Peterborough Astronomical Association

The Reflector

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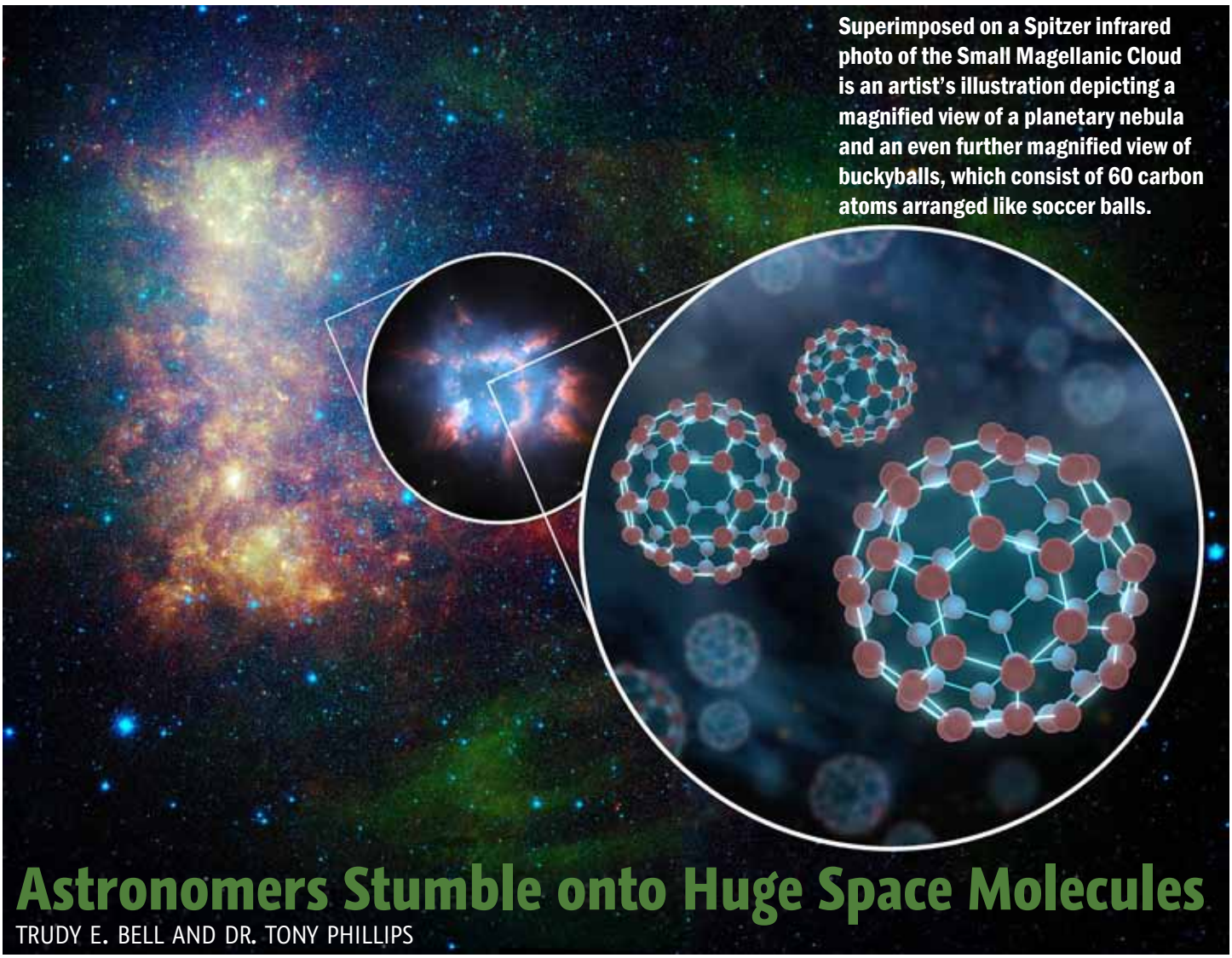

Superimposed on a Spitzer infrared photo of the Small Magellanic Cloud is an artist's illustration depicting a magnified view of a planetary nebula and an even further magnified view of buckyballs, which consist of 60 carbon atoms arranged like soccer balls.

Astronomers Stumble onto Huge Space Molecules

TRUDY E. BELL AND DR. TONY PHILLIPS

Deep in interstellar space, in the swirling gaseous envelope of a planetary nebula, hosts of carbon atoms have joined together to form large three-dimensional molecules of a special type previously seen only on Earth. Astronomers discovered them almost accidentally using NASA's Spitzer Space Telescope.

"They are the largest molecules known in space," declared Jan Cami of the University of Western Ontario, lead author of a paper with three colleagues published in Science online on July 22, 2010, and in print on September 3.

Not only are the molecules big: they are of a special class of carbon molecules known as "fullerenes" because their structure resembles the geodesic domes popularized by architect Buckminster Fuller. Spitzer found evidence of two types of fullerenes. The smaller type, nicknamed the "buckyball," is chemical formula C60, made of 60 carbon atoms joined in a series of hexagons and pentagons to form a spherical closed cage exactly like a black-and-white soc-

see *page* 16

President's Message

Happy New Year!

I trust you all had a safe and fun filled Christmas. With any luck you had some time off with friends and/or family. I hope Santa brought you what you wanted. My stocking was hung by the chimney with care and it paid off once again. I guess I was good last year?

Welcome to our new members and welcome back to our renewing members. Yes, it is that time of year again for membership renewals. We need your support in this way too, as membership funds are what keep us going annually.

Thank you to our previous and existing executive and welcome to our new member too.

I hope you all got to experience that total lunar eclipse on December 21st. It was a beautiful sight to behold and one to cherish, as you will have to wait a few years for another opportunity. I assume there will be coverage in this issue of *The Reflector*.

As we get ready to start another year of club activities and events, I hope you all make a resolution to get involved and do something with and for this club we call the P.A.A. Try something you have never done before, like write an article for *The Reflector*, get involved in light pollution abatement, give a talk at a monthly meeting, or find someone else to present for the club. Anything you can do will help this club grow. We have a great year shaping up, but there are a few holes to plug for speakers and observing opportunities on a monthly basis. Step up to the plate and let us know what you are able to do and when.

If you are new to the P.A.A. and have questions about our hobby, please speak up and either submit your questions to an open forum like our monthly newsletter, or ask someone at a monthly meeting or come to a public event during the year and learn from those that know. Let's all make the best of it; we all have a lot to offer and a fresh new start to a new year. I look forward to seeing you all at some point throughout the year. Stay safe and healthy and let's make the best of it!

Rick Stankiewicz
President

Letter from the Editor

Volume Ten

PHILLIP CHEE, EDITOR

As I reflect on the beginning of the back-half of my second term as editor of *The Reflector* I want to bring your attention to the fact that 2011 marks the beginning of the tenth volume of this remarkable publication. My role has been to carry on the club committment of providing the membership with informative astronomy articles where there is something for everyone's taste from novice to skilled amateur of our fine hobby.

Of course there would be nothing to publish if not for the dedicated contributions from the members of the P.A.A. We should give a hardy thank-you to our regular contributors such as John Crossen, Mark Coady, Rick Stankiewicz, Rodger Forsyth, John Galle, and most recently, Brian McGaffney and Ben Morgan. We'd love to have more of you contribute. It could be something as basic as an astrophotograph or a report of your visit to a club observing session. Sharing your experience in astronomy I think would be greatly appreciated by other members. So make that one your New Year's Resolutions.

And some news hot off the press. P.A.A. president, Rick Stankiewicz, has confirmed Terence Dickinson as our monthly meeting guest speaker for June. Now that's one meeting not to be missed!

Peterborough Astronomical Association

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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The Cassini Mission

Six years out and running smooth

It has been six years since the Cassini Mission made its rendezvous with Saturn.

JOHN CROSSEN

From that moment Carolyn Porco and her imaging team have been showered with remarkable discoveries about the ringed planet and its moons.

Perhaps the most important had to do with Saturn's large moon Titan. Prior to the mission all we knew about Titan was that it was shrouded in an orange mist. Nothing was known of its surface. Then Cassini released the Huygens probe and those of us back on Earth held our collective breath as the probe descended onto the giant moon's surface and began sending photographs back to scientists.

What we discovered was a world much like Earth, only one of extreme cold. Methane which is usually a gas on Earth was condensed into liquid form. It rained methane on Titan. Methane formed lakes and ran in rivers.

Water wasn't just ice in the extreme cold. It was as hard as granite. The photographs showed mountains shoreline features and one of the methane lakes was given the name Ontario—*Ontarius Lacus*.

Cassini flew through the F and G gaps in Saturn's rings. The images it took are unprecedented for clarity and detail. We learned that tiny moonlets within the rings were responsible for the rings undergoing a state of constant evolution, creating clumps, streamers and altering the size of the gaps. And we discovered a new moonlet, Daphnis in an area known as the Keeler Gap.

This was our first opportunity to study Saturn's atmosphere close up and in great detail. What we discovered was shocking—literally. The planet's gaseous atmosphere was home to unimaginable lightning storms and thunderstorm columns that rival Earth in size. They would boil up to the visible cloud tops, emerge suddenly and last for weeks.

We also discovered new elements in Saturn's atmosphere: ammonia ice and carbon.

One of the most exciting discoveries was the plumes (geysers) blasting hundreds of kilometres above the surface of Saturn's moon Enceladus. Their existence has now made Enceladus a prime target to explore for life forms. We have all the ingredients—liquid water, heat and molecular building blocks.

There have been numerous other discoveries such as the origin of Saturn's moon Phoebe. With its retrograde orbit around the planet, it is now considered to be a captured element from the Kuiper Belt which lies at the very outer edge of our solar system.

The Cassini Mission will continue until 2017 when the spacecraft will be allowed to tumble into Saturn's atmosphere. But the mission won't end then. There will continue to be data for analysis and as usual, every answer leads to a flood of new questions.

Dr. Carolyn Porco is an imaging scientist famous for working on the Voyager and Cassini missions to Uranus, Neptune and Saturn. She is also in charge of the upcoming New Horizons imaging mission to Pluto and the Kuiper Belt.

In Astronomy it Helps to See Things in a Different Light

Most people assume that all telescopes see their targets in the visible light spectrum.

JOHN CROSSEN

Until 50 years ago, that was true. But now we have telescopes that image objects in different ranges of the infrared spectrum as well as x-ray wavelengths. Plus telescopes such as the one in Arecibo and the Very Large Telescope Array that do their imaging in radio wavelengths where day or night never matter.

The end result is that our new generation of space telescopes can probe the depths of space in ways that the human eye with its limited capabilities could never do. These new sky-peepers are like "Superman Eyes," able to see through clouds of dust and into the hearts of nebula to witness star birth and more. Here's what's up starting with the Hubble Space Telescope.

The HST has a number of imaging systems that perform different functions. The Space Telescope Imaging Spectrograph (STIS) spreads out the light gathered so that it can be analyzed to determine such properties of celestrial objects as chemical composition and abundances, temperature, radial velocity, rotational velocity as well as magnetic fields.

The intricate detail in this Hubble photo is beyond anything an Earth-based telescope is currently capable of. But that will soon change thanks to mammoth multi-mirror scopes with adaptive optics.

The Near Infrared Camera and Multi-Object Spectrometer (NICMOS) is an HST instrument providing the capability for infrared imaging and spectroscopic observations of astronomical targets. NICMOS detects light with wavelengths between 0.8 and 2.5 microns—longer than the human-eye limit.

The Advanced Camera for Surveys (ACS) is designed to provide HST with a deep, wide-field survey capability of imaging from visible and near-ultraviolet to the near-infrared. The recently-installed wide field camera in the ACS is a 16 megapixel camera.

The Cosmic Origins Spectrograph (COS) is a fourth-generation instrument that was installed on the Hubble Space Telescope during the 2009 servicing mission. COS is designed to perform high sensitivity, moderate- and low-resolution spectroscopy of astronomical objects in the 115-320 nm wavelength range. The primary science objectives of the COS are the study of the origins of large scale structure in the Universe, the formation and evolution of galaxies, the origin of stellar and planetary systems, and the cold interstellar medium.

The Wide Field Camera 3 (WFC3) is also a fourth generation instrument that was installed during the 2009 servicing mission. Equipped with state-of-the-art detectors and optics, WFC3 provides wide-field imaging with continuous spectral coverage from the ultraviolet into the infrared, dramatically increasing both the survey power and the panchromatic science capabilities of HST.

In future articles we'll explore the Chandra X-Ray Telescope, the Kepler Exoplanet mission and more.

Three points during the lunar eclipse of 21 December 2010. From right to left, minutes before totality, totality, and minutes after totality. Photos by Rick Stankiewicz.

A Lasting Eclipse!

RICK STANKIEWICZ

There was much ado about nothing leading up to this most recent lunar eclipse. The fact that it fell on the winter solstice and had not done so for 372 years was inconsequential to me. The big deal was just to observe a celestial show that is surpassed by few other events in the heavens (okay, solar eclipses and transits are rarer and neater to see). The weather could not have been better for this time of year, meaning clear skies and light to no wind, but it was still a chilly -12 degrees C, on the morning of December 21st. For those that braved the cold and stayed outside we were rewarded with the only eclipse visible in eastern North America since February 20th, 2008. There is just something about being outside in the night when a pack of coyotes are howling just hundreds of metres away to one side and the Otonabee River is cracking and booming on the other. This is part of the allure for me living where I do south of Peterborough, near Keene.

It was a very nice dark eclipse when the moon slipped into the darkest part of the Earth's shadow (umbra). The attached images (right to left) show the full moon minutes before it slipped "into totality" (right), "at totality" (centre) and minutes after starting to slip "out of totality" (left). What I like about these particular images is that they capture the subtle colour gradients from the over exposed portion of the moon, that was in the lighter penumbral shadow, verses the darker umbral portion in the shadow of the Earth. This is the "coloured" eclipsed portion that was clearly in the umbra, the blue grey transition from one to the other too.

These cropped images were taken between 2:33 and 3:59 a.m. using a piggyback mounted Canon 400D camera and Sigma 70–300mm lense at 300mm on a Meade ETX 90 telescope. Settings varied, ISO 400; f/5.6; exposure 1 to 3.2 sec.

I hope you got your lunar eclipse fix because there will not be another opportunity for a lunar eclipse in this part of the world until April 15, 2014, and forget about the next one on a solstice in 2094.

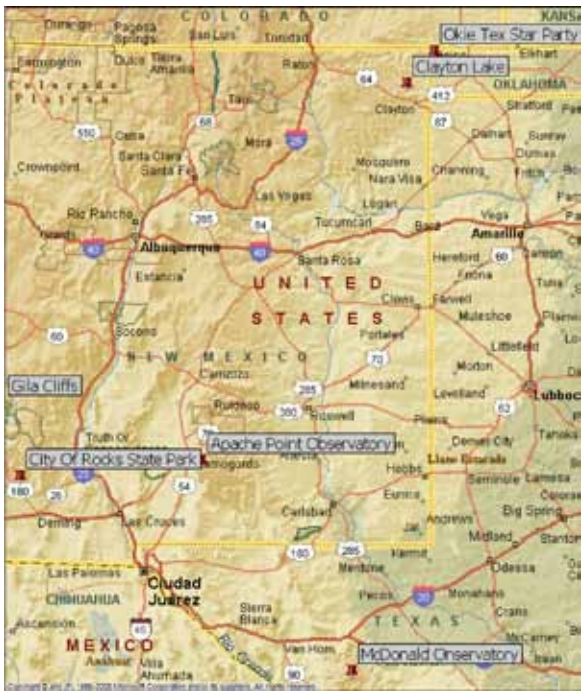
Stargazing on the High Plains

This Fall I decided to go on a six week grand tour of the U.S. South.

JOHN GALLE

Part of the itinerary was to attend the Okie-Tex Star Party and to check out the potential for astronomy in the area.

The region is known as the High Plains, encompassing a large area of eastern New Mexico, southern Oklahoma and western Texas. The elevation ranges from 5 to 8,000 feet, is very dry and perpetually sunny. In the time I was there (September 27 to October 17) the skies were clear every night but one, with nightly temperatures in the 40's and 50's. The declination ranges from 36° in Oklahoma to 30° near the Mexican border (great views of Sagittarius).



The Okie-Tex Star Party is held annually in October, runs over two weekends, and attracts about 4-500 people. Every star party seems to attract a particular crowd, and at Okie it is definitely big Dobs; but there were lots of others as well. It's very well organized, with everyone getting electricity for their astro gear, but none for RVs—best to bring a generator. The presentations were generally excellent. The food caterer is the best I've ever encountered at a star party.

There are many remote areas in the High Plains, with some State and National Parks that cater to astronomy. Of particular note are the ones shown on the above map, i.e. Clayton, Gila, City of Rocks, and Davis Mountain, just down the road from the McDonald Observatory and adjacent to the site of the springtime Texas Star Party. These are some of

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the most isolated spots in the lower 48 states—in fact, Davis Mountain claims to be the most isolated, based on their claim that they are the furthest from Walmart i.e. 90 miles!

This is also a region with some famous professional observatories. The observatory shown in the above picture is part of the McDonald Observatory, and is the 4th largest optical scope in the world. They put on a very interesting tour, plus there are special viewing nights.

The Apache Point site in New Mexico includes the Sloan Digital Sky Survey telescope, amongst others. You can tour the grounds during the day, but can only get into the observatories as part of a formal, pre-scheduled, group.

The High Plains are a great alternative to Florida or other areas in the South, and the travel distance is about the same i.e. 2500 km, a nice 3 day drive. And there's lots of non-astro things to do during the day—the only challenge is trying to find time to sleep!

See you there in 2011.

Curved Space-Time and Compressed Space-Time are the Same Just Letting You Know

I've been watching a few documentaries lately and I've gotten so tired of how they mention space-time being curved without explaining why it truly is. When they do explain it, they'll say it's because of the Earth or the Sun, but that's not much help to us. To truly explain general relativity and why Einstein had to say it also had a limited speed, read on.

Let's start off with an experiment. Say you had an air tight box with a normal amount of air; now imagine a ball that just teleports right in it while ignoring the laws of conservation. What would happen to the air, shouldn't it compress, rise in air pressure? Yes. The air pressure would press on the ball creating this force that presses the ball in on itself, something like gravity. The exact same thing happens with space-time and energy; they seem to be competing and incidentally, this is one of the problems of searching for what happened to the Big Bang; was there one or two entities made out of it; is energy space-time or space-time energy and so on.

Now this was what Einstein stumbled upon: if the universe is infinite, no gravity is caused; if the universe isn't, then there's gravity; but, if there is a speed limit in space-time, then an infinite universe is allowed and so is the limited universe. Now Einstein was allowed to go on and say that the universe is infinite, that there was a speed limit, most presumably the speed of light, and how gravity was caused.

Einstein can then explain through general relativity that there were probably two infinites in one infinite as shown in the equation below; U is universe, S is space-time, and E is energy:

see "Cuved Space" on page 14

PHOTO GALLERY

Cresecent Nebula NGC 6888

The Crescent Nebula (also known as NGC 6888, Caldwell 27, Sharpless 105) is an emission nebula in the constellation Cygnus, about 5,000 light-years away. It is formed by the fast stellar wind from the Wolf-Rayet star WR 136 (HD 192163) colliding with and energizing the slower moving wind ejected by the star when it became a red giant around 400,000 years ago. The result of the collision is a shell and two shock waves, one moving outward and one moving inward. The inward moving shock wave heats the stellar wind to X-ray-emitting temperatures. This object is about 25 light-years wide.

Imaging Details:
CCD image taken from the Nutwood observatpory 9 December 2010. This object is fading from view into the western sky, but managed to get fair results. CCD camera an Apogee U16M, with a 300mm Ceravol Astrograph on an ME mount using Astrodon Filters. This image is a composite of Luminance, Ha (substituted for red by 80%)BG, hence LHa+HaGB.

Photo by Brian McGaffeny

End of Lunar Eclipse
Time Sequence

During the last lunar eclipse of 20 February 2008 I stayed to watch the event till the Moon began emerging from totality and then packed up my gear on Armour Hill and went home. This time on 21 December 2010 I decided to continue observing till the Moon completely left the Earth's shadow. I also recorded the event by taking a photograph every 2 or 3 minutes as the Moon descended to the horizon and left the shadow. This composite photo is a one hour sequence of the end of the lunar eclipse.

Photo details:
Nikon D200 DSLR with Nikkor 17-55mm f/2.8G lens at 55mm focal length. Aperture f/2.8 to 8, exposure 1 second to 1/125 second and ISO 200.

Photo by Phillip Chee

Misadventures of an Aspiring Imager

Adventure #11—Computerization.

JOHN GALLE

If you recall, I have now got to the point where I feel reasonably competent taking clear, crisp, reasonably high quality astro images. Now I'm thinking about actually processing and displaying some wonderful snaps that everyone will 'ooooo' and 'aaaaaa' over. However, as it turns out, I'm a long way from doing that!

Image selection, generation, processing, massaging, etc involves a number of distinct activities. However, it is now much simpler than in the past, when you had to get into film developing, enlarging, fixing, etc, etc. Now we have the wonders of CCD cameras.

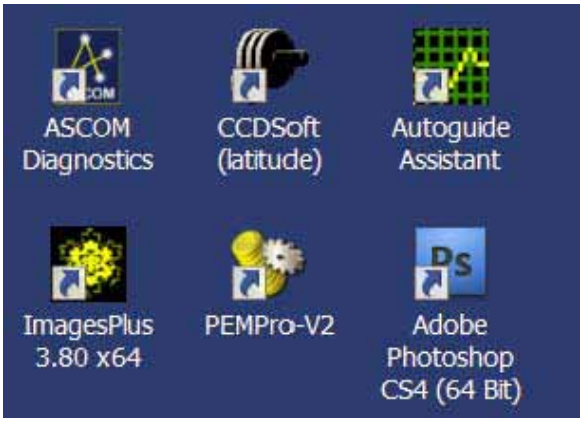
But, there is, as usual, a catch. The processing of digital images requires computerization, both hardware and software, and this can cost mega bucks. In fact, it is very easy to spend more money on computerization than all of your astronomy gear put together. A very simple shopping list of the most desirable items would include:

- A durable, water and shock resistant laptop computer for use in the field. The one I drool over is the Dell Latitude XFR E6400, starting at $4,400.
- A quad processor desktop computer, with a humungous video card and giant screen, for image stacking and processing, let's say $2,000.
- Maxim DL (support the Canadian software industry) for image taking, stacking, etc for $600.
- Adobe Photoshop CS5 for image massaging—let's say $800 brand new.
- Courses and books so as to figure out how on earth to use all those sub-routines in Photoshop—at $500 or so.
- An unbelievable number of speciality software packages, which can very easily add up to over $1,000.

So, for $8-10,000 you'll be all set to go! Upon realizing this I decided to devote considerable time to figuring out exactly what my processing needs would be.

It's best to first define the software needs, but always keeping in mind the hardware implications. I broke this up into two types of software. In the field, the software needed to capture images, and for which a laptop is preferred. And secondly, the processing required, after the fact, when back home.

There are some important overall considerations, aside from cost, that come into play. The ability of all software packages to talk to each other is essential—many packages are not good at doing this. Look for software (and drivers) that are ASCOM-compliant, the standards organization for astronomy software. Another factor is the type of camera and/or mount GoTo capabilities—some come with built in software. Also, some software is well suited to one-shot cameras, but many are not.



In my particular case the field needs included the capability to polar align, locate the targets, focus, take images, handling darks, flats & biases, autoguide,

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perform periodic error corrections, and to preview and file the images. As CCDSoft from Software Bisque was included with the purchase of my camera I have stuck with it, and it's pretty good (but not the best). To cover some of the deficiencies I use CCDWare PemPro ($150) for PEC, backlash control and precise polar aligning. Also, to enhance the autoguiding I use Autoguide Assist ($20 donation).

At home, processing includes normalizing, grading and stacking images, plus a multitude of processes to enhance the luminance and color components of the image. I use ImagesPlus ($180), which specializes in one shot color processing, for the stacking and initial enhancing, and then finish the job in Adobe Photoshop CS4 (cost depends on luck; it's possible to get it a legal copy second hand for $300 or $400). I've never tried Photoshop Elements, but I am told that it is not well suited for astroimages. Another option is GIMP, a freeware program that has some very avid astroimaging enthusiasts.

I use two computers simply because I had them for other purposes.

I have a 5-year-old laptop of modest capabilities, but with an added external 500GB drive since in a one night session it's very easy to generate several gigabytes of images. Also added some RAM for $20 second hand. There are two basic nuisances with the field laptop. The worst is the very heavy dew that can be encountered, especially in the U.S. South—my solution is to setup the laptop inside a fairly large rectangular shaped garbage bin—works great. The other nuisance is bugs, sometimes hundreds of them—they just love your laptop screen. I use a Thermacell repellent device, stuck inside the garbage bin—only thing is that at the end of the night you need to turn the laptop upside down and give it a good shake, or your keyboard is going to get quite gross after a while.

At home I have a fast quad-core processor computer with large amounts of video memory and random access memory (RAM). Stacking is the big processing items—even with the large computer it can take quite a while. Also, to get the best images a really high quality video card is necessary.

Many people do use only one laptop to perform both functions, but the field vs. home computing needs are really in direct conflict with each other. A workable compromise is to use a physically small laptop (think in terms of 14" screen) with high horsepower innards, but use an add-on video screen at home.

The next steps is learning how to use all this software. Fortunately I found that most of the it is fairly intuitive and comes with good documentation and very active Yahoo Groups. In the case of CCDSoft, ImagesPlus, and PemPro you can also get directly in touch with the software designer—which can be very handy. On the other hand, Photoshop is massive, not intuitive, and is designed by a corporation way too large to deal person-to-person with lowly amateur astronomers. Luckily, there are highly competent astroimagers that give courses and/or provide documentation. The best, as far as I'm concerned, is Adam Block in Arizona—and he sells an excellent DVD specifically for astroimage processing in Photoshop for about $100.

In the next instalment I'll get into some of my misadventures with image processing, including:

- everything is stacked
- being color blind doesn't help
- digital developments
- and I thought curves was all about beautiful women and fast cars
- keeping things in balance and sharp
- presenting the snaps to the world
- and what makes it all worthwhile

Stay tuned.

Canadian scientists are hoping for a whiff of life on Mars

MARS SCIENCE LAB ROVER. After 6 years of service the Mars Rover Spirit became bogged down in sand and has now gone silent. Its partner, Opportunity, is still on track and as of Labour Day had reached the half-way point of its long journey from Victoria Crater to Endeavour Crater. As of this writing, a new more sophisticated rover is under development that will amble across Mars' surface with greater speed and a host of new on-board science labs to analyze more materials in with greater precision.

JOHN CROSSEN

The Canadian Space Agency has teamed up with NASA, Jet Propulsion Laboratory and the California Institute of Technology to sniff out traces of life on Mars. A Canadian team of scientists are developing a tool that will detect traces of biologically-produced methane on the red planet.

Called MATMOS (a welcome acronym for Mars Atmospheric Trace Molecule Occultation Spectrometer) the project is a partnership between the Canadian Space Agency, NASA's Jet Propulsion Laboratory and Cal Tech. The idea stems from the discovery of unexpectedly large amounts of methane gas on Mars in 2003.

Here on Earth biologically-produced methane gas is generally attributed to herds of cattle (and the male gender of the human species after a long Sunday afternoon of beer and football ogling on television). On Mars the source or sources of the methane could be life forms living beneath the planet's surface or it could be geologically produced. But that's something we'll have to wait to learn more about.

MATMOS will orbit Mars as part of the ExoMars Trace Gas Orbiter which is scheduled to launch in 2016. The European Space Agency (ESA) will also be part of the Mars mission.

Canadians currently working on the project are James Drummond of Dalhousie University in Halifax, Jonathan Abbatt, Barbara Sherwood Lollar, Kimberly Strong and Kaley Walker of the University of Toronto, Jack McConnell of York University in Toronto and Ed Cloutis of the University of Winnipeg.

see "Life on Mars" on page 14

City Light Pollution affects Air Pollution

INTERNATIONAL DARK-SKY ASSOCIATION

Excess light at night can contribute to air pollution, according to a study by scientists at the National Oceanic and Atmospheric Administration (NOAA) and the Cooperative Institute for Research in Environmental Sciences (CIRES) at the University of Colorado. Findings presented at the American Geophysical Union in San Francisco on Monday indicate that uplight from outdoor lighting that contributes to sky glow over cities also interferes with chemical reactions that naturally clean the air during nighttime hours.

Every night, chemicals from vehicle exhaust and other human created sources are broken down and prevented from becoming smog, ozone, or other irritants by a form of nitrogen oxide called the nitrate radical. Sunlight destroys the naturally occurring nitrate radical, so this process occurs only in hours of darkness.

Measurements taken over Los Angeles by aircraft show that light pollution from cities is suppressing the radical. Though the lights are 10,000 times dimmer than the Sun, the study's first results indicate that city lights can slow down the nighttime cleansing by up to 7% and they can increase the starting chemicals for ozone pollution the next day by up to 5%.

As many cities are close to their limits of allowable ozone levels, this news is expected to generate immediate interest in light pollution reduction as a way to improve air quality among city, state, and federal bodies, including the Environmental Protection Agency.

"[This effect] is more important up in the air than it is directly on the ground so if you manage to keep the light pointing downward and not reflected back up into sky, into the higher parts of the air, then you would certainly have a much smaller effect of this," NOAA investigator Harald Stark told BBC News.

International Dark-Sky Association (IDA) Executive Director Bob Parks is hopeful that results of this study will encourage cities to adopt environmentally responsible dark sky lighting practices that include using fully shielded fixtures, minimum lighting levels, and lighting only when necessary. "The impending transition to LED outdoor lighting will also allow cities to utilize adaptive lighting controls to dim or turn off lights when not needed. Not only will this vastly reduce energy consumption, based on this new research, it could also improve air quality. This reinforces IDA's long term goal to reduce total lumens in the environment," adds Parks.

Starting in 2008, IDA has held yearly educational briefings for both houses of U.S. Congress to raise federal awareness of light pollution. After the 2008 event, eleven members of Congress signed a letter to EPA Administrator Johnson requesting support for research and education on the environmental, health, and safety effects artificial light at night. On 9 October 2008 EPA was petitioned to review light pollution to monitor and reduce atmospheric discoloration of the night sky under the Clean Air Act. The EPA has made no formal response to the petition.

continued from page 12

Life on Mars

What will we find? We know there was (and still is) water on Mars. Can life, even in a minor form, be far behind? I'm betting the answer is yes.

The data we have gathered from orbiting satellite photographs is powerful evidence that Mars was once a home to flowing rivers and large oceans. Both the rovers on the Martian surface found more evidence of a watery Martian past. And the remarkable Phoenix Lander scooped up water ice shortly after touching down. There is even evidence that water may still be flowing beneath the planet's surface.

Even factoring in wishful thinking, I'd say we're soon going to know that life is common throughout the universe. Mars may well be the first to tell us so.

continued from page 7

Curved Space

$$U=S+E$$
$$1/0=1/0+1/0$$
$$1/0=2/0.$$

Of course, this is can be confusing to some, but if there is any number except for zero as a numerator and a zero as a denominator, then it equals infinite. Now, this equation is allowed because there is no denominator to give a limit, it basically says that there is nothing, yet there is something; infinity. The equation runs in a stealth, hiding the question with this answer:

$$U=S+E$$
$$\infty=\infty+\infty.$$

With some polynomials, you can spill some paint on these invisible numbers:

$$U=S+E$$
$$1\infty=1\infty+1\infty$$
$$1\infty=2\infty.$$

Now, the numerators don't have to be ones, but when E and S are added up they basically have to be greater than U.

$$U>S+E$$

Ben Morgan

The Sky this Month

Mercury is in the southeastern dawn sky first half of the month. On the 2nd it is 5° N of the crescent Moon. Reaches greatest elongation west (23°) on the 9th.

Venus is very bright in the eastern morning sky. Greatest elongation west (47°) on the 8th. The planet lies 8° N of Antares on the 15th and 3° N of the Moon on the 30th.

Mars is not visible. Approaches conjunction with the sun on February 4th.

Jupiter in Pisces in early evening and sets late evening.

Saturn is in the morning sky in Virgo. Begins retrograde motion on the 27th.

Moon partially eclipses the sun on the 4th (not visible from North America).

Quadrantid Meteors peak on the evening of the 4th.

Moon Phases

New Moon	4:03 AM	January 4
First Quarter	6:31 AM	January 12
Full Moon	4:21 PM	January 21
Last Quarter	7:57 AM	January 26

Orion
the Hunter

Photo by Rick Stankiewicz. Canon 400D camera and Sigma 10–20mm lens, tripod mounted for 1 sec, f/4.0, ISO 1600.

RICK STANKIEWICZ

This scene of the night sky will be common and prominent in the northern hemisphere for the next few months. Though taken on October 4, 2010 before sunrise, in Killbear Provincial Park, near Parry Sound, Ontario. This view showing the familiar constellation of Orion "The Hunter" and his famous three "belt stars" and "sword" that hangs down and contains the famous Orion Nebula (M42), is what those living north of the equator can expect to see high in the southern sky throughout the winter months. Also featured in this image is the constellation of Taurus—The Bull—with its "V" shaped head of stars (upper right of Orion) and above to the right of this, is the familiar open cluster of stars called the Pleiades (Seven Sisters). To the upper left of Orion is the constellation of Gemini—The Twins. Get out and get familiar with your winter constellations, it is worth the time and effort. Be sure to dress warm find some dark skies. The lighting in this image was from a parking lot, but do added to the effect of this image to frame the night sky. These constellations are out there just waiting for a visitor. There are other constellations and parts thereof in this image too, can you find them?

continued from page 1

cer ball. Spitzer also found a larger fullerene, chemical formula C70, consisting of 70 carbon atoms in an elongated closed cage more resembling an oval rugby ball.

Neither type of fullerene is rigid; instead, their carbon atoms vibrate in and out, rather like the surface of a large soap bubble changes shape as it floats through the air. "Those vibrations correspond to wavelengths of infrared light emitted or absorbed—and that infrared emission is what Spitzer recorded," Cami explained.

Although fullerenes have been sought in space for the last 25 years, ever since they were first identified in the laboratory, the astronomers practically stumbled into the discovery. Co-author Jeronimo Bernard-Salas of Cornell University, an expert in gas and dust in planetary nebulae, was doing routine research with Spitzer's infrared observations of planetary nebulae with its spectroscopy instrument. When he studied the spectrum (infrared signature) of a dim planetary nebula called Tc 1 in the southern-hemisphere constellation of Ara, he noticed several clear peaks he had not seen before in the spectra of other planetary nebulae.

"When he came to me," recounted Cami, an astrophysicist who specializes in molecular chemistry, "I immediately and intuitively knew it I was looking at buckyballs in space. I've never been that excited!" The authors confirmed his hunch by carefully comparing the Tc 1 spectrum to laboratory experiments described in the literature.

"This discovery shows that it is possible—even easy—for complex carbonaceous molecules to form spontaneously in space," Cami said. "Now that we know fullerenes are out there, we can figure out their roles in the physics and chemistry of deep space. Who knows what other complex chemical compounds exist—maybe even some relevant to the formation of life in the universe!"

Stay tuned!

Learn more about this discovery at `http://www.spitzer.caltech.edu`. For kids, there are lots of beautiful Spitzer images to match up in the Spitzer Concentration game at `http://spaceplace.nasa.gov/en/kids/spitzer/concentration`.

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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`

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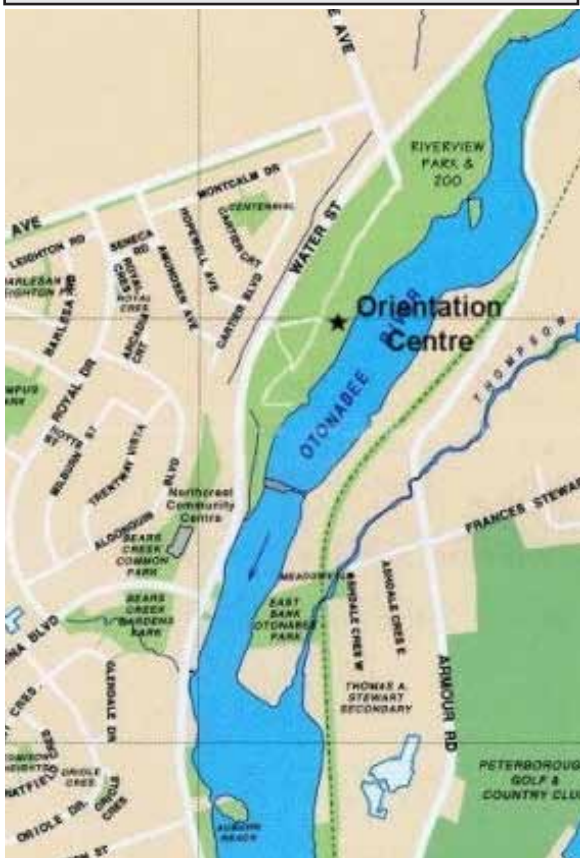

Meetings
The Peterborough Astronomical Association meets every first Friday of most months at the **Peterborough Zoo Orientation Centre** (Next to the PUC Water Treatment Plant) at p.m. P.A.A. executive business will be conducted starting at 7:30 P.M. Members and the public are welcome to attend the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