that Jupiter is comprised primarily of 75% hydrogen gas and 25% helium.

Some have described Jupiter as a rocky little ball wrapped in an incredibly thick blanket of weather. If a 125 pound lady could stand on Jupiter she would peg the tub-o-meter at 292.5 pounds. Hefting your quarter-pound hamburger might even qualify as healthy exercise. And you needn't biggie your fries. They, too, would be 2.32 times their Earthly weight.

Jupiter is also big on moons with 63 natural satellites as of the latest tally. It can also claim the largest moon in our solar system, Ganymede. It is one of the four large moons Galileo discovered in 1610. Collectively, the foursome is referred to as the Galilean Moons.

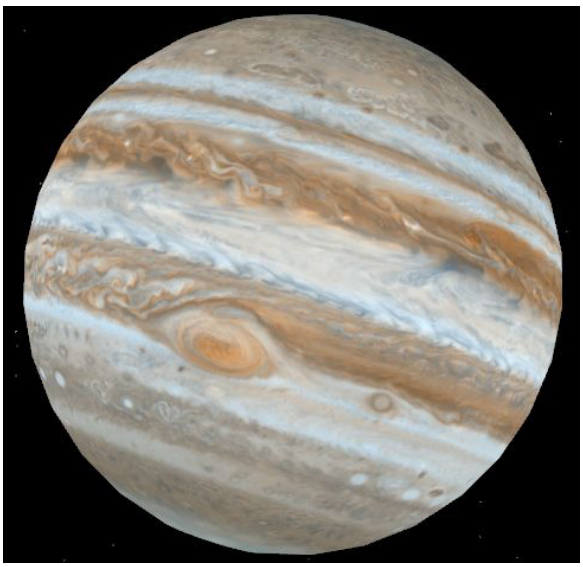
Amazingly for its size, Jupiter is also fast. It rotates completely in just 9 hours and 55 minutes. Puny Earth takes 24 hours to complete a single pirouette.

Jupiter's weather is also cruising for a speeding ticket. Wind speeds of 640km/h have been measured via the Galileo probe that parachuted about 156km beneath Jupiter's thick cloud cover.

While storms are prevalent in the cloud cover, one storm has been roiling away for the last 300 years. Known as the Great Red Spot (GRS) this phenomena is large enough to fit almost 2.5 Earths into it. Wind speed at its centre are relatively calm compared to the 240 and 680 km/h mega winds as you mover further out to its edges.

This November Jupiter will be rising at 10:00 early in the month and at 8:00 by the end of the month. It will be sharing the night sky with the constellation Gemini, the twins. Jupiter will be rising in the east and should be easy to spot, even from light-polluted suburban areas. It will be the brightest object in that part of the sky.

Tripod-mounted 10 × 50 binoculars will show the Galilean Moons as tiny specks orbiting the planet. A small telescope will reveal much more detail, including the GRS if your timing is right.



Jupiter. Jupiter's weather systems become obvious at a glance. The dark bands are known as belts and the light areas are zones. They often move in opposite directions from each other. The Great Red Spot is visible in this image.

The Moon (Layer 1 – Galileo)

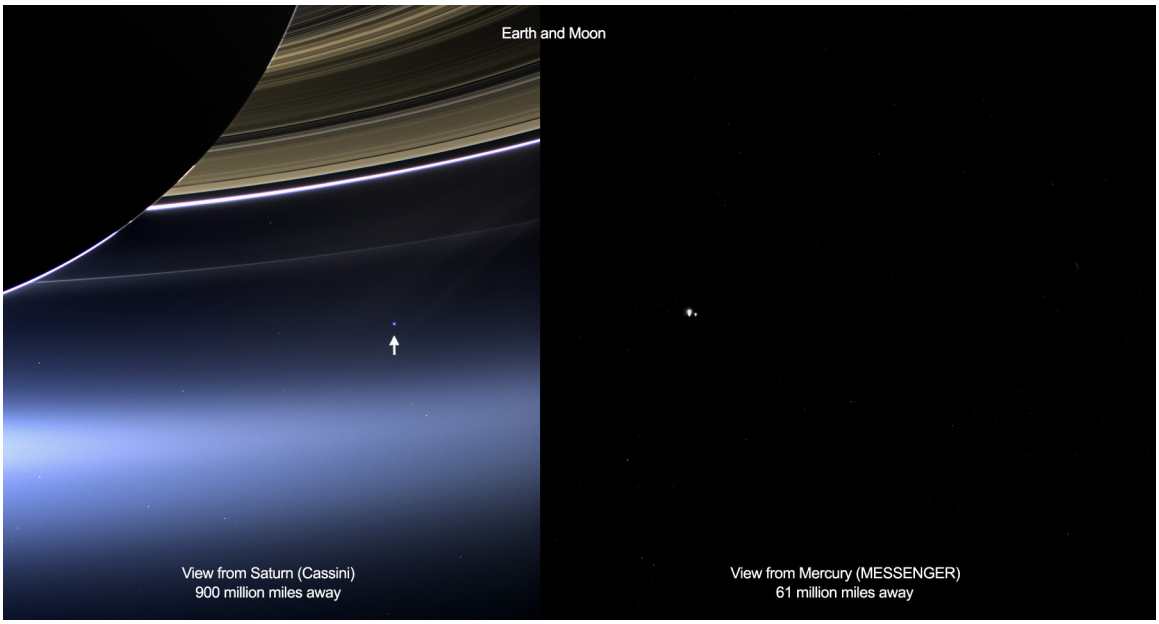


FIGURE 1. Earth-Moon system as seen from Saturn and Mercury. Source: http://photojournal.jpl.nasa.gov/figures/PIA17038_fig1.jpg

KENNETH SUNDERLAND

THIS PAIR OF BREATHTAKING images (Figure 1.) bluntly shows our true situation. Such an image should turn every citizen of planet Earth into a passionate environmentalist. To state the obvious ... there is nothing else. It is incorrect to think of the Moon as something apart from Earth. Rather the Earth-Moon is a linked system sharing a common history with the one affecting the other in a locked dance. This is reason enough to give the Moon a very close look.

Last winter I made a project of observing Jupiter's Galilean moons. A four-part account was serialized in *The Reflector* between February and May 2103. I propose a similar project for the Moon. Among the reasons: a) the Moon repeats its cycle every month facilitating repeated observations; b) dark sky quality is not an issue; c) daytime viewing is a pleasant addition to night time; d) even small scopes (binoculars too) reveal much and, e) the abundant resources available.

As a relative beginner, my ideal reader is still any recent club member. Perhaps you will learn something along with me as I begin this lunar exploration.

My starting point? Galileo's decisive *Sidereus Nuncius* (1610). I wondered if it could still be relevant? Yes. Before anyone looked with a telescope, dogma asserted that the Moon was a perfect heavenly sphere, quite different from Earth. (To tell the truth, I've never understood this because even to the naked eye, it doesn't look perfect with those dark areas and bright spots.) Galileo's overall goal was to shatter this myth and render the Moon imperfect.

He first notes that the terminator is not a smooth curve which only a perfect sphere could produce. It is uneven due to the lunar terrain. Look for it. He further observes that there are points of light within the shadow area but not too far from the terminator. Can you see some? Galileo observes "Now, on Earth, before sunrise, aren't the peaks of the highest mountains illuminated by the Sun's rays while shadows still cover the plain?" He has brought Heaven down to Earth.

He proceeds to estimate mountain elevations using the geometry of a single Pythag-

continued on next page

Continued from previous page

orean triangle. Answer? About 7 km. Close enough, and calculated by judging how far those points of light were from the terminator. The only other fact needed is the diameter of the Moon which was already known to remarkable accuracy since antiquity.

He notes that the brighter areas (terrae) are "filled with depressions and prominences" and the large dark areas (maria) are relatively smooth. The land/sea parallel with Earth is cemented. Figure 2. shows Galileo's sketch on the left compared to a photograph of the same view. (BTW: One might have hoped for more accurate sketches but, remember, his goal was to show that the Moon is as imperfect as Earth, with mountains, valleys and plains.) By comparing the shadows and prominences at first and last quarter he deduces that the maria are lower than the brighter terrae. True enough! He observes that the maria are gently connected and don't change much in appearance as the Sun angle changes. This latter observation is easy enough to confirm.

By contrast, he describes the smaller dark spots (crater interiors) as ever changing in appearance due to the shadow play at the crater rim. It's interesting to watch these changes during the course of a single evening as the terminator advances westward 0.5° per hour. Pick a dark floored crater near the terminator and keep checking it for changes. Your patience will be rewarded.

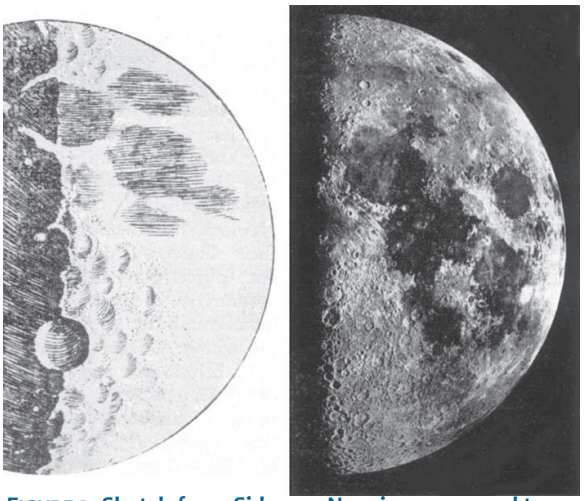


FIGURE 2. Sketch from Sidereus Nuncius compared to photograph Source: http://commons.wikimedia.org/wiki/File:Galileos_Moon.jpg

If, indeed, the lunar surface is mountainous, the edge of the disk should appear jagged, like a toothed wheel. Yet, through his low power instrument the edge appeared smooth all around. Conflict. Galileo offers clever explanations that are not only wrong, but unnecessary. In fact, better glass directly shows a jagged edge resulting from mountains and valleys. See for yourself, especially in the Polar Regions.

Galileo finally discusses the moon's "ashen light" or what we call Earthshine. In Galileo's time this was a great puzzle. It wasn't appreciated that if the Moon reflects the Sun's rays toward the Earth, that means the Earth should reflect the Sun's rays toward the Moon. After reducing competing explanations to nonsense, he succinctly concludes "When the Earth is most illuminated by the Moon, the Moon is least illuminated by the Earth, and vice versa." One could make a tidy project of studying this doubly reflected light as it changes through the lunar cycle.

One way to begin an exploration of the Moon is by trying to see what Galileo saw. Sure, they're simple observations given the power of modern instruments, but what a pedigree.

References

Van Helden, A., (1989), *Sidereus Nuncius*, University of Chicago Press.

PHOTO GALLERY

Comet ISON

This image of Comet ISON, was taken this morning, October 12th here at the Nutwood Observatory. There has been quite a few morning that were clear over the last week, but fog in the higher altitudes here made taking close up images of the comet not possible. However, this morning at 4:30 AM it was less misty and we were able to take the image.

Currently when taken this comet is at Magnitude 10 and moving very fast. Images were taken with a 14 inch Astrograph, guided and with an Apogee 16 M CCD camera.

Total aqusition was about 20 minutes, however, processing time was another story.

I can supply the 16 bit tiff's on request.

Brian McGaffney

Pinwheel Galaxy

M101 The Pinwheel Galaxy is located about 27 Million Lights years away. M101 was the first galaxy ever seen as a spiral. In 1851, a British amateur astronomer,Lord Rosse, drew M101 after viewing it through a giant telescope he had designed and built himself. It was the first picture (drawing) ever to show a galaxy's full spiral structure, even if he did not know M101's true nature, in those days many thought it was a spiral nebula within our Milky Way. We now know it is beyond the Milky Way Galaxy, M101 is a massive nearby Face-on Spiral Galaxy!

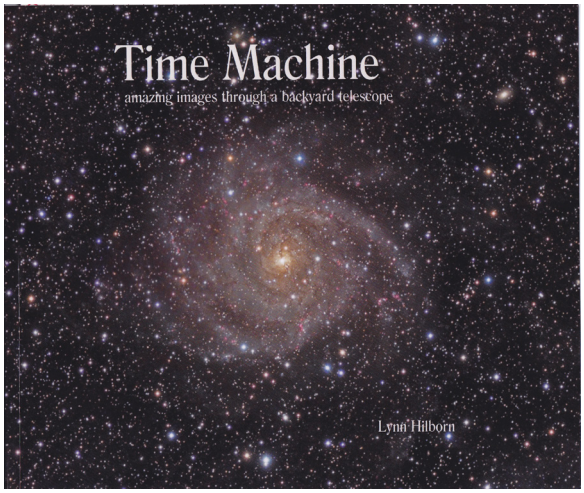
The galaxy M101 is visible in binoculars from a dark location, just north of the handle of the Big Dipper in Ursa Major! M101 spans approximately 170,000 light years across — seventy percent larger than the Milky Way. The tiny bright blue dots in the spiral arms are young hot blue star clusters. The little pink spots are Large Nebulae/HII Star Formation Regions, massive stellar nurseries forming new stars. It is estimated that over 3,000 of these HII regions are scattered throughout the spiral arms! Visible in and around the spiral arms are several background galaxies.

I have been imaging the night sky for more 25 years using mostly my homemade telescopes and low-cost camera equipment. It is capturing images like this that makes all the time and effort I put in worth it! This is certainly my personal best and most detailed image of M101 to date!

Best Regards,

John Chumack www.galacticimages.com

BOOK REVIEW



Time Machine

Amazing Images Through a Backyard Telescope Author: Lynn Hilborn

It never occurred to me before reading this book, but we are all time travelers with our "time machines" that we continually look back in time with. Yes, our telescopes and binoculars are what enable us to see the past and to some extent, predict the future. Last year I had the pleasure to meet author/astrophotographer, Lynn Hilborn, and ever since then I have been taking note of where his incredible astro images have been popping up.They are everywhere these days, from *SkyNews Magazine* to the RASC *Bulletins and Journals* and every time I see one of Lynn's images I am struck by the incredible detail and colours he brings out. So, when I found out Lynn had published a book with some of his work I had to check it out. I was not disappointed. This small format glossy book of the cosmos transported me from our inner solar system, starting with the Moon and continued out past nebulae (lots of nebula) and star clusters, to distant galaxies and the ancient light of quasars up to 8.5 billion light-years in the past. What a trip and I can share it with others, now that I have the book.

The text that accompanies each image is succinct and informative yet explains not only what the object is, but how far back in time the light traveled to create the image. Telescopes really are time machines.

Not since becoming friends with the likes of *Reflector* contributor, John Chumack and the PAA's very own Brian McGaffney, have I personally known such accomplished astrophotographers and I mean topnotch!

If I had any regret about this book, it was that the format could have been larger (I know it costs more to do this and Lynn is doing this on his own), as I just can't get enough of these amazing quality images. I look forward to many more topnotch images from Lynn at the WhistleStop Observatory (Grafton, Ontario). He has come a long way for a guy from Preston (Cambridge, Ontario).

To see more of Lynn's work, visit: **www.nightoverontario.com**. eBook and print copies of this book are available on iTunes, **https://itunes.apple.com/ca/book/id583664888** and Blurb Books, **http://www.blurb.ca/b/4038933-time-machine**, respectivley. Hard and soft cover are also available.

Fellow Time Traveler from Preston,
Rick Stankiewicz

When it comes to space telescopes MOST is most

John Crossen

With a slight stretch of the imagination MOST is an acronym for micro variability and oscillation of stars. The acronym may not be perfect, but the little space satellite that bares its name most certainly is.

MOST is a space telescope about the size of a blanket trunk that has been charged with the monumental task of searching for stars that may be home to distant solar systems. When launched 10 years ago MOST was—and still is—the world's smallest space telescope. It is also Canada's first ever "Eye in the Sky."

MOST cost a grand total of $10 million dollars, which is micro-money when you're talking space exploration. So how has our bargain basement Hubble done?

Orbiting 850 kilometres above Earth, MOST's goal is to find ideal locations in our galactic neighbourhood to scan for planets beyond Earth. Called exoplanets, they orbit stars just as we do the Sun. But those stars are light-years away and their planets are difficult to detect. Nonetheless, MOST has gone beyond just road mapping likely spots to find exoplanets and found two of its own.

One is a super-Earth sized planet orbiting the star 55 Canceri e. Not to take any glory away from MOST, but it is easier to detect a super-Earth, because the big planet's gravitation tug on its home star causes the star to wobble or oscillate more.

In this particular case the super-Earth also orbits Canceri e super close and super fast. It takes just over 17 hours to make one trip around its star. We take 365 days to make the same journey around our Sun. So it's almost a given that a planet this close to its star will also be super hot and life forms as we know them probably wouldn't exist.

But on a positive note, it has been determined to have a carbon-rich core and has been called the Diamond Planet. (See my October 25 article for more details).

MOST's other find is now known as HD 97658 b. It's an exoplanet that may have a solid metallic core.

Beyond scanning 5,000 stars in the past ten years, our 53 kilogram MOST has also made Canada a leader in the micro-satellite industry. The technology developed for MOST has created a niche for small, inexpensive satellites. Today, we are producing micro-satellites for Norway, Australia, and Slovenia.

Artist's Rendering of MOST in space. Using the science of astro-seismology MOST looks for tiny wobbles in a star as it spins. The wobble can indicate that a planet tugging on it. MOST can concentrate on a single star for days or weeks at a time to confirm its data. MOST was launched on June 30, 2003. Canada Day, July 1 is now regarded as its official birthday.

The astronaut heroes of my youth are fading away

John Crossen

The death of astronaut Gordon Cooper on October 4 and Scott Carpenter just six days later triggered a rush of memories. It also gave me a somewhat foreboding realization.

On the memories front, I can still see the newspaper headlines from February 2, 1962 when John Glenn in the Friendship 7 capsule became America's first man to orbit the Earth. He made a repeat space flight in 1998 aboard the space shuttle Discovery. In doing so he also became the oldest man to journey into space. He was 77 at this time and is still with us today.

The most spectacular achievement was the Apollo 11 Moon landing in 1969. Television covered it—live. Those flickering black-and-white images of Neil Armstrong taking that "giant leap for mankind" as he stepped onto the Moon's surface will live forever on my memory banks.

Accompanying Armstrong on the Moon was "Buzz" Aldrin while Michael Collins flew the Command Module in an orbit around to Moon. Collins was the return ticket for Armstrong and Aldrin. The trio gave America the "big win" in the space race with the Russians.

A note to all you Moon landing conspiracy fans, if it was all faked, how come the Russians have never protested? See Phil Plait's "Bad Astronomy" for further details.

Sadly Neil Armstrong died from complications following heart surgery in August of 2012. Thus the first man to set foot on the Moon is gone.

Two more firsts were established on June 19, 1983 when astronaut Sally Ride became America's first woman in space. She was also the youngest American astronaut to be

see "Sally Ride" on page 14

Mars Colony. Who will be the first person to set foot on Mars? With mission dates set for the 2040's I'll be pushing 100 so chances are I'll miss that one.

My "Finest NGC" Quest

My quest for the Royal Astronomical Society of Canada (RASC) "Finest NGC" Certificate started in July 2009 and ended in September 2013. The New General Catalogue (NGC) includes 7,840 numbered objects in the night sky. This certificate is comprised of 110 objects from this catalogue that are not Messier objects. The idea is that you build on your observing experience. I had completed the Messier Certificate in 2007, joining 307 other people since 1981 to do so. What a great opportunity to educate yourself about the night sky. You do have to be an RASC member to participate in most of these programs, but it is worth the price of admission. I thought it would be neat to try for another level by kicking it up a notch. What a challenge it turned out to be (at least for me). I picked away at the easier objects initially. Then I got serious and purchased a new telescope, so I have made most of my observations for this certificate with a 12" (305mm) SkyWatcher Dobsonian reflector and my eyepiece of choice was a Meade 5000 series SWA 24mm (62.5×). Maybe this was not totally necessary, but it sure made it fun and I am getting use out of my equipment and it is getting me out under the stars. To me, this is what it is all about and it does not hurt that you end up with a record of your observing efforts.

Sounds easy enough with equipment like this, but you need a few things to do this, like an accurate finder, star atlas, nebula filters, good weather, clear skies and patience. I found that usually one of these aforementioned elements was missing on any given night. Often the "spirit was willing, but the body was not" or the weather would not cooperate. It does take time and it was not a matter of finding the object listed, ticking it off your list and on to the next one. Each "find" had to be sketched and logged on a separate sheet with your exact observing details before moving on to the next object. It should go without saying that no GoTo scopes are allowed, unless used manually. Yes, you need a good star atlas and ability to "star hop" your way around the constellations, but it can be done and it is fun. I can honestly say that if I know where I am going, I can usually beat most GoTo scopes for speed of getting an object in the eyepiece. I more than once had my finder on the spot I wanted and then looked in the eyepiece to see that the object was dead centre. Going through the effort of a certificate does give a sense of accomplishment, plus you get to know your gear and learn the night sky. It is worth a try. Once you have started by getting your "Messier Certificate", the "Finest NGC Certificate" is a logical challenging next step and I highly recommend it, if observing and learning the night sky is your goal. I guarantee your journey through the heavens will be full of surprises and rewarding in the end and you can have the logbook and certificate to prove it! As of this moment I have submitted my records for approval and hope to become one of only 110 people that have been issued this certificate since 1995 and possibly the first person in 2013. Time will tell.

Where to from here? Maybe I will try to "shoot for the Moon" with the "Isabel Williamson Lunar Observing Certificate", or I could also consider the "Deep Sky Challenge". Whatever I do, I will be having fun under the stars for years to come. Why not join me?

Rick Stankiewicz
Observer & RASC Member

to 'The Sky this Month'

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Sally Ride

launched into space. Her flight was aboard the ill-fated Challenger Shuttle.

In 1984 Sally Ride joined the crew of the Challenger Shuttle again. On this flight she ran her total hours in space up to 343.

Her retirement life was filled with activity, much of which was directed towards getting more women and girls more involved in science.

In addition to her achievements as an astronaut, Sally Ride also held a Ph.D. in Physics. She served on many NASA committees, was the author of 7 children's science books and, in her younger years, was a nationally ranked tennis player. Sally died on July 12, 2012 at from pancreatic cancer.

Nobody lives forever, and that includes me. I'm not planning to pop my socks soon, but I suddenly realized that I have had the privilege of living through the pioneering days of space flight. My heroes from those days will live on forever in the pages of history—may there be many more in the future.

to next article

The Sky this Month

Mercury is at inferior conjunction on the 1st. Reappears in the dawn sky second week of November. Greates elongation W (19°) on the 18th. Passes 0.3° S of Saturn.

Venus reaches greatest elongation E (47°) on the 1st. Waxing crescent Moon passes 8° N on the 7th.

Mars in the morning sky in Leo and passing into Virgo later in the month.

Jupiter rises in the east-north-east in late evening in Gemini. Begins retrograde motion on the 7°.

Saturn in conjunction with the Sun on the 6th. Reappears low in dawn twilight late in month in Libra.

Hybrid Solar Eclipse rare annular/total eclipse in progress at sunrise on the3rd.

S. Taurid Meteors peak 6 a.m. on the 5th.

N. Taurid Meteors peak 5 a.m. on the 12th.

Leonid Meteors peak 12 p.m. on the 17th.

Moon Phases

New Moon	7:50 AM	November 3
First Quarter	12:57 AM	November 10
Full Moon	12:38 PM	November 17
Last Quarter	2:28 PM	November 25

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ISON

urn will be joining ISON and should make a tempting trio for camera buffs.

Mars makes its way into the sky via the constellation Leo. It will glow a ruddy red colour between Regulus, the lion's heart and Denebola, which brings up the lion's posterior.

While we're carousing with Leo, I should mention that this year's Leonids meteor shower is going to be skunked by a full Moon on November 17th. The Leonids are one of the year's best meteor showers, but we'll just have to settle for a comet instead. Even astronomers can't have it all.

November's First Quarter Moon will arrive on November 10. That's the best phase of the Moon for exploring with either a telescope or binoculars. The reason is that the Moon is lit from an angle, so the mountains and craters cast long shadows. The shadows highlight detail that is lost as the Moon becomes more and more evenly lit. When the Moon is full, it is at its most boring phase for observing because everything appears flat.

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Comets

system, but is almost 2 light-years (20 trillion kilometres) away.

The two birthing areas produce different orbital durations for the comets. Those which sling shot around our Sun every few thousand years are called long period comets. Those with orbits in the tens or hundreds of years are called short period comets

As the Sun's gravity pulls our big, dirty snowball ever faster and closer, the solar heat begins to melt the ice and release the gasses within the comet. That's what produces the long plume of the Comet's tail. Because the solar wind pushes outwardly against the comet's tail, it always points away from the Sun. Even when the comet is receding, the tail will point away from the Sun.

There are 4,894 known comets at this time, but more will be discovered at an ever-increasing pace thanks to the telescopes orbiting our planet and sky surveys.

There isn't much to worry about with ISON. The closest it will come to Earth is 64,210,000 kilometres. And if someone tries to sell you a gas mask because Earth will pass through ISON's tail, tell them to bugger off. We already did that in 1910 with Halley's Comet and everyone survived.

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Great Nebula

spectra of stars, and to discover stellar and nebulous features too faint to be seen with the human eye.

Working initially with a 7-inch refractor that was later upgraded to a 20-inch reflector, amateur astronomer Isaac Roberts pioneered a number of astrophotography techniques in the early 1880s, including "piggybacking," where his camera/lens system was attached to a larger, equatorially-mounted guide scope, allowing for longer exposure times than ever before. By mounting photographic plates directly at the reflector's prime focus, he was able to completely avoid the light-loss inherent with secondary mirrors. His first photographs were displayed in 1886, showing vast extensions to the known reaches of nebulosity in the Pleiades star cluster and the Orion Nebula.

But his greatest achievement was this 1888 photograph of the Great Nebula in Andromeda, which we now know to be the first-ever photograph of another galaxy, and the first spiral ever discovered that was oriented closer to edge-on (as opposed to face-on) with respect to us. Over a century later, Andromeda looks practically identical, a testament to the tremendous scales involved when considering galaxies. If you can photograph it, you'll see for yourself!

Astrophotography has come a long way, as apparent in the Space Place collection of NASA stars and galaxies posters at `http://spaceplace.nasa.gov/posters/#stars`.

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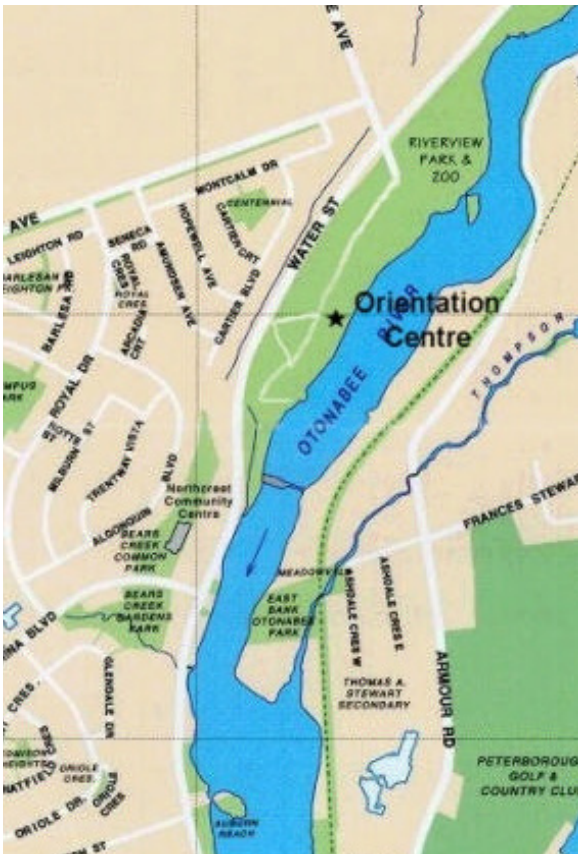
Articles

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 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:
November 26, 2013



Meetings

The Peterborough Astronomical Association meets every first Friday of most months at the **Peterborough Zoo Orientation Centre** (Next to the PUC Water Treatment Plant) at 8 p.m. P.A.A. executive business will be conducted starting at 7:30 p.m. Members and the public are welcome to attend the earlier time.