Volume 12 • Issue 10
December 2013
ISSN 1712-4425
peterboroughastronomy.com
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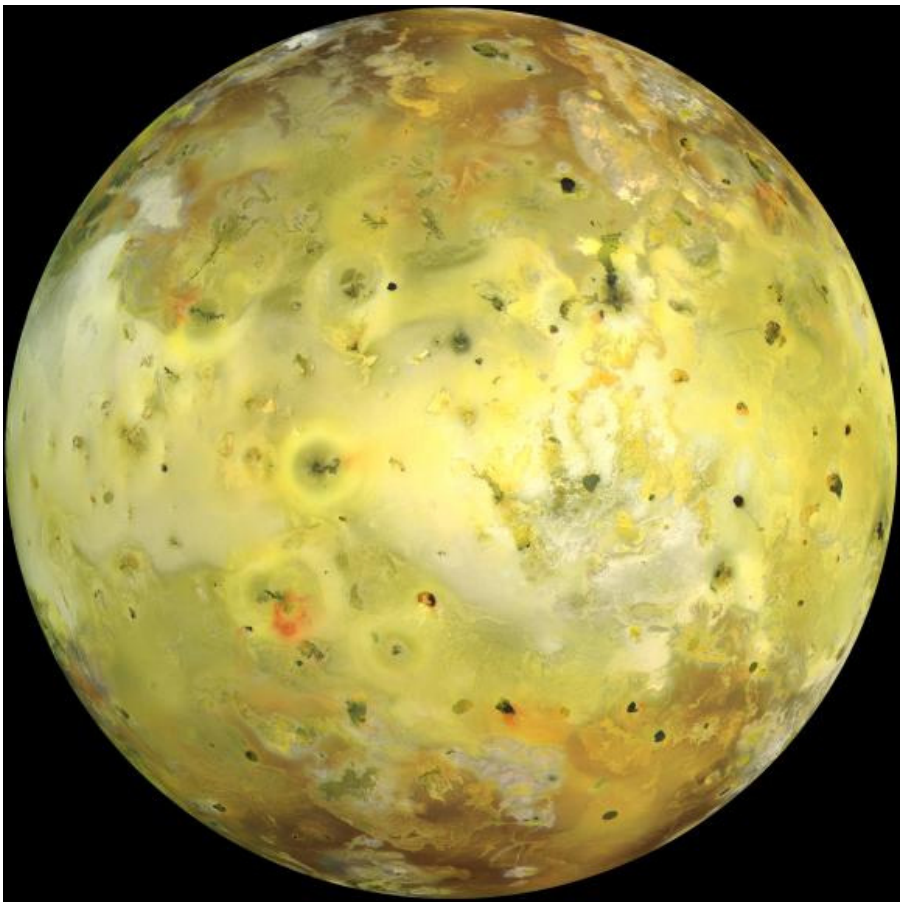
The Reflector

Newsletter of the Peterborough Astronomical Association

The Most Volcanically Active Place is Out-of-this-world!

by Dr. Ethan Siegel



Io. Image credit: NASA / JPL-Caltech, via the Galileo spacecraft.

Volcanoes are some of the most powerful and destructive natural phenomena, yet they're a vital part of shaping the planetary landscape of worlds small and large. Here on Earth, the largest of the rocky bodies in our Solar System, there's a tremendous source of heat coming from our planet's interior, from a mix of gravitational contraction and heavy, radioactive elements decaying. Our planet consistently outputs a tremendous amount of energy from this process, nearly three times the global power production from all sources of fuel. Because the surface-area-to-mass ratio of our planet (like all large rocky worlds) is small, that energy has a hard time escaping, building-up and releasing sporadically in catastrophic events: volcanoes and earthquakes!

Yet volcanoes occur on worlds that you might never expect, like the tiny moon Io, orbiting Jupiter. With just 1.5% the mass of Earth despite being more than one quarter of the Earth's diameter, Io seems like an unlikely candidate for volcanoes, as 4.5 billion years is more than enough time for it to have cooled and become stable. Yet Io is anything but stable, as an abundance of volcanic eruptions were predicted before we ever got a chance to view it up close. When the Voyager 1 spacecraft visited, it found no impact craters on Io, but instead hundreds of volcanic calderas, including actual eruptions with plumes 300 kilometers high! Subsequently, Voyager 2, Galileo, and a myriad of telescope observations found that these eruptions change rapidly on Io's surface.

Where does the energy for all this come from? From the combined tidal forces exerted by Jupiter and the outer Jovian moons. On Earth, the gravity from the Sun and Moon causes the ocean tides to raise and lower by one to two meters, on average, far too small to cause any heating. Io has no oceans, yet the tidal forces acting on it cause the world

see "Io" on page 16

President's Message

Our "Focus" Shifts to Next Year

The PAA had in my opinion another good year with respect to outreach activities. Our annual events on Armour Hill, the encounters with the various Girl Guide groups and our annual session at Emily Provincial Park. I thank all members that participated in these sessions. The weather wasn't always as kind as it could be but we gave it a shot anyway.

We can now turn our attention to the coming year. One of the changes we will see is that a number of faces in your club's executive positions will change. Some directors will stay on, some will leave. I will leave it up to the Election Chair (Sean Dunne) to divulge the status at our "Annual General Meeting" (AGM). I will take this opportunity to thank the directors that have served so well during the past two years while I was President. Thank you, alphabetically of course, Boyd Wood, Dean Shewring, John Cameron, John Crossen, Margaret Scorthorne-Brons, Michael McCarthy, Pat Crebar, Phil Chee and Rick Stankiewicz.

I have received the documentation already for securing permits for the coming year for activities that occur on City property. The dates have been set and will be announced early in the new year. Let's "focus" on making 2014 another great year for the PAA. I invite you to get out to these events and help the club. It is rewarding to interact with the public and help them understand "What's out there."

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 astro-tourist, Rick Stankiewicz on Astro Tourism. 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 two years.

Reminder. It's membership renewal time.

Rodger Forsyth
PAA President

Letter from the Editor

Well, Comet ISON is not exactly fulfilling its billing as "Comet of the Century". It was a naked-eye dud as Rick Stankiewicz illustrates with his photo on page 3. As we go to press, the sungrazing comet survived its perhelion and emerged substantially smaller. However, the news is not good. Its dust cloud appears to be dissipating and chances of it brightening appear to be zilch.

You might be able to see Comet ISON in binoculars and John Crossen has some advice for those looking for a nice Christmas gift.

Ken Sunderland has the second installment of his Moon series in this issue.

Enjoy and see you in the new 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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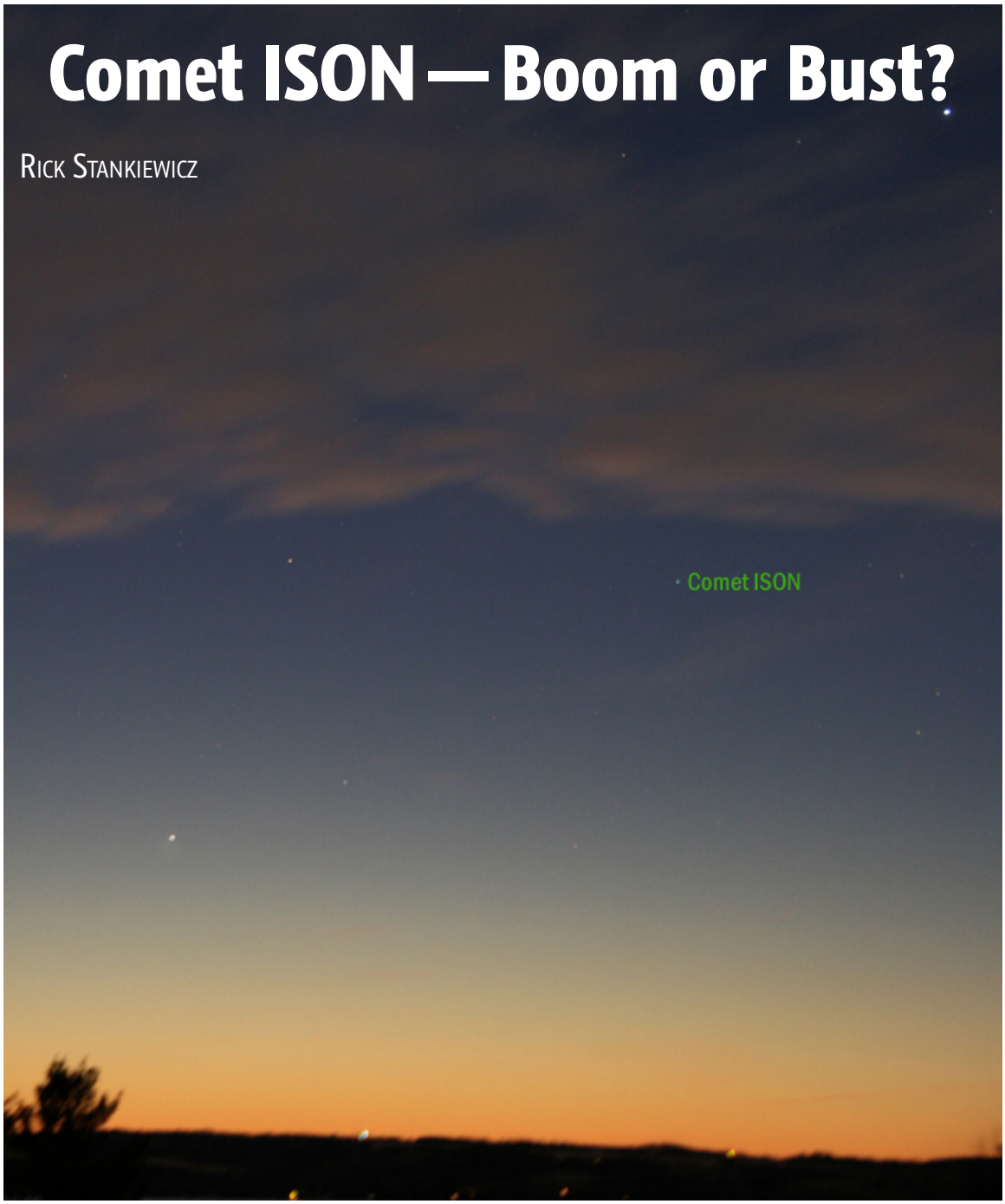
Comet ISON — Boom or Bust?

Rick Stankiewicz



Compared to what it could be or should be at this point, I would say that Comet ISON is a "bust", but maybe I just expect too much. At this writing (last week in November), as Comet ISON dives toward the Sun for its close encounter of the unknown kind, it has performed no better than Comet PanSTARRS of earlier in the year. It is barely naked-eye visibility and not a great photographic target even with time exposures.

The last time I had a chance to check out Comet ISON under decent morning conditions was on November 20th over Rice Lake in Keene and the accompanying image is the result. I was able to locate the comet with my 20 × 80 binoculars and even then it was only a distinct fuzzy head (coma), but no tail was clearly evident. However, I was not able to see the comet with my camera until I took test exposures. Luckily, this morning it was conveniently located between Spica (alpha star in Virgo), in the upper right and the planet Mercury, in the lower left in this image. It appears as

See "Comet ISON" on page 15

Telescopic Tripods and Tribulations

John Crossen

At Christmas people frequently ask me what's the best telescope to buy their child or grandchild for Christmas. My advice is emphatically—none. I will be blunt here.

For starters, a decent telescope is going to cost about $250 to $300. That's a bundle to spend on something that may just be a passing fancy.

If you spend less than that the chances are good that you'll wind up with an instrument with a wobbly tripod, poor optical quality, horribly outdated eyepieces and a complex set of controls that are difficult for even an adult to operate, much less assemble correctly. The next step after a few frustrating nights under the stars is "yard sale."

What I have just described is known throughout the astronomy world as the Big Box Store Christmas Trash Scope. Leave it on the shelf.

Instead, wait until you are sure your "maybe astronomer" really has a keen interest in the subject and you have the resources to buy a good quality scope from a real astronomy store. The kid in the Big Box store was probably selling snow tires or sports equipment two weeks ago. What he or she doesn't know about telescopes could fill the Library of Congress.

Another reason not to buy a telescope is the simple fact that if its user doesn't have any idea of where to point the scope other than the Moon, boredom will set in quickly. It takes about a year of working with star charts and binoculars before the beginner is ready to move up to a telescope.

Dobsonian Telescope. The Dobsonian style telescope is easy to assemble and simple to operate. Just push and peek. The one shown above will fit into a compact car so getting out to a dark-sky location is not a problem.

What about computerized telescopes? Now you've raised the entry fee to over $500 for something worth having. There are some that come in for less money, but remember, you're dealing with electronics and computers that can be fussy as well as frustrating outside in the cold.

Celestron and Meade have GoTo models that require nothing more than setting up and flicking a switch to get them oriented to your location and the stars overhead. You don't have to know the name or location of a single star.

In just a couple of minutes you can be observing from thousands of objects in their hand controllers. Entry fee for the Celestron Sky Prodigy is $599. The Meade Light Switch is $1,400 on sale. Both are a serious cash investment.

See "Dobsonian" on page 15

Binoculars — astronomically great Christmas gifts

Display of binoculars. The smallest pair of binoculars here won't let in enough light for stargazers. The big set weighs 10 pounds. That's just too heavy to hold. The mid-size models are just the right compromise at 7 × 50.

John Crossen

Binoculars are by far the handiest tool for digging out the hidden treasures of the night sky. They don't have to be expensive, but you do need to choose the correct ones.

A pair of 7 × 50 or 10 × 50 models is best. What are the numbers about? The first number is the magnification the binoculars will deliver. Thus 7 × means the object will appear 7 times closer. Moving up to 10 × brings the subject 10 times closer.

The second number is the number of millimetres in diameter of the front lens. In the case of both the examples mentioned, that is 50mm. The bigger the diameter of the front lens (called the objective lens), the brighter objects will appear.

I don't recommend bigger binoculars than those mentioned. Smaller ones such as 8 × 25 are more compact, but won't let in enough light for stargazers. A larger pair such as the 20 × 80 giant binoculars must be mounted on a tripod to hold them steady.

At the observatory we use 8 × 40 and 7 × 50 binoculars for our guests. Our 20 × 80 pair is mounted on a specially built system that holds them steady and can be adjusted for optimum viewing comfort.

If you'd like to complete the binocular gift, Phil Harrington's *Binocular Universe*

See "Binoculars" on page 14

The Moon (Layer 2 – Ancient Spots)

Kenneth Sunderland

Consider those big dark patches — the maria. Galileo called them the "ancient spots" since people from time immemorial have always seen them. In the early days of the lunar cycle Mare Crisium is a dominant feature. With each passing day the adjacent interconnected basins are revealed. Their names are Fecunditatis, Tranquillitatis (where humans first walked), Serenitatis and Nectaris. Together, they form what I think is the convincing shape of a poodle with Serenitatis the head and Crisium a pom-pom tail. (Figure 1.) Silly perhaps, but this shape allows for quick orientation no matter how the Moon is positioned in the sky. The other maria follow in their turn; Vaporum, Imbrium, Insularum, Nubium, Cognitum and Humorum along with Oceanus Procellarum. They do not form a convincing shape. Perhaps a chunky space-suited astronaut feeding the poodle? The helmet is Imbrium with Procellarum playing the role of life support backpack. With this image, the face of the Moon becomes a familiar place. This list of a dozen prominent near side maria is completed by Mare Frigoris above the astronaut's helmet. There are additional smaller maria on the near side and very few on the far side — a striking asymmetry. The total count is 22 maria plus one Oceanus. In memorizing the overall maria pattern, along with names, one is able to locate features to first approximation. For example, if someone said to me "Apollo 16 landed in the hills northwest of Nectaris" I would immediately visualize the poodle's front paw and then go northwest. It's in the ballpark.

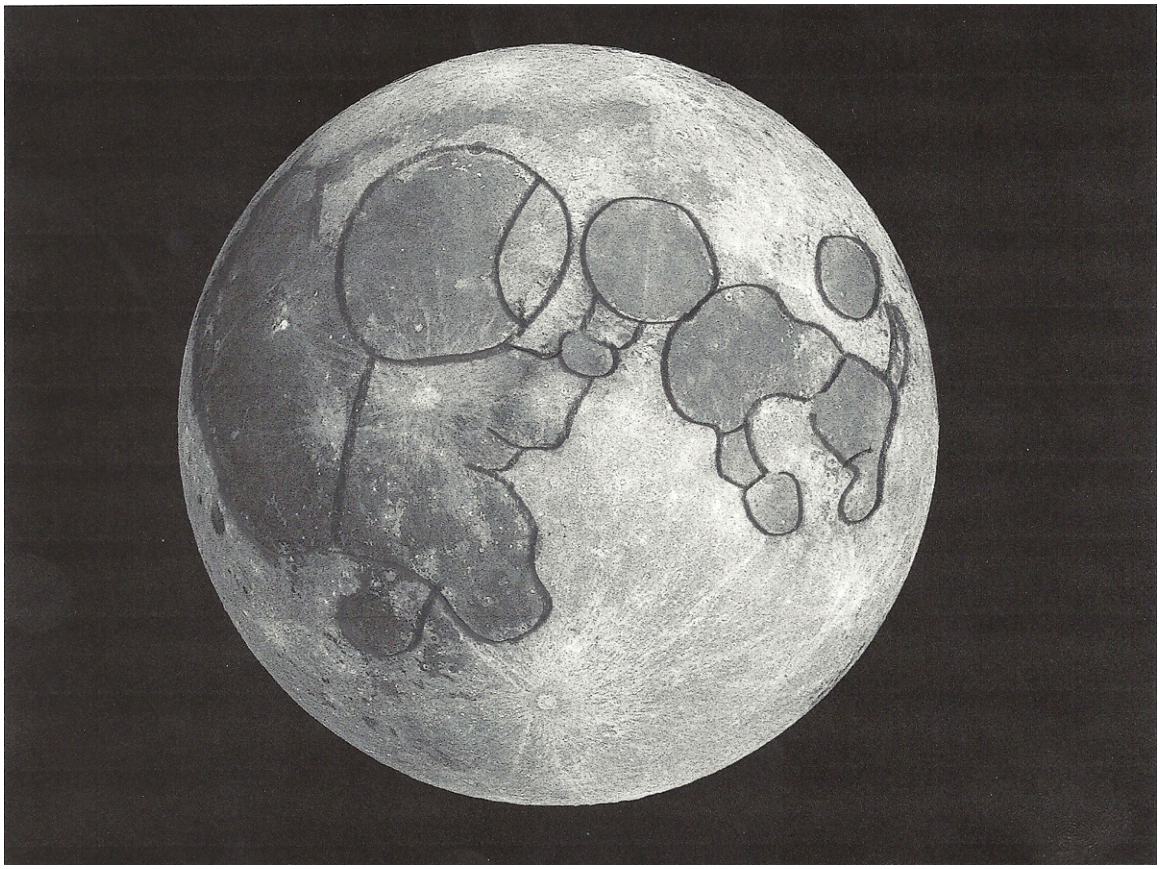


Figure 1. Lunar maria form a distinctive pattern. credit: Google image modified by author.

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In order to make identifications, you will need an atlas. May I suggest an interactive atlas called **Virtual Moon Atlas 6.0** by Christian Legrand & Patrick Challey—it's awesome! A download site is given in the references.

Locating the six Apollo landing sites is a way to practice finding your way around. Since it is safer to land on flat surfaces, the early missions landed on maria. Successive missions landed in more challenging terrain adjacent to maria. Locating these historic landmarks provides context, giving human meaning in an otherwise utterly alien landscape. A Google search, by the interested reader, will find much fascinating material about the Apollo missions. Looking at stills and movies taken at the landing sites provides "ground truth" to supplement your observations. Here's the target list;

Apollo 11: at the bottom of Tranquillitatis where it merges into Nectaris or more precisely Sinus Asperitatis.

FIGURE 2. Buzz Aldrin's iconic boot print on Mare Tranquillitatis. Credit: NASA.

Apollo 12: directly above the centre of Cognitum and below the equator (Figure 3.)

Apollo 14: to the northeast of Cognitum and below the equator. Apollo 12 and 14 nearly shared the same latitude and were only 181 km apart—the closest pair of landings sites.

Apollo 15: in the hills and just below the junction between Serenitatis and Imbrium.

Apollo 16: in the hills to the northwest of Nectaris or more precisely Sinus Asperitatis.

Apollo 17: in the boundary between Serenitatis and Tranquillitatis toward the east where the hills start.

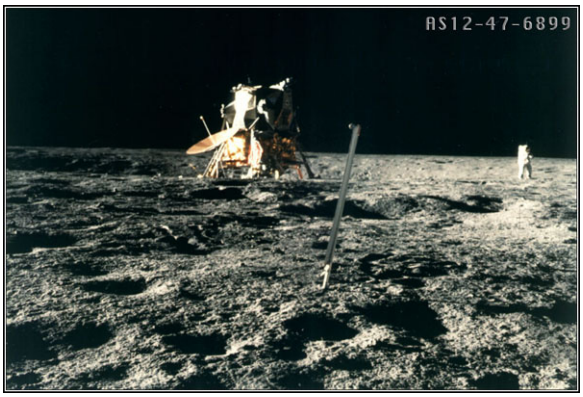


FIGURE 3. Apollo 12 on the plains north of Mare Cognitum. Credit: Google Images.

Immediate questions arise such as; 1) Why are they dark? 2) Why are they so big and mostly round? 3) Why so few craters? etc. As is usually the case, the more you look, the more you see and wonder.

The maria are composed of an igneous rock called basalt whose chemistry naturally produces a dark colour. (Figure 4.) Lunar basalt samples returned by Apollo 11 proved to be Earth-like. At the time, it was a good clue suggesting the Moon's origin.

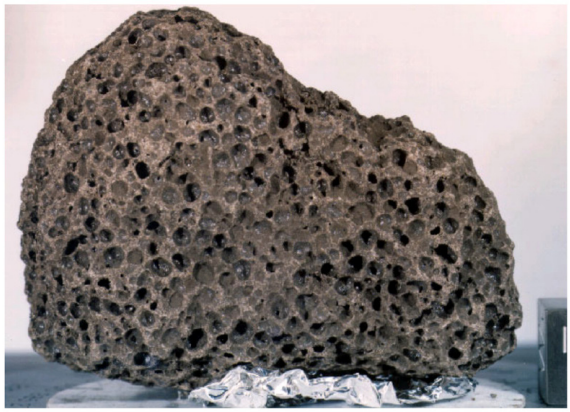


FIGURE 4. Lunar basalt is responsible for dark maria . Credit: Google Images.

The answer to the second question is that they are giant craters resulting from planetesimal size impacts. Mountain chains are the rims of these immense craters. For example, let your eye follow the ring of moun-

See "Lunar Maria" on page 13

PHOTO GALLERY

Crescent Nebula

This is an Hα-LRGB image of NGC 6888 the Cresent nebula in the Constellation Cygnus of the Cygnus Region. This is an emission nebula about 5,000 light years away. Discovered by William Herschel.

The purpose of the image attempt was to acquire a large frame format, while capturing the subtle detail of the nebula itself and include the surrounding regions around it. Hence the large file size. Can be best viewed on a large flat screen.

Equipment used was a 14-inch carbon fibre astrograph telescope at f/8 guided on an ME mount. The camera was a an Apogee U16M.

Acquisition was fifteen 6 minute guided frames L, and fifteen 4 minute subs RGB. The Hα subs were fifteen at 10 minutes guided.

Taken October 8th.

Brian McGaffney

Comet Lovejoy

The attached is Comet Lovejoy 2013 R1 discovered on September 9th, 2013 by my friend Terry Lovejoy in Australia. Comet Lovejoy R1 has become naked-eye 6th magnitude, but looks better in binoculars ... it is easily visible in any finder scope too!

I was the first to notice and captured Comet Lovejoy with a long tail, and immediately notified Terry Lovejoy of this earlier this month, but now to see his comet become really bright is awesome! Comet Lovejoy has become spectacular, outshining the much awaited Comet ISON which was expected to get bright come November and December.

The Comet is very large and green color is very noticeable visually through any optical instrument, Comet Lovejoy is now 6th magnitude. The nucleus is a bright stellar point, with a strong bow shock on the leading edge. The outer coma is ranging from 15 to 18 arc minutes in diameter. An ion tail is now stretching over 60 arc minutes long. A recently developed faint red broad dust tail is visible extending back ~15 arc/minutes in length.

I took the photo with my homemade 16" diameter telescope & QHY8 cooled color CCD camera. The image scale is 0.89 arc seconds per pixel, (18) x 2 minute sub exposures, tracking on the Comet's nucleus and a total 36 minute exposure from 8:17 to 8:51 UTC or 4:17am to 4:51am EST.

This image is 36 minutes long shows the ion and dust tail well. This was imaged from 4:00am to 4:14 am EST. The location is from my observatories at John Bryan State Park in Yellow Springs, Ohio on 11-13, 2013.

Best Regards,

John Chumack www.galacticimages.com

JFK Anniversary

Last month marked the 50th anniversary of President John F. Kennedy's assassination in Dallas, TX. If you missed this anniversary you must have been living in a cave the last month because every day in every media format there was coverage of this event, or so it seemed. So much so, that I got thinking how can I turn this into a story for *The Reflector*?

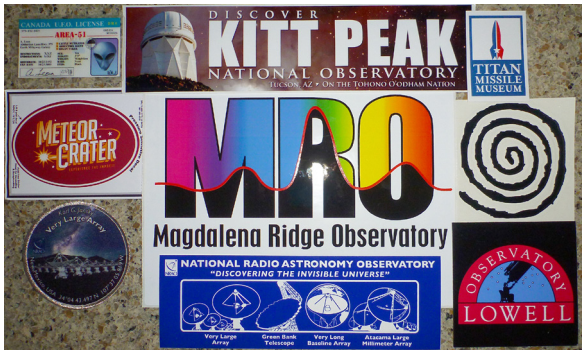
I decided that JFK had enough of a connection to space to mark his passing in some way. Just a little over 13 months before his assassination in Texas he gave his famous "Moon Speech" at Rice Stadium, in Houston. (Sept.12, 1962):

"... We choose to go to the Moon. We choose to go to the Moon in this decade and do the other things, not because they are easy, but because they are hard, because that goal will serve to organize and measure the best of our energies and skills, because that challenge is one that we are willing to accept, one we are unwilling to postpone, and one which we intend to win, and the others, too ... Well, space is there, and we're going to climb it, and the Moon and the planets are there, and new hopes for knowledge and peace are there. And, therefore, as we set sail we ask God's blessing on

see "JFK" on page 13

Astro Tourism

Rick Stankiewicz



I have found over the years that there are astronomically related points of interest or tourist destinations all over the world and I have made a point of trying to include them as much as possible when I travel. Rarely would they be a destination (because I am not traveling alone) but if you are going to be "in the area" why not include a few hobby related hi-lights? With a bit of research ahead of time you can stop in and uncover some real gems.

Case in point was what happened during my recent trips to the southwest United States (Nevada, Arizona, New Mexico, Colorado and Utah) and England, when my wife and I spent 5 weeks driving around these countries to see the sites and check off a few things on our "bucket lists", like the Grand Canyon and the London Eye. However, being the trip organizer allowed me to ensure that we dropped into see the Lowell Observatory and the Royal Greenwich Observatory while in the vicinity. We were so close anyway, right?

I plan to present a visual travel log at our AGM in December, so if you want to see what I describe below I hope you make it to the meeting and social on December 6th (7:00 p.m. start).

The first leg of our journey was flying to Las Vegas on September 21st and renting a car that over the next three weeks I preceded to drive almost 5,000 km. Keep in mind that the places I will list are only the astronomical related venues and not all the other places and sites we took in along the way, or the "tip of the iceberg" of our trip as it were.

Our first stop was the historical Lowell Observatory, in Flagstaff, AZ where Percival Lowell studied Mars from 1894 using his 61cm (24") Clark Refracting Telescope, Clyde Tombaugh discovered Pluto in 1930 using photographic plates from a 13" astrograph. Asteroid, exo-planet and Kuiper Belt Object research is occurring today. I did some solar observing in the afternoon and returned in the evening for a planetarium show and public stargazing.

2) Meteor Crater, AZ, aka Barringer Crater or Canyon Diablo Crater, is 1.2 km wide and 170m deep and claims to be one of the best preserved meteor craters on earth. This 50,000 year-old impact crater was formed when a meteor 50m in size slammed into the Earth at 12 km/sec. or about 26,000 mph.

3) Saguaro National Park, Tucson, AZ might seem unrelated, but besides alien looking saguaro cactus there are ancient petroglyphs of the 1,000 year old Hohokam Culture at Signal Hill that may have astronomical significance. It sure looked like it to me.

4) Kitt Peak National Observatory, AZ west of Tucson is a large complex of 26 telescopes all run as a consortium of 25 U.S. universities including the unique and impressive solar scopes under the National Solar Observatory complex. This is one of the largest collection of telescopes in the world.

5) Steward Observatory Mirror Lab, Tucson, AZ is on the campus of Arizona State and actually under the football stadium there. Here the largest telescope mirrors in the world are being made (at 8.4m). You can watch each step of design, casting, grinding and polishing. Three of the seven mirrors for the Giant Magellan Telescope are in production here right now and due to be complete by 2020, and will be equal to a 22m telescope mirror. We saw "history in the making".

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Tourist

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6) Titan Missile Museum, Green Valley, AZ, home of an actual Titan rocket still in a missile silo. The same sized rocket that launched the Gemini space capsules, but this is left over from the cold war era and you get to experience it from "top to bottom", including the launch sequence.

7) National Radio Astronomy Observatory (Very Large Array), NM is right out of the movie "Contact", with Jodie Foster and home to 27 × 25m, 230 ton radio dish/antenna in a "Y" shape on rail tracks forming a baseline of 36 km, on the Plains of San Agustin, allowing research to be done during daylight using radio vs. optical wavelength.

8) Magdalena Ridge Observatory, Socorro, NM, I only got a view from afar, but this was still a bonus as I didn't even know it existed until we started looking at local maps. This facility is not open to the public without an appointment and it is hours to drive in and this did not fit our schedule at the time.

9) The "Enchanted Skies Star Party", Socorro, NM just happened to be going on at the time we were in Socorro as part of the New Mexico University Campus at the Etscorn Observatory, there were guest speakers from the Lowell Observatory and guests had personal scopes and I had a look at some of the university scopes including one tracking asteroids.

10) New Mexico Museum of Natural History & Science, Albuquerque, NM which has Moon rocks, Mar Rover display and an 18m diameter planetarium, where I caught two shows.

Then on October 12th we flew home for four days to change clothes and repack and off to England on October 17th to start the second leg of our adventures, which astronomically included driving almost 1,600 km to see:

11) Avebury World Heritage Site, Avebury, is an older and larger Neolithic site of stone monoliths and embankments than its more famous cousin 27 km to the south, Stonehenge. They both may have had roles in the marking of seasons and ceremonies of the ancient cultures as far back as 3,000 B.C.

12) Stonehenge, Salisbury, definitely "rocks" when it comes to impressive historical sites. Though smaller than Avebury, it is more complete and has more massive stones (25+ tons) which help you to envision how they may have been used to mark celestial even, but no sun shine while we were there, just heavy wind and rain.

13) National Marine Museum, Greenwich, houses a nice collection of astronomically related instruments, including astrolabes dating back to 1230 A.D.

14) Royal Observatory, Greenwich, was full of surprises from the International Date Line, and telescope collections, to the house of the Astronomers Royal and the John Harrison Museum with the "timekeeper" that solved the "Longitude Problem" in 1765 and won a 20,000 pd. prize and a place in history.

15) Fantastical Art, along the Liverpool waterfront is an example of just being open to whatever you happen to stumble upon. None of this was operational, but it sure was unique.

16) Clifton Observatory and St. Vincent's Cave, Bristol, is now used as a camera obscura and lookout, that some day may be a restaurant that along with the Clifton Suspension Bridge located on the cliffs 92m above the Avon River.

Don't forget that even night flights are worth the window seat sometimes, as many celestial sites may await you, as they did for us. We arrived home on Halloween night, tired but fulfilled in our travels.

How can you do this? A bit of research, a little time, lots of money and willing travel partner, are all it takes. We are already looking forward to our next globetrotting adventures.

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to 'The Sky this Month'

Lunar Maria

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tains clockwise around the helmet (Mare Imbrium). They disappear toward Oceanus Procellerum but the mind's eye easily completes the circle. These huge impact basins, with their underlying system of rings, are filled with solidified lava. They look as if they were poured with plaster of Paris. A recent theory (Jutzi, M. & Asphaug, E., 2011) suggests that the filling was coincident with the late impact of a second moon on the far side. Magma was driven out on the near side, flooding the big ringed basins. Several lunar features are neatly explained. For example, it accounts for the far side crust being some 50 km thicker than the near side. It explains why maria basalts date to within a narrow range, while the actual basins themselves do not. The storyline implies a lower crater count on the maria compared to the terrae regions ... another checkmark. Figuring out the whole chronology of crater and maria formation remains an area of active research.

Single isolated craters (mountains too) stand out on the smooth maria making them easy to locate and identify. It's a good place to begin studying crater features. These excavations also serve as natural drill sites. Mare Imbrium craters that penetrate to the substrate were used in a study (Bradley, J. et al., 2009) to determine the basalt depth. The average is about 2 km. Assuming that this number is applicable to other maria, the total volume can be estimated. Result? Together they constitute a tiny fraction of the Moon by volume (or mass) and yet the "ancient spots" are a defining observational feature covering some 30% of the near side area. By this reckoning, the Moon presents a delicately painted face in dark basalt tones. Not just a pretty face, but a telling face and one from which we can infer the events in its ancient past if we look closely enough.

KW Telescope
PERCEPTOR

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the most hazardous and dangerous and greatest adventure on which Man has ever embarked." I just cut out the juicy bits for you to chew on, but if you want the full meal deal see the attached link: http://er.jsc.nasa.gov/seh/ricetalk.htm

In case you are not convinced that this speech is such a big deal or that JFK was influential in the space race of the 1960's, I have included a few stamps from around the world that have been issued to honour Kennedy and the role he played in helping seriously kickstart the exploration of space. I have found more examples over the years from far off places than from the U.S.A. or Europe for example. It is obvious the link between JFK and the Apollo program with most stamps showing a launch at Cape Kennedy or the Lunar /Command Modules orbiting the Moon.

I think we owe a lot to this influential 35th President of the United States, in getting us to where we are today and we could use a few more visionaries like him to guide us into the future. Conspiracy theories aside, you be the judge of whether I am on the right track.

Philatelicaly yours,
Rick Stankiewicz, Astronomical Philatelis

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Binoculars

makes a perfect companion. Harrington also has a regular column in *Astronomy Magazine* that gives the reader a binocular tour of the season's best deep sky objects.

To be honest, it is absolutely astounding what you can discover in the night sky with binoculars. Plus binoculars are versatile. Take them hiking, up to the cottage, birding, to the football game, hunting. They're easy to carry and no set-up time is required. Try that with a bulky, complicated telescope!

So where should you buy your binoculars. Canadian Tire has some at a very reasonable price. A reputable camera store or astronomy shop is probably a better bet because you will be dealing with a person who can make knowledgeable suggestions.

Brands to look for at the more affordable end of the spectrum are Celestron, Bushnell, Bresser, Zhumell, Orion, Vixen and Meade. If you're a recent lottery winner, you can spend thousands of dollars with brands like Nikon, Pentax and Canon.

What separates the affordable binoculars from the dream bins is optical quality. My suggestion is to start out with an affordable pair. After a few years, try the high-end models. An experienced observer is more likely to appreciate their better quality coatings and precision-ground optics.

While we're in binocular dreamland, don't overlook the image-stabilizing models. Just press a button and all of a sudden the jiggles are gone. No more dancing stars. You can see more stars with a steady image. You'll also pay more money—lots more in most cases. A simple tripod adapter is my inexpensive alternative.

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The Sky this Month

Mercury is still visible in the morning the first 10 days of the month and then disappears into the dawn light as it heads to superior conjunction on the 29th.

Venus is 8° south of waxing Crescent Moon on the 5th. Reaches maximum brightness (–4.9) on the 6th.

Mars in the morning sky in Virgo and passes several degrees south of the Moon on the 26th.

Jupiter rises in the east-north-east in early evening in Gemini, retrograding towards opposition on January 5, 2014.

Saturn in Libra in morning sky. Occulted by the Moon on the 1st and 29th.

Geminid Meteors peak 1 a.m. on the 14th.

Ursid Meteors peak 9 a.m. on the 22nd.

Winter Solstice arrives 12:11 p.m. on the 21st.

Moon Phases

New Moon	7:22 PM	December 2
First Quarter	10:12 AM	December 9
Full Moon	2:28 AM	December 17
Last Quarter	8:48 AM	December 25

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Comet ISON

a greeny-blue object just below the cloud bank (I used a tripod mounted Canon 400D and Sigma 70-300mm lens at 50mm, ISO 800, f/5.6, and 30 second exposure.)

Is Comet ISON the "Comet of the Century"? Not yet it's not, but let's keep our fingers crossed that it will survive the trip around the backside of the Sun and come out the other side in a blaze of glory. I write this article for those members who might be thinking they had really missed something up to this point. I had better luck getting up early this November to hunt deer than I did comets, but I this may all change in December, so be patient and …

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Dobsonian

For someone who has about a year of stargazing under their belt, the best telescope is a simple Dobsonian style. The mount is one piece and the telescope drops down into it. No wobbly tripods. No floppy controls. And no troublesome polar alignment required. Just set it down and start stargazing.

The price for a SkyWatcher 6" model is $339. It's light enough for a child of 10 to move around and has good quality optics, eyepieces as well a customer support. If you have any questions, contact me at johnstargazer@xplornet.com. Merry stargazing!

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Peterborough Local 590

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Io

itself to stretch and bend by an astonishing 100 meters at a time! This causes not only cracking and fissures, but also heats up the interior of the planet, the same way that rapidly bending a piece of metal back-and-forth causes it to heat up internally. When a path to the surface opens up, that internal heat escapes through quiescent lava flows and catastrophic volcanic eruptions! The hottest spots on Io's surface reach 1,200 °C (2,000 °F); compared to the average surface temperature of 110 Kelvin (-163 °C / -261 °F), Io is home to the most extreme temperature differences from location-to-location outside of the Sun.

Just by orbiting where it does, Io gets distorted, heats up, and erupts, making it the most volcanically active world in the entire Solar System! Other moons around gas giants have spectacular eruptions, too (like Enceladus around Saturn), but no world has its surface shaped by volcanic activity quite like Jupiter's innermost moon, Io!

Learn more about Galileo's mission to Jupiter: http://solarsystem.nasa.gov/galileo/. Kids can explore the many volcanoes of our solar system using the Space Place's Space Volcano Explorer: http://spaceplace.nasa.gov/volcanoes.

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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:
December 27, 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.