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The Reflector

Newsletter of the Peterborough Astronomical Association

Surprising Young Stars in the Oldest Places in the Universe

Dr. Ethan Siegel

Littered among the stars in our night sky are the famed deep-sky objects. These range from extended spiral and elliptical galaxies millions or even billions of light years away to the star clusters, nebulae, and stellar remnants strewn throughout our own galaxy. But there's an intermediate class of objects, too: the globular star clusters, self-contained clusters of stars found in spherically-distributed halos around each galaxy.

Back before there were any stars or galaxies in the universe, it was an expanding, cooling sea of matter and radiation containing regions where the matter was slightly more dense in some places than others. While gravity worked to pull more and more matter into these places, the pressure from radiation pushed back, preventing the gravitational collapse of gas clouds below a certain mass. In the young universe, this meant no clouds smaller than around a few hundred thousand times the mass of our Sun could collapse. This coincides with a globular cluster's typical mass, and their stars are some of the oldest in the universe!

These compact, spherical collections of stars are all less than 100 light-years in radius, but typically have around 100,000 stars inside them, making them nearly 100 times denser than our neighborhood of the Milky Way! The vast majority of globular clusters have extremely few heavy elements (heavier than helium), as little as 1% of what we find in our Sun. There's a good reason for this: our Sun is only 4.5 billion years old and has seen many generations of stars live-and-die, while globular clusters (and the stars inside of them) are often over 13 billion years old, or more than 90% the age of the universe! When you look inside one of these cosmic collections,

Globular Cluster NGC 6397. Credit: ESA & Francesco Ferraro (Bologna Astronomical Observatory) / NASA, Hubble Space Telescope, WFPC2.

see "Globular" on page 16

President's Message

Report From the Executive Meeting

Your executive met in January to formulate plans for the coming year with an emphasis on our monthly meetings. We decided to change the start time of the meetings to 7:00 p.m. and to continue with the format change tried out at the January meeting. This means that after some announcements and general interest items the guest speaker will have the floor no later than 7:30 p.m. This should expedite matters concerning astronomy, and allow for travel time for the guest speaker/presenter, and for some younger members who may have to be home at a fixed time. The coffee break will follow the guest speaker then the "sky this month" feature followed by any other business. I hope this works out well for everyone. Other items at the executive meeting will be discussed briefly at the February meeting.

Rodger Forsyth
PAA President

Letter from the Editor

Baby, It's Cold Outside!

January and cloudy nights are synonymous, but even when the sky is clear it is bone-chillingly clear. So, happy stargazing turns into happy to staying inside and gazing at the Hollywood Stars via Netflix.

There are some brave ones amongst our membership. Rick Stankiewicz braved the frigid pre-dawn air to observe Comet Lovejoy. The proof is in the photo and article this month. Rick also loves the Sun and so he has given us a warm photograph of sunspot AR1944.

John Crossen enumerates the February sky for those willing to observe them this month He also pens an interesting article on star sizes.

Our man Ken Sunderland returns with the final installment of his lunar series. He must be moon-faced by now as he also contributed a book review of Norman Mailer's book, *Moonfire: The Epic Journey of Apollo 11*.

If you haven't already heard the news, club meetings will now commence at 7 p.m. with the guest speaker starting no later than 7:30 p.m. So, until next month, wish for clear skies and warmer temperatures.

Phillip Chee
Editor, The Reflector

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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Jupiter Reigns, Mars Rises and Venus Hits the Morning Sky

Big Dipper in Winter. The Big Dipper stands on its handle during the winter months. As spring arrives it begins to swing overhead. This image shows it in February.

John Crossen

Planet watchers have a full night of observing in February. Bright Jupiter will still be close to Earth and should be visible from sunset until dawn. It is accompanying the constellation Gemini, the Twins, as they cross the night sky.

Mars is brightening and takes to the sky at midnight. By the predawn hours it is at its highest in the Southern Sky. The Red Planet will escort constellation Virgo through the winter night sky. Look for it near the star Spica.

Saturn is just a few hours behind Mars when February opens. It rises about 3:00 a.m. in early February and at 1:00 a.m. towards the end of the month. Saturn's rings will still be tilted nicely. So from Earth's point of view it will be a real stunner. The constellation Libra will be home to Saturn during the late winter and spring seasons.

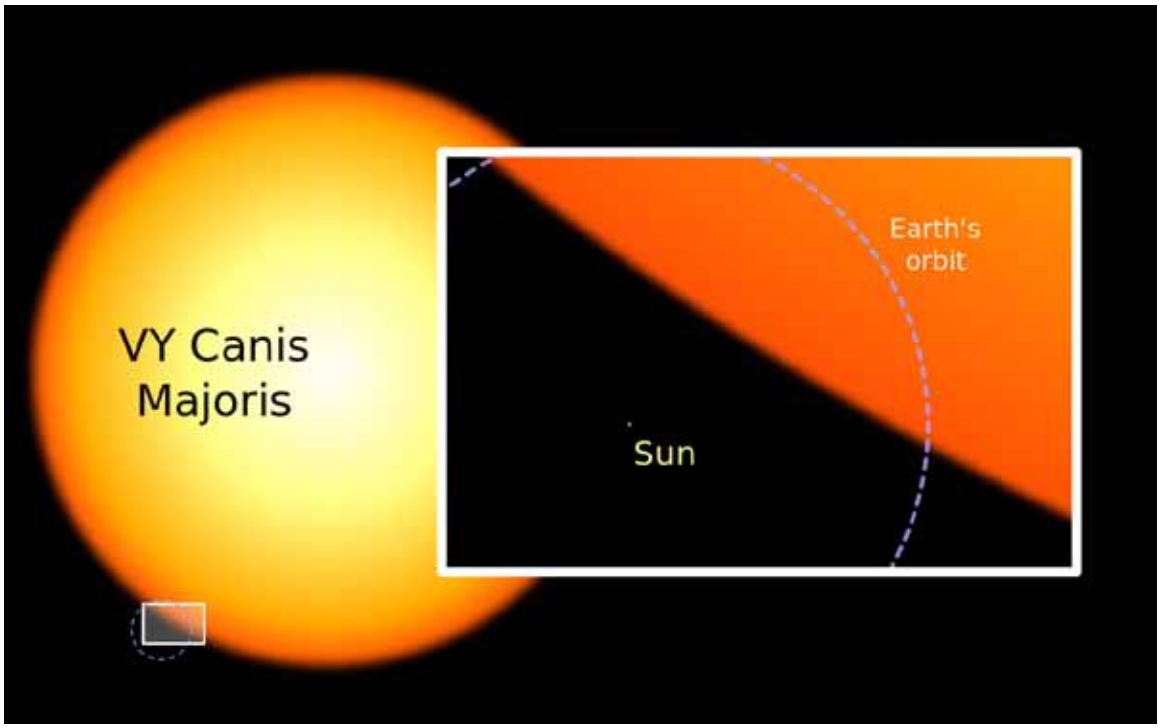
Venus switches from the "evening star" to the "morning star" this month as it passes behind the Sun and emerges from the other side of old Sol to become the brightest beacon in the morning sky.

Uranus and Neptune are bidding us farewell as they dip behind the western horizon. Mercury also joins this "sayonara set" low in the west at sunset. Canadians will have to wait until late May to catch the little horizon hugger as a night time target again.

The spring constellations are chasing the winter characters towards the west. Mighty Orion is now in the south/southwest at sun-

See "February" on page 15

My Star is Bigger Than Your Star



SUN COMPARED TO VY CANIS MAJORIS. Our Sun looks like a pea next to a tractor tire when compared to VY Canis Majoris. Shining at magnitude 7 from a distance of 4,900 light years it is well below the visual limit of the unaided eye. VYT Cma will end its life as a hypernova and end up as either a neutron star or a black hole.

John Crossen

With an estimated 200 billion stars in our Milky Way Galaxy, it should come as no surprise that some are bigger than others. Size-wise they range from tiny neutron and white dwarfs to supergiants and hypergiants.

Our Sun is way below average when it comes to star size. It is ranked as a yellow dwarf, a designation that's hard to swallow when you consider the fact that the Sun is 1 million times larger than planet Earth.

Top dog in the size race is the hypergiant star VY Canis Majoris or VY Cma in the constellation Canis Majoris, the Big Dog. If our Sun were the size of a 10-inch basket ball, VY Cma would be about 2,000 feet across in comparison. Where 1 million Earths would fit inside our Sun, 7 quadrillion Earths would fit inside VY Cma. An airplane traveling at 900 km/h would take 1,100 years to fly around it.

Numbers two and three on the list of pudgy gas balls are VV Cephei and Mu Cephei. Both are in the constellation Cepheus. He's the guy married to Cassiopeia. Together they are the parents of Andromeda in Greek legend.

With a visual magnitude of 4.83 it is just at the edge of unaided human vision. If you replaced our Sun with VV Cephei, it would extend out to the orbit of Saturn.

See "Big Star" on page 14

Comet Lovejoy in the Morning

Rick Stankiewicz

Catch a comet before it's gone, if you can find a clear morning to do so and your eyelids or fingers don't freeze first.

Comet Lovejoy (C/2013 R1) has left Hercules and is heading south through Ophiuchus in the eastern morning sky and is about 30 degrees above the horizon (the angular distance of three fists end to end at arm's length; if you don't have 3 fists, then improvise).

The tail is shorter than a month ago. My 10 power binoculars just picked it up okay in early January when it was still magnitude 5.5. It is currently around Magnitude 7.0 and binoculars of 15 or 20 power should show you a distinct fuzzy ball in the star field in your eyepieces.

I tried on the morning of January 7th when it was about -22 °C with a high wind chill (-33 °C), but at least there were no clouds. It was close to 6 a.m. by the time I was set-up and ready to go, but I got a few images before my fingers started to freeze. I think anytime about 1 ½ hours before sunrise is good to start looking.

I used my iOptron SkyTracker on Januar 7th with the 50D and 135mm lens setting, (ISO 2000, 45 sec., at f/5.6).This image is cropped a bit too.

See "Lovejoy" on page 12

The Moon (Layer 4 – Craters and Rays)

Kenneth Sunderland

At this point in the series we've: considered what Galileo saw, interpreted the dark maria, and profiled the heavily cratered highlands. But, as Giovanni Cassini's exuberant map[1] from 1679 shows (Figure 1), no "big picture" is complete without discussing craters, and especially the big ray craters. Just look at those fanciful rays emanating from Copernicus, Kepler and Tycho. Such vivid detail in each crater! Cassini's scientific Moon map looks like some message written in hieroglyphs.

After the maria-highland dichotomy, craters are a standout feature. The 4 billion year old highlands are saturated with them, and the surface layers have been mixed in a process called gardening. By 3.5 billion year ago the heavy bombardment had diminished to today's rate—a rate insufficient to re-saturate the younger maria. So out on the uncrowded lunar plains is a good place to single out craters for closer examination.

Figure 1. Cassini's 1679 Moon map
Credit: Google images

According to veteran SkyNews columnist Gary Seronik, an 80 mm aperture puts 800 named craters within reach down to 4 km across and an 8-inch scope will resolve craters just over 1 km in diameter[2]. There are thousands of craters available to even a modest backyard telescope. Good luck with that checklist!

Craters look the same and yet are all different. Why? Some variables in play during formation are the mass, size, shape, and composition of the impactor, its speed, and the impact angle. Think of the combinations! This is how such variety is created from essentially a single mechanism. Examining crater features in detail provides a lifetime of things to observe and enjoy. It is crater variety that supplies endless raw material for magazine columns like Charles Wood's "Exploring the Moon" and Gary Seronik's "On the Moon."

As crater diameter increases, a transition occurs from simple to complex with 16 km a generally accepted dividing line. This progression is called the main sequence.

Figure 2 illustrates some differences between the two crater types. Simple craters are bowl-shaped hemispheres—nice and clean. Complex craters are more distorted with benches, slumping walls, and a central mountain peak(s) caused by rebound. At the eyepiece, a good starting point is to identify a crater as simple or complex. However, bear in mind that later events can substan-

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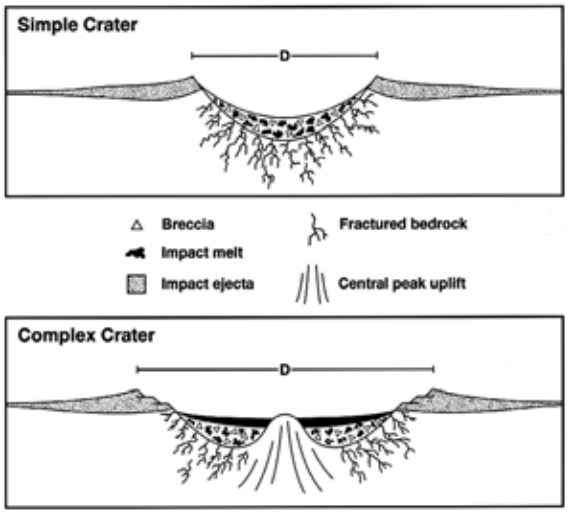


FIGURE 2. Two categories of craters
Credit: Google images

tially alter craters. For example, craters may have been flooded with lava or subsequently impacted.

Figure 3 is a photograph of an Apollo 16 astronaut on the rim of Plum crater. It's a simple crater only 40 m across and certainly beyond the reach of any backyard telescope. I love this iconic photo! Moltke, with a 6 km diameter, is a better example that probably is within reach of your telescope.

Let's take magnificent Copernicus as a case study. Not only is it big and complex, but it has serious rays. Figure 4 is a photograph taken from Apollo 17 showing Copernicus on the south limb and its bright rays on the Sea of Rains. The foreground crater is Pytheas.

At the eyepiece, Copernicus will reveal all the features of a complex crater listed above. If it's near the terminator you may see a point, or even points, of light floating in the crater floor darkness. A profile across the crater diameter shows why (Figure 5). I distinctly remember watching a single point of light in the depths of Langrenus one time—an easy interpretation. How delighted I was when that single point slowly became two!

FIGURE 3. Charlie Duke on the rim of Plum crater
Credit: NASA/John Young.

FIGURE 4. Copernicus as seen from Apollo 17
Credit: NASA.

The 300 km elevation profile shows that Copernicus is about 100 km across. The rim is at 0 m elevation and the ejecta blanket spreads out about another diameter. The excavation itself is a whopping 3.8 km deep with central peaks rising maybe 1,000 m above the floor. The ability to verify what is seen at the eyepiece really inspires confidence as one's observing skills develop.

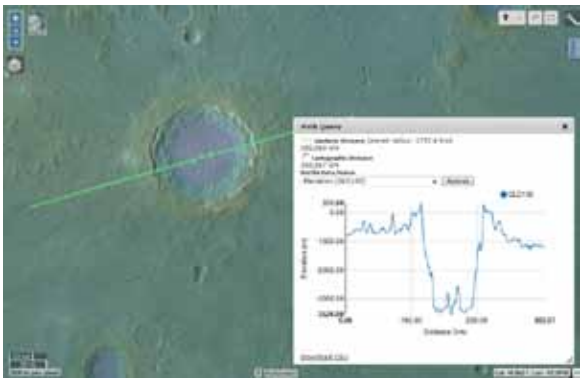
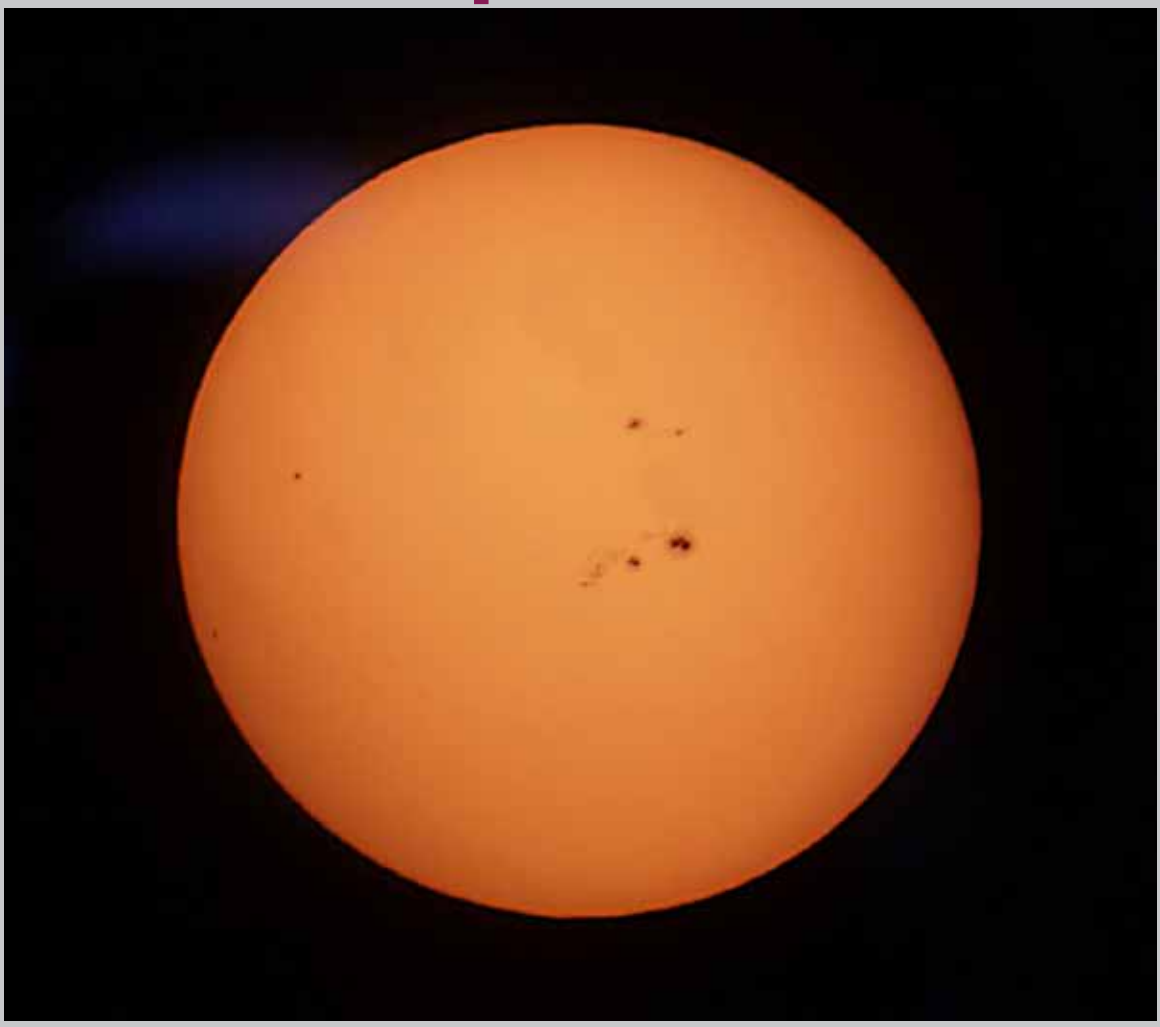


FIGURE 5. Copernicus crater and elevation profile
Credit: generated using ACT-REACT-QuickMap[3].

See "Lunar Rays" on page 13

PHOTO GALLERY

Sunspot AR1944



The week of January 8th, 2014, saw some of the largest sunspot activity in many years. The main source of all this activity was AR1944 (Active Region), one of the biggest sunspots of the past decade that burst on to the scene on January 2nd and was visible until the 15th when it disappeared around the opposite limb of the solar disk. At its peak the sprawling active region was more than 200,000 km from end to end and contained dozens of dark cores. Its primary core, by itself, was large enough to swallow Earth three or four times over, the second largest spot alone was about the size of Earth.

The attached images from my viewing session on January 8th where taken by holding my point and shot camera to the eyepiece of my Meade EXT90 telescope with a 32 mm eyepiece attached. AR1944 shown here was just a day past its maximum size, but well positioned for viewing. At the writing of this article in late January, AR1944 was poised to return for another transit across the face of the Sun. Not many sunspots are big enough to survive a full rotation of our Sun.

It was this group of sunspots that erupted around January 4th sending a large dose of energized particles hurdling toward Earth on the solar winds. This caused many experts to predict that there would be a nice auroral display in the southerly reaches of North America but it never occurred as predicted as the Earth only received a "glancing blow", so you did not miss anything, but it is these sorts of large active regions that do help produce nice aurora when Earth takes a "direct hit". Over the next year it is worth watching this solar activity if you wish to increase your odds of seeing the northern lights locally and it will happen, it is just a matter of time.
I find the best way to track the daily activity of the Sun and possible aurora activity is to check out the NASA website www.spaceweather.com. You will see the sunspot activity with an image supplied by

see "Sunspot" on page 11

Red Giant Star Betelguese

Alpha Orionis — The Red Super Giant Star Betelgeuse — The Eventual Supernova!!!

Here is my 1 minute close-up shot with my homebuilt 16" scope QHY8 Color CCD camera.

Betelgeuse is the upper left Shoulder, the Red-Orange colored star in the figure of the constellation of Orion the Hunter!

A bright-red intrinsic variable star, 425 light-years from Earth, in the constellation Orion.

Here are more details on Betelgeuse http://www.aavso.org/vsots_alphaori.

Betelgeuse, one of the brightest stars in the sky, could burst into its supernova phase and become as bright as a full moon — and last for as long as a year. The massive star is visible in the winter sky over most of the world as a bright, reddish-orange star, and could explode as a supernova anytime within the next 100,000 years.

Some astronomers believe that one of the plausible reasons we have yet to detect intelligent life in the universe may due to the deadly effects of local supernova explosions that wipe out all life in a given region of a galaxy.

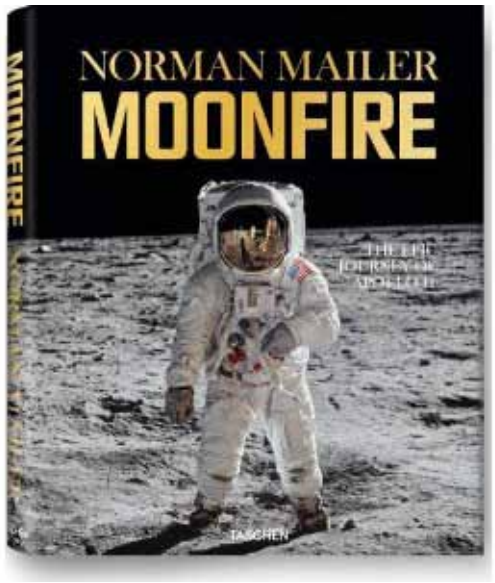
While there is, on average, only one supernova per galaxy per century, there is something on the order of 100 billion galaxies in the observable Universe. Taking 10 billion years for the age of the Universe (it's actually 13.7 billion, but stars didn't form for the first few hundred million), Dr. Richard Mushotzky of the NASA Goddard Space Flight Center, derived a figure of 1 billion supernovae per year, or 30 supernovae per second in the observable Universe!

John Chumack www.galacticimages.com

BOOK REVIEW

Moonfire: The Epic Journey of Apollo 11

Kenneth Sunderland



Norman Mailer

Taschen America 2010

348 pages; ISBN 978-3836-52077-5, $20, hard-cover

This is a massive coffee table book with a split personality. The photographs are gorgeous, including iconic foldouts of the Saturn V lift-off and Earthrise from the Moon. The photos taken on the surface that historic day are simply stunning. I found myself staring at them as if in a trance. The photographs and captions alone outline the story, from a growing realization in the late 1950's that going to the Moon might just be possible, to ticker-tape parades for the returned heroes. For this reason alone the book is solid gold. "Are we poised for a philosophical launch?" So begins the provocative accompanying text by that famous ego that was Norman Mailer. The text is excerpted from Mailer's fifteen chapter book *Of a Fire on the Moon* (1970) which in turn was an extension of a three part Life magazine serialization which consisted of: Part I: A Fire on the Moon (29 August 1969), Part II: The Psychology of Astronauts (14 November 1969), Part III: A Dream of the Future's Face (9 January 1970). It was an exception for Life, a photo journal magazine, to run long stories. Mailer scribbled some 115,000 words — novel length! (The Life magazine articles are available on-line with links collected together in a Wikipedia entry. http://en.wikipedia.org/wiki/Of_a_Fire_on_the_Moon)

Moonfire is a re-packaging of Mailer's book into four parts, each with subsections. In Part I Mailer attempts to get behind the mask the astronauts present to the public. Their professional training makes them clinical and remote. Mailer complains that the jargon forces them to speak like computers. Who are they really? What kind of modern-day hero? Obviously they have special qualities and are not like you and me. The writing is anything but straightforward and demands interpretation.

Part II reviews the development of rocketry with particular attention given to the role of Wernher Von Braun who worked on the V2 for the Nazi's. He and his team were captured by the Americans at the end of WW2. Would Apollo have been possible without these tainted men? Intrigue. Guilt? Mailer's description of the Vehicle Assembly Building as a modern cathedral dedicated to the god of technology is good. His description of the Saturn V launch, that chariot of fire, is a tour de force. No wonder he won literary prizes.

Part III gets us to the Moon, finally down on the surface, and successfully off. Mailer leads us through the chronology of events using the disembodied, almost surreal, chat among CAPCOM-Armstrong-Aldrin-Collins. Exciting stuff ... the descent, the landing, Armstrong on the ladder, and the first footstep. Watching the black & white feed Mailer remarks that "It was as if ... a man were descending ... into the kingdom of death itself." The whole EVA description

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is solid reporting. But whatever the text, for me this section is really all about the magnificent Hasselblad photographs.

Part IV tidies-up the remaining bits — astronaut quarantine, chatting-up President Nixon, and ticker-tape parades around the world. Mailer gets up close and personal with the moon rock. Mailer contemplates. Mailer confesses.

In my view, the editors have excerpted much of the "right stuff" but not all. They opted to feature Mailer's ego as he broods and ruminates on the meaning of it all for mankind. Different choices would have given the text a different skew. For me, they chose too much inner space and not enough outer space.

In this role, Mailer plays no Joe Friday at a crime scene adhering to the catchphrase "Just the facts ma'am," because for him this was no ordinary journalism assignment. He was commenting on mankind's most impressive, audacious, feat ever. But significant in what way? To meet his goals he used a style of writing called New Journalism which allowed subjective interpretation and dramatized personal involvement. Who got the Moon? How? Why? Good or Evil at the helm? Here he wrestles, covering the gambit in an attempt to give perspective to the event; our relationship to technology, the brave new world of computers (numbers), what it means to be a hero, God, the Devil, the Establishment, his ego, corporate America, the poor, race relations, human psychology, politics, and so on. In the end, perhaps it's all too much. Too much analysis across too many specialized fields of inquiry, by an amateur. While I felt like I was being turned inside out at times — on the couch — I will grant Mailer this: his writing is never dull. When you're taking a swim with him, you're in the deep end. Frankly, it's a psychological relief when he gets technical and just describes something concretely. With a degree from Harvard in aeronautical engineering he was fully capable. To his credit, he does capture, and freeze in time, the zeitgeist of the 1960's which culminated with the incredible Moon Landing. His observations may well endure, escaping the narrow confines of a particular time and place. Time will tell.

So this is a book with two sides — a split reflecting the near side and dark side of the Moon. The book's near side is the straight ahead account of man's first flight to the Moon told in historic — no epic, photo journalism. It is wonderfully told in full daylight. The other side, the darker side, shaded in Mailer's brooding tones with a turbulent 1960's backdrop, is one man's attempt to interpret the meaning of the Moon Landing in the trajectory of human evolution — nothing less ambitious.

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Sunspot

spacecraft dedicated to following the Sun. It is also nice to know what you will be looking at, as the sunspots are labelled in numerical order. Another tip is to check www.skynews.ca for details on aurora displays in Canada. This site offers an Aurora Watch tab on their main page and the map that follows is really handy to know if it is worth going outside and looking up.

With the Solar Maximum upon us this sort of activity is long overdue, but it still never ceases to amaze me and I love getting my monies worth from my solar filters. For just over $100 over 15 years ago I have been able to safely view partial solar eclipses and show scores of public the transits of Venus and numerous sunspots over the years. I find it a great way to get so much more out of my telescope. It is normally difficult to get use out of your telescope during the day, but not with a good quality solar filter.

Rick Stankiewicz

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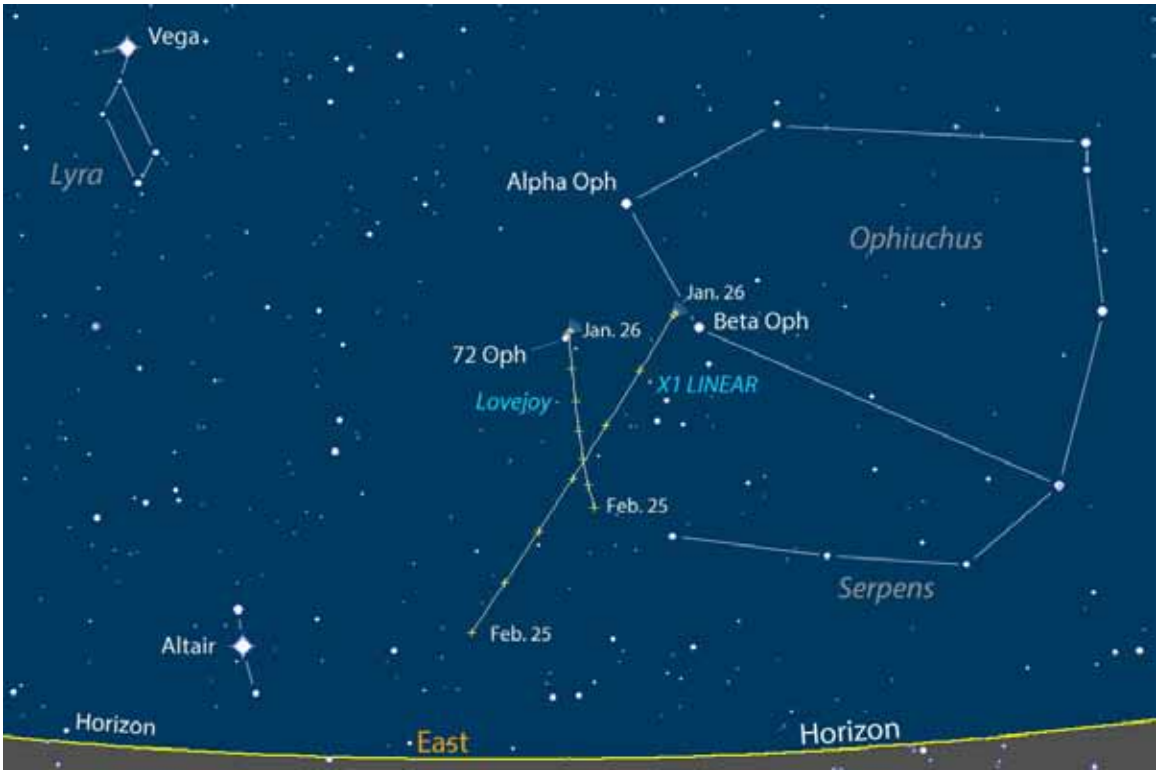
Lovejoy

It would sure look nice in those 15 × 70 binos that so many of you snatched up before Christmas!

I got out again on the morning of January 28th at close to 6:00 a.m. to see what I could, besides snow and ice, and even though it was -21 °C it was clear and calm. I had no problem finding Comet Lovejoy to the immediate left of Beta Ophiuchi I used my 20 × 80 binoculars and spotted the fuzzy ball in a nice patch of stars. The tail had diminished, but the stub that was left did point upward (away from the Sun). I was about to try and find Comet LINEAR that was to be close at hand but dimmer, when my next door neighbour let their dog out for a romp which meant that every light had to be turned on outside, including the double set of triple coach lights. It was not till then that I realized that even dogs must be afraid of the dark and so ended my viewing session. Talk about a wet blanket (frozen actually).



Comets Lovejoy and X1 LINEAR are neighbors in northern Ophiuchus this month and next. This map shows the sky facing east about 1 hour 45 minutes before sunrise shortly before the start of morning twilight. Tick marks show the comets' position every 5 days. Created with Chris Marriott's SkyMap software.

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Lunar Rays

With the QuickMap tool you have the capability of doing your own crater research!

What about rays? They remained mysterious until the 1960's and the acceptance of crater formation by impact — not some other process, like volcanism. Rays are not some kind of ridge, for they do not stand above the surrounding surface. Studies from ballistics show that impacts utterly pulverize some of the rock and eject it in long streamers. Rays are bright for two reasons: 1. Powdered solids scatter light in all directions and so look brighter than their parent material, even if the parent material is dark; 2. Impactors often penetrate to the underlying light coloured, aluminum-rich, anorthosite. Powdered anorthosite, spewed across dark basalt plains is definitely going to show up. Of course, rays can be bright for both reasons.

Rays can be traced back to their common origin to locate the "smoking gun". With Copernicus it's obvious. But take that heart-piercing ray crossing Serenitatis in Cassini's map. Its likely origin, named after the last great naked-eye astronomer, shows that rays can stretch thousands of kilometres. Quite a splash!

If all craters produce rays at formation, then why isn't the surface laced with rays? Space weather darkens rays over the eons and a constant hail of micro-meteorites slowly but surely gardens the soil, mixing the powered material with the darker substrate. They fade. Brighter rays normally accompany younger craters.

In the case of Copernicus, the impactor excavated, and pulverized, highland material from below the shallow mare. At 810 million years old, it's young. Add in the size, and no wonder its rays are so prominent.

But wait ... enough analysis! After all, the Moon is for poets and lovers. Reclaiming the rays for the poets, Norman Mailer is quoted from his book *Of A Fire on The Moon* (1970): "... lines flew out across the surface, thousands of lines from certain craters, lines straight, and lines which wobbled, lines which stopped short and lines which seemed to skim from peak to peak like a pencil drawn across the grain of a rough plank, lines which continued as a hundred separate little flutterings, and thick lines, thick as brush strokes scumbled across the ridges of an old oil canvas, then lines which wove in and out of valleys — these lines, these rays, hundreds of miles long, even thousands of miles long, were without vertical dimension, they were not ridges or grooves, it was merely that they possessed some special property of the moon soil - they reflected light in a different way ..."

And who will speak for the lovers? None more artfully than Cassini, who has left his message embedded in the great 1679 Moon map itself. The ray-pierced heart is easy enough to see. More challenging is to find the "Moon Maiden", gazing across from the edge of Mare Imbrium.

Further Reading & References

1. Launay, F., Sheenan, W. (2010, September), "The Mysterious Lady on the Moon", *Sky & Telescope*, 27-30 (This article describes how the great Moon map was made and a charming detail.)

2. Information was taken from an article at Gary Seronik's searchable website entitled Gearing Up for a Moon Shot. www.garyseronik.com.

3. QuickMap at http://target.lroc.asu.edu/q3/.

4. Wood, C., (2006, January), "Why Are Crater Rays Bright?", *Sky & Telescope*, 67-68

5. Wood, C., (2006, February), "Weird Crater Rays", *Sky & Telescope*, 58-59.

6. Wood, C., (2008, June), "The Crater Main Sequence", *Sky & Telescope*, 63-64.

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Big Star

Dropping down to number three in our size-a-thon is Mu Cephei. Known to backyard astronomers as Hershel's Garnet Star, it would span the distance out past Jupiter were it to replace our Sun. Compared to our Sun Mu Cephei is 1,000 larger in diameter and could swallow our Sun 1 billion times over.

Antares is the next biggy on my list. Located in the constellation Scorpius, the bright red supergiant's name is quite appropriate. It means rival of Mars, and many people do confuse it with the angry Red Planet. It lies just 550 light years from Earth.

Betelgeuse (*bet-el-jews*) is the red-giant star that marks Orion's armpit in the constellation that bares his name. Ranked number 5 on our list of stellar big shots, Betelgeuse is famous as the red giant that's going to go Supernova soon. It lies at a distance of about 500 light years, so if it went Supernova 499 years ago, we'll see the blast in 2014. If not, we'll just have to wait.

Visually Betelgeuse would outshine our Sun by 7,500 times were it at the centre of our solar system. But be glad it's not because it is 1,000 times our Sun's diameter. That means that planet Earth would be in the belly of Betelgeuse. No more ice storms!

That ends our battle of the titans. Estimates of star sizes are just that and can vary greatly from one source to another. So consider all of the above as being approximate. Hypergiant VY Cma was once considered the upper limit for star growth. Then three other supposedly larger stars were discovered. However their sizes are still under study, so for now VY Cma remains the "official" biggest of the big.

The Sky this Month

Mercury is fading into evening twilight during first week. After inferior conjunction on the 15th will reappear as a morning apparition.

Venus is high in the south east dawn sky and reaches maximum brightness (-4.9 mag.) on the 15th.

Mars in the morning sky in Virgo and rises late evening.

Jupiter is well placed in evening sky and retrograding in Gemini.

Saturn in Libra rising after midnight.

Zodiacal Light visible in northern latitude in the west after evening twilight for next two weeks from the 17th.

Moon Phases

New Moon	4:38 PM	January 30
First Quarter	2:22 PM	February 6
Full Moon	6:53 PM	February14
Last Quarter	12:15 PM	February 22

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February

set. In Gemini, the twins Castor and Pollux are now high in the south and Auriga the Charioteer is also in the south/southwest as the night darkens. Replacing them are the first constellations of spring. Leader of the pack is Cancer the Crab, followed by Leo the Lion and Hydra the Water Snake.

February is a great month for binocular viewers. Many of the objects catalogued by Charles Messier are on brilliant display. The Orion Nebula (M42) is still a prime lure. Its glow can be seen with the naked eye.

Look to Castor's toes in the constellation Gemini for M35, the best winter star cluster going. Auriga is home to the trio M38, M36 and M37, three star clusters that form a nearly straight line. And you can't overlook M41 in the constellation Canis Major, Orion's hunting dog.

M44 in Cancer the Crab ushers in the spring set. M44 is right in the middle of the "K-shaped" grouping of dim stars that make up the crabby little gaffer. A dark, moonless night is the best for spotting the elusive crab for beginners. Just look to the rear of Gemini or to the front of Leo. If your sky is dark and your eyes nicely dark adapted, it should make itself seen fairly easily.

As usual there's more, but even a column on outer space can run out of space. If you're getting keen on learning the night sky, pick up a copy of Terence Dickinson's *NightWatch* from Amazon for about $20.00. Other good teachers are *Turn Left at Orion* and *The Stars, a New Way to See Them*. Anyone of the three will take you through the constellations and the treasures within them for each season of the year.

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Globular Clusters

you're looking at some of the oldest stellar swarms in the known universe.

Yet when you look at a high-resolution image of these relics from the early universe, you'll find a sprinkling of hot, massive, apparently young blue stars! Is there a stellar fountain of youth inside? Kind of! These massive stellar swarms are so dense — especially towards the center — that mergers, mass siphoning and collisions between stars are quite common. When two long-lived, low-mass stars interact in these ways, they produce a hotter, bluer star that will be much shorter lived, known as a blue straggler star. First discovered by Allan Sandage in 1953, these young-looking stars arise thanks to stellar cannibalism. So enjoy the brightest and bluest stars in these globular clusters, found right alongside the oldest known stars in the universe!

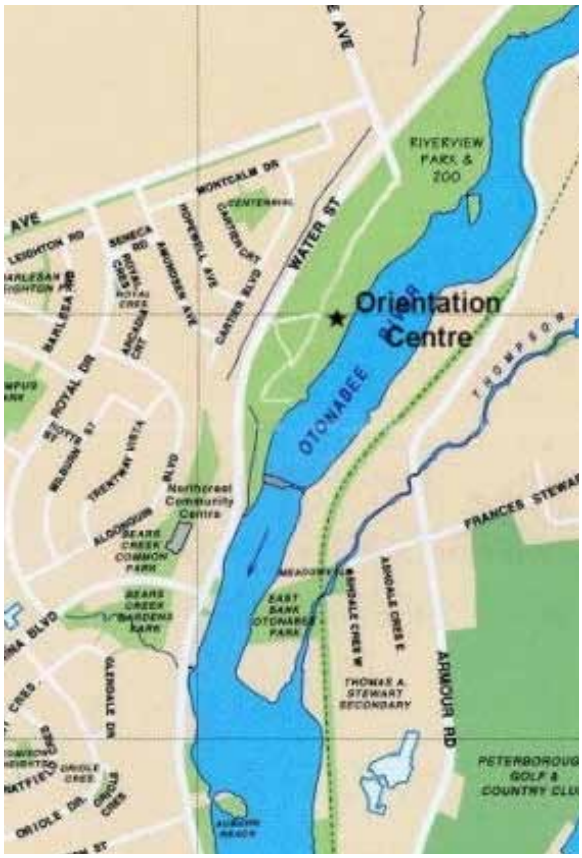
Learn about a recent globular cluster discovery here: http://www.nasa.gov/press/2013/september/hubble-uncovers-largest-known-group-of-star-clusters-clues-to-dark-matter. Kids can learn more about how stars work by listening to The Space Place's own Dr. Marc: http://spaceplace.nasa.gov/podcasts/en/#stars.

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:
February 24, 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.