Peterborough Astronomical Association
The Reflector
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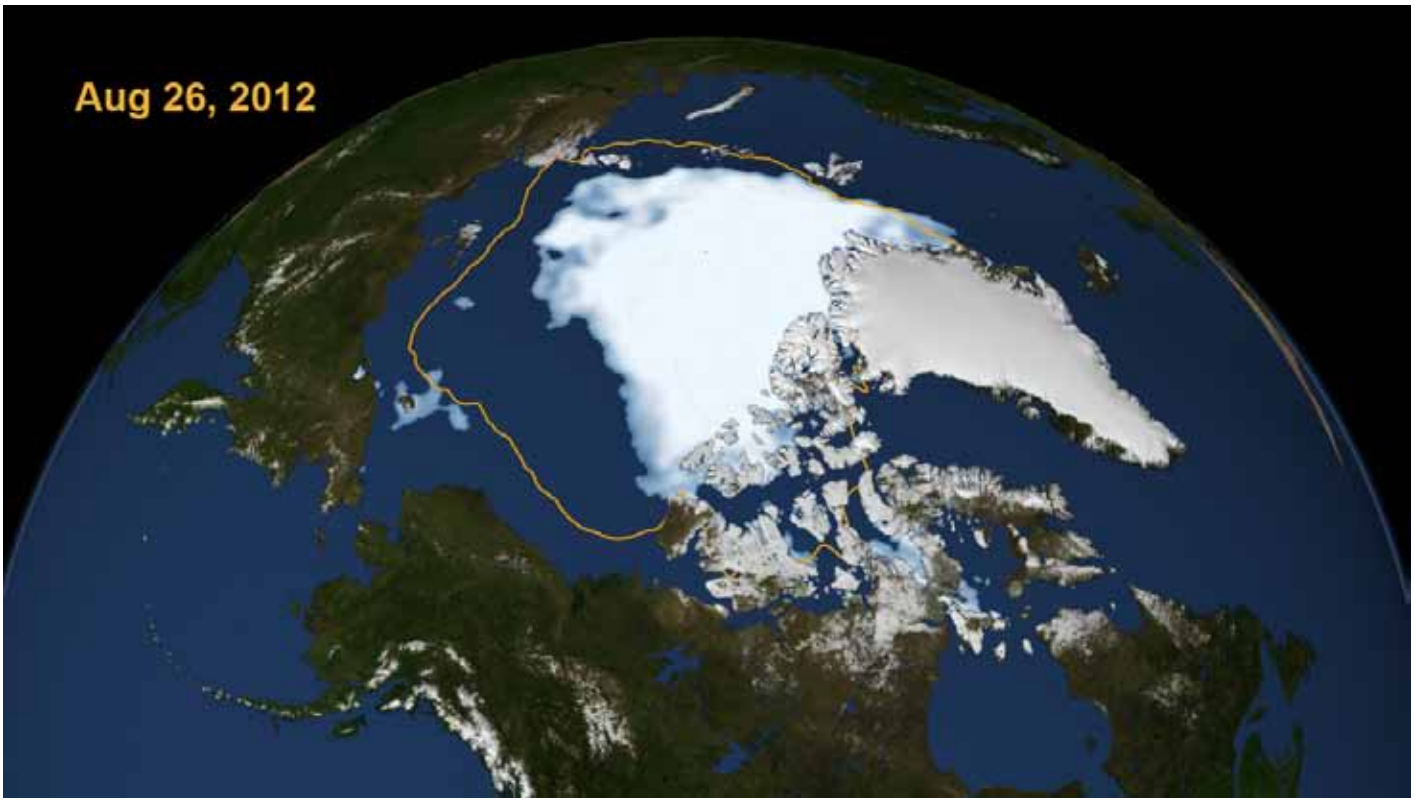
Exploring the Water World



This image from September 2012, shows that the Arctic sea is the smallest recorded since record keeping began in 1979. This image is from NASA's Scientific Visualization Studio at Goddard Space Flight Center. Photo courtesy of NASA.

by Diane K. Fisher

In some ways, we know more about Mars, Venus and the Moon than we know about Earth. That's because 70% of our solar system's watery blue planet is hidden under its ocean. The ocean contains about 98% of all the water on Earth. In total volume, it makes up more than 99% of the space inhabited by living creatures on the planet.

As dominant a feature as it is, the ocean — at least below a few tens of meters deep — is an alien world most of us seldom contemplate. But perhaps we should.

The ocean stores heat like a "fly wheel" for climate. Its huge capacity as a heat and water reservoir moderates the climate of Earth. Within this Earth system, both the physical and biological processes of the ocean play a key role in the water cycle, the carbon cycle, and climate variability.

This great reservoir continuously exchanges heat, moisture, and carbon with the atmosphere, driving our weather patterns and influencing the slow, subtle changes in our climate.

The study of Earth and its ocean is a big part of NASA's mission. Before satellites, the information we had about the ocean was pretty much "hit or miss," with the only

see "Arctic Ocean" on page 16

President's Message

We're Still Waiting For Spring

It's been rumoured that the lousy weather we are experiencing is because John Crossen and I acquired new telescopes. To add insult to injury I'm planning on purchasing new golf clubs. These actions combined will undoubtedly mess up the weather for the rest of the year. But hey, who believes in rumours anyway?

Another great science fair was held last week at Trent University and once again the Frank Hancock Award was presented for the best astronomy related project plus two, one year family memberships for the PAA were handed out. The Buckhorn Observatory prize was also awarded. The full story follows in this issue.

On May 11th and 12th we will host our 8th annual "Astronomy on the Hill" weekend on Armour Hill and the Peterborough Museum and Archives. We need your help. There are a number of things you can do to help with this public outreach event. If you have a telescope, bring it along, if not we need volunteers to watch equipment, direct traffic and mingle with the public answering questions etc. Please come out and support your club. This is a great weekend for families to get out and participate in live astronomy events. Contrary to the opening remarks, we are planning on excellent weather.

Rodger Forsyth
PAA President

Letter from the Editor

March Madness

Another issue of *The Reflector* is now in your computer. I must thank Ken Sunderland for submitting his series on the Galilean moons, which concludes this issue. We encourage you to submit to your newsletter. Your observation experiences would be welcome by other members. Nothing as ambitious as Ken's series is required, just 400 words about your astronomical adventures.

The usual gang is here. I especially hope you enjoy Dean Shewring's report on the re-opening of the Montreal Planetarium. This could be a great vacation destination!

Phillip Chee
Editor, The Reflector

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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Comets, Meteors and Asteroids

Comet Hale-Bopp was so bright that it was visible in the evening sky from downtown Toronto. I used to point it out to fellow GO Train commuters when I lived there. Comets are visible for weeks as they drift around the Sun. Meteors are bright flashes as they burn up in our atmosphere. Image by Jerry Lodriguss.

John Crossen

With Comet PanSTARRS being a recent naked-eye visitor to our night sky and Comet ISON promising a bright November appearance, some people are a bit confused as to what's the difference between a comet, an asteroid and a meteor.

A comet is essentially a big dirty snowball. Comets originate in the most distant realm of our solar system—an area called the Oort Cloud. It is essentially a huge ball of ice balls that surrounds our solar system. Occasionally one of those ice balls feels the tug of the Sun's gravity or gets a nudge from a neighbouring ice ball and drifts in towards our solar system.

The journey can take thousands of years. For instance Comet PanSTARRS won't be around again for another 106,000 years. What happens is that a comet is pulled in by the Sun, orbits around it and is slung back into the depths of space. Sometimes Jupiter's immense gravitational tug will rope it in and the comet will establish a much shorter orbit within our solar system. Comet Halley is a short-term comet with a 78-year orbital cycle. Come Hale-Bopp has a 40,000 year cycle. That's a long-term comet.

Meteors are space junk of the natural variety. They can be the debris from comet tails that melt as they near the Sun. Other meteor sources are bits of asteroids that have collided or they can be ancient leftover chunks of material that have simply been floating around our solar system since it coalesced.

Most meteors burn up in our atmosphere thanks to their high speed and the friction created by our friendly local air supply. Sometimes a meteor succeeds in surviv-

See "Falling Stars" on page 15

Peterborough Regional Science Fair

Roger Forsyth

The 44th annual Peterborough Regional Science Fair was held at Trent University on Tuesday April 9th. The PAA can be proud of the fact that we had four judges there and awards were handed out in three categories. The Frank Hancock award went to Isaac and James Chandra for **Big Planet Bigger Planet**. These young lads were quite knowledgeable and had a very good display. The award is presented here by your president.

Photo by Sean Dunne

The second place winners were Naomi Larocque and Elyse Rahiri with ***Les éclipses***. These girls each won a One-year family membership in the PAA. Unlike a lot of projects where two people are involved they

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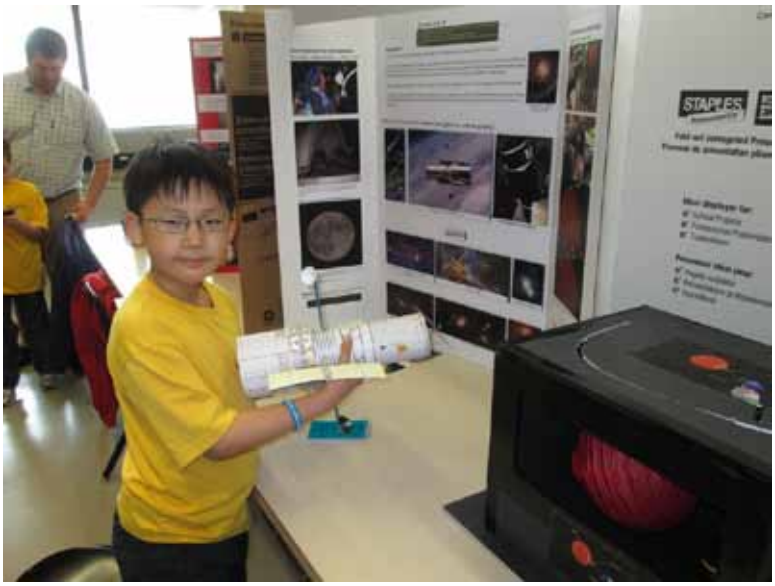
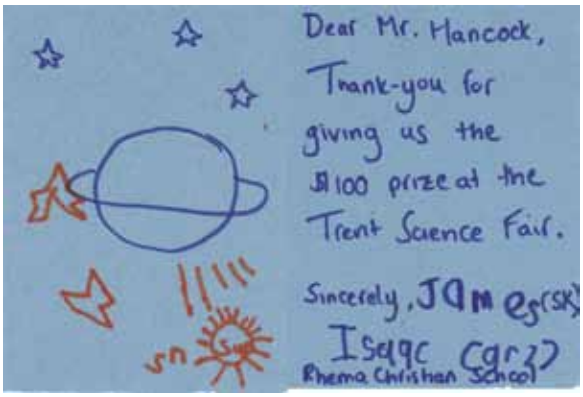
split up their talks quite well. One talked about solar eclipses, the other lunar eclipses. They were absent at the award ceremony.

The Buckhorn Observatory award went to Joshua Lee with **Universe vs. Galaxy**. You may recall that Joshua won a family membership last year. His project entitled "Universe vs. Galaxy" was very well done and he referenced the BHO on his display in many locations. The award is presented by Trish McCloskey. Joshua had put a lot of effort into his display including a clever animated "transit of Venus" in the black box you can see in the foreground.



I think the four of us had a rewarding day and I'm sure we'll be back next year to encourage these youngsters along. On Friday I received in the mail a heart-warming thank you card from Isaac and James Chandra. I've included a scanned image of it here.

This handmade card says it all.



Photos by Roger Forsyth excpet where noted.

PHOTO BY SEAN DUNNE

Starting Out

The Galilean Moons (Part IV)

Kenneth Sunderland

Dear Galileo,
Just finished your “Starry Announcement” -- Sidereus Nuncius. Loved it! Would you believe people are still reading it four hundred & three years later? I really got a kick out of it but that Latin is tough! Thank goodness for an excellent English translation by Albert Van Helden (ISBN 0-226-27903-0). Anyway, I wanted to compare notes because I tried to repeat your historic Jupiter observations. Your telescope was around 20X magnification and so was mine. We both made observations during the winter months when Jupiter was in Taurus. Quelle coincidence!

It happened fast. Your spyglass revealed the true nature of the Moon, The Milky Way, and a couple of open clusters. You saved the best for last -- Jupiter’s little planets. In your own words you moved “... from doubt to astonishment...” all in that first week. At first you saw three little stars by Jupiter. (Most would assume that you missed (IV) because of your small FOV but the truth is one moon was occulting another. Eventually the fourth appeared.) They were in a straight line along the ecliptic -- two to the east and one to the west. It grabbed your attention. Next night all three were to the west of Jupiter. You knew Jupiter could not move that fast with respect to fixed stars. Next night “...the sky was everywhere covered with clouds.” I feel your pain buddy. Believe me, things aren’t any different today. At least you were in Italy, which sounds like a vacation to me. A few nights later and another configuration along with the realization that they were “... wandering around Jupiter like Venus and Mercury around the Sun”. Why didn’t you include Earth? Anyway... Bingo! The heliocentric model is the thing. Between 7-Jan and 2-March-1610 you recorded moon positions, brightness, and size, night after night without much explanation. This journal style isn’t refined but it successfully conveys your growing excitement -- still delightful to read all these years later. You really didn’t get much sleep during those months -- quite understandable! As you said, you “... were making known four planets never seen from the beginning of the world.” You knew you were making history.

It’s amusing to read your descriptions of events, which we now recognize as transits, occultations and eclipses. It seems you’re

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not quite sure what's going on. Any observer today can easily interpret your observations because we've got the necessary framework -- the correct "paradigm" as Thomas Kuhn would say. There are so many possible configurations for action at Jupiter that, of course, you saw things I didn't and vice versa. The remarkable thing is that I can make sense of all your observations. For example, take that night you saw only one moon. I've never seen that and yet I can understand what was probably going on. Let's talk about a few other observations -- a sampling of wonders.

The night you saw one of the moons displaced must have raised doubts because, up to that time, you had emphasized how they formed a straight line along the ecliptic. So you noted it, but you didn't offer any explanation. Why not? On 8-Jan-2013 I saw three moons dramatically displaced from a straight line. In fact, they were stacked atop each other. Then the uppermost of the group stayed in view as it went over the top of Jupiter's north pole -- not behind as expected. That surprise got me thinking about orbital inclinations.

On 28-Feb-1610 I see you had a little mystery. "But at the fifth hour a third little star was perceived ..." where there hadn't been one earlier. You had witnessed (II) emerging from Jupiter's shadow. For my part, it was fascinating to watch (III), which was well away from Jupiter, vanish into the night sky on 4-Feb-2013, eclipsed by Jupiter's shadow. A couple of hours later it reappeared from the blackness, and noticeably further away. Magic!

On 24-Jan-1610 you suspected that two little stars had merged into one. Why didn't you wait a few hours to see what would happen? The weather must have turned because you, of all people, would understand that with time the truth would emerge. A disciplined approach makes it possible to both ask and answer your own questions. Patience required.

Fast forward: On the evening of 24-Jan-2013 it was remarkable to follow (I), with its short period, as it moved closer to Jupiter, merged into the halo, disappeared, and later reappeared on the other side. I wonder why you didn't make more sketches, at regular time intervals, to nail down this sort of event? I suspect the answer to this question and all the others is the same -- you needed to publish fast. Although still rare, increasing numbers of telescopes meant that you risked being scooped. Reputations were at stake ... best make it a rush job.

More generally on the topic of observing I note a parallel between you and me. (As great a conceit as ever there was!) For example, you soon realized that time should be accurately recorded, and then much later that a fixed star should be part of your sketches. In others words, you got a feeling for what might be important as your observations progressed. Me too. I find the closer you look the more you see.

see "Sidereus Nuncius" on page 15

PHOTO GALLERY

Solar Flares on the Sun

Rick Stankiewicz asked Brian Colville if he could send us an image he made of the Sun from April 4. This is a colourized full disk image taken with the LS80T (2 exposures combined to get the disk and limb details). Image courtesy of Brian Colville, Maple Ridge Observatory, Cambray, ON.

A new Planetarium for Montreal

Dean Shewring

It's been 18 months since Montreal has had an operating planetarium in the city. The Montreal Planetarium closed on October 10, 2011 after 45 years, 58,000 presentations in French and English, and nearly 6 million visitors since its opening on April 4, 1966.

On April 6, 2013, the new Rio Tinto Alcan Planetarium opened to the public offering a space four times larger than the old planetarium and a location at Olympic Park adjacent to three other science exhibitions — the Biodome, Insectarium and Botanical Garden — under the umbrella title of "Space for Life". There is a bold new design for the building which has three levels; an upper level for administration, a middle level for the theatres and exhibits, and a lower level where there are three large rooms for workshops and meetings as well as the old Zeiss projector.

The Rio Tinto Alcan Planetarium (photo credit – Space for Life)

There is a link to the Biodome from the lower level. The Biodome's boutique is making space for a modest amount of astronomy-related merchandise.

The planetarium is not associated with a university or observatory, so does not offer facilities for research. However, there will be a periodic offering of lectures, the first of which (in French only) was provided on April 30 by astrophysicist Roland Lehoucq who explored questions about whether life exists beyond our planet.

The highlights of the planetarium are the new permanent exhibition and the original productions in the two new theatres — the Chaos Theatre and The Milky Way Theatre.

There is a ticket booth near the entrance, though the main exhibition is free. Your ticket is for both shows at the planetarium and the shows are timed and designed so that you attend one of two shows at the Chaos Theatre (98 seat capacity) before visiting the respective show in The Milky Way Theatre (196 seat capacity) in your official language. You can also purchase tickets well ahead of your visit online. Ticket costs are: Adults – $18.75; Age 65+ – $17.50; Students 18+ (with card) – $14; and Children 5 to 17 – $9.50. There are discounts for families and Quebec residents. The hours of operation are: Sundays to Tuesdays, 9 am to 6:30 pm and Wednesdays to Saturdays, 9 am to 10:30 pm from spring through autumn. Planetarium shows run continuously during these hours.

The permanent exhibition is an interactive experience called **EXO: Our Search for Life in the Universe**. This family-friendly exhibit uses "spectacular images and animation, projectors and multi-media games." The focus is on astrobiology — how life was formed on Earth (examining extreme organisms) and what to look for in our quest to discover life beyond Earth. There are large touch-screens and game tables — you can create Earth, terraform or operate a robot on Mars, travel through the solar system, and transform yourself into an alien! One section of the exhibition is devoted to the huge collection of over 300 meteorites — the original permanent collection from the old planetarium — plus a couple of new finds which together dis-

See "Planetarium" on page 13

May is the hello/goodbye season for constellations

John Crossen

It's May, and time to part company with our winter comrades Orion, Canis Major, Auriga and Gemini. We'll see them again next November. But right now it's time to welcome Leo, Virgo and Libra. For us night-hawks the trio of constellations that make up the Summer Triangle also put in their first showing.

Leo the Lion has been with us since early March and is now in the southern sky when night falls. Leo's brightest star is Regulus which is at the bottom of the sickle shape that marks the lion's head.

Virgo makes her appearance towards the rear of Leo in the southeast sky. Her brightest star is Spica which can be located by following the arc of the big dipper's handle down to Arcturus in the constellation Boötes, then further down to the first bright star after that—Spica. Arc to Arcturus and spike to Spica as the old saying goes.

To the left of Spica is another bright star-like object. It's the planet Saturn. If you have a small telescope, even one of those spindly junk jobs from Costco, have a look at Saturn. At thirty power of magnification you can just make out the beautiful rings. Higher power with a more stable telescope will show their jaw-dropping magnificence.

Other spring constellations include Coma Berenices, Corvus, Crater, Libra and Boötes. I highly recommend you pick up a book on the constellations, so that you can have a constellation "meet 'n' greet" on one of our warm spring nights.

Anyone looking for the dippers, large or small, should be looking almost directly overhead. In springtime Earth's orbit and angle place them near the zenith—almost straight up. If you have binoculars, take a look at the second star in from the tip of the Big Dipper's handle. That's Alcor, or more properly Alcor and Mizar, a double star.

Late spring also brings with it a treasure of globular star clusters. Most are visible with binoculars and M13 in Hercules is naked eye visible to those with keen vision. Learning to find the globular clusters M3, M5 and M13 in binoculars will be a gift to yourself when you purchase a good telescope. These clusters contain up to 1 million stars spread out in a burst that looks like diamonds on black velvet. If you don't have a scope, but know someone who does, mosey over to their place some clear night. But glue your socks on 'cause if you don't your first sight of M13 will likely blow them into the next door neighbour's petunia patch.

That's if for this edition. Spring is a great time to get started in astronomy. There are no bugs, the number of clear nights is increasing and you don't have to dress like an Eskimo to enjoy it. Your eyes, a star chart and a clear night are all you need.

M31 Star Cluster. Almost as stunning as Saturn's rings is globular star cluster M13 located in the constellation Hercules. The cluster is composed of about 1 million stars, some of which are 10 billion years old.

What ever happened to good old what's its name?

John Crossen

Back in the days of elevated purple disco shoes and afro hair frizzes NASA launched a mission to explore the Asteroid Belt, as well as the outer gas giant planets Jupiter and Saturn. After that it would go on to hurtle through space for infinity, or until some intelligent life form discovered it.

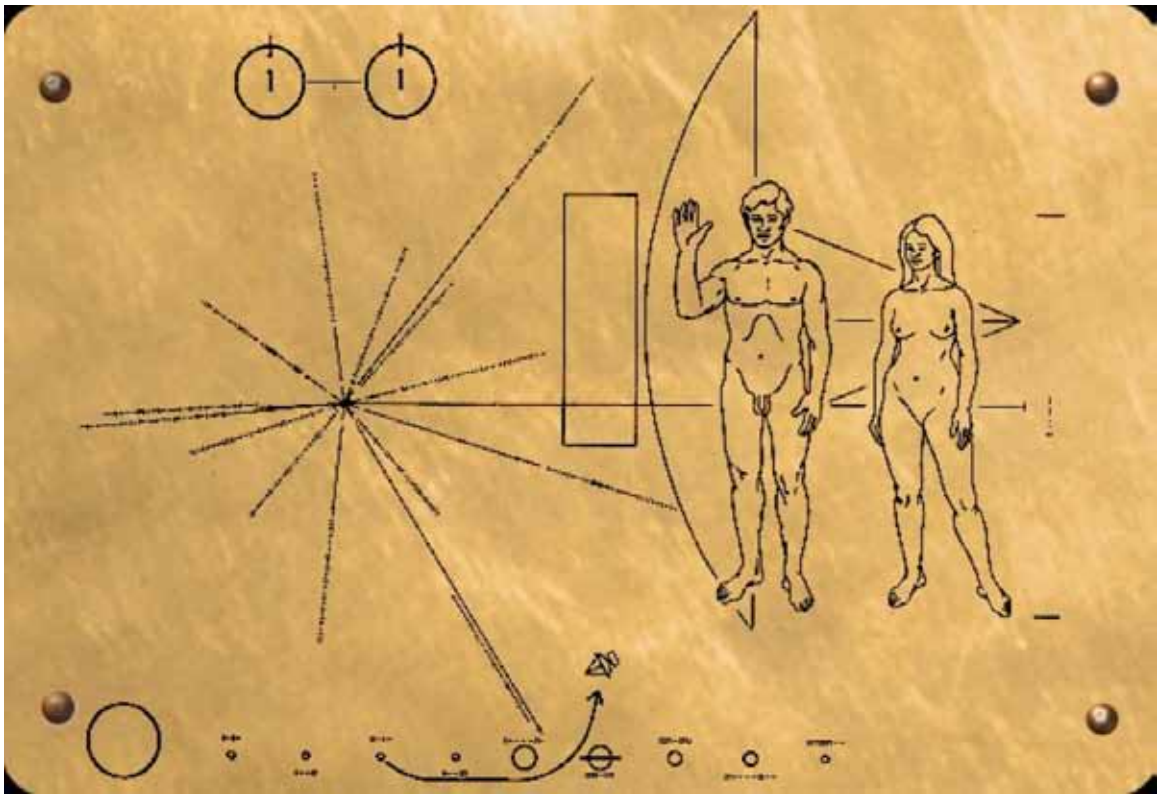
Its name was Pioneer 10 and the most memorable part of its onboard cargo was a small gold-anodized aluminum plaque. The 6 × 9-inch plaque features a drawing of a man and woman as well as our position in the galaxy, the planets and the Sun's position. In other words, howdy from Earth, here's what we're about. The mission launched on March 3, 1972, from Cape Canaveral in Florida and is sending data back to Mission Control 41 years later. So what's happened in the last four decades?

Just 11 hours after launch Pioneer became the fastest man-made object ever when it passed by our Moon at a speed in excess of 50,000 km/h.

As soon as all its instruments were up and running Pioneer 10 began to analyse the interplanetary medium (the dust, cosmic rays and particles of the solar wind). It discovered interplanetary helium as well as aluminum and sodium in the cosmic wind.

Another first for the mission occurred on July 15 when Pioneer 10 became the first spacecraft to enter the Asteroid Belt. During its pass through the Asteroid Belt the craft measured the size of particles within it. To the surprise of everyone, none larger than 1mm were measured. That doesn't mean the Asteroid Belt is a safe place to travel, only that it can be done. Pioneer 10 emerged

See "Pioneer 10" on page 14



Disc on Pioneer 10. If Pioneer 10 is intercepted by other space travellers, this disc will tell them a little about Earth and its people.

The Straight Goods

Rick Stankiewicz

For you "lunar lovers" you might like to know that on May 18th, during the First Quarter Moon, there will be a great opportunity to view one of the many interesting lunar features. For those with any size telescope, train it along the terminator and about half way across the lunar disk and you will see a large crater formed on the southeastern shore of the *Mare Nubium* (Sea of Clouds) with a distinct line running vertically down the middle of it. The lighting on the 8th or 9th day after a New Moon is perfect for accentuating *Rupes Recta*, Latin for Straight Fault or you might have heard it referred to as the Straight Wall. There are many linear faults on the Moon, but this is one of the most well-known. It is akin to the Niagara Escarpment here in Ontario, but on the Moon. This fault runs about 120 km, with a typical width of 2–3 km, and a height of 240–300 m. So, although it appears to be a vertical cliff in the lunar surface, in fact the grade of the slope is relatively shallow. Follow the shadow of the "wall" until it terminates in the south against a jumble of short ridge segments that the 17th-century selenographer Christiaan Huygens likened to the handle of a sword, with the Straight Wall being the blade. Do you see it? Now you'll have seen the Crater Sword or Huygens's Sword. Looks are deceiving and your eyes can play tricks on you, but "the shadow knows"?

The accompanying photo is similar to what you can expect to see if the night is clear. I took this image about ten years ago with a small digital camera "afocal" (shooting through the telescope eyepiece). If you are weathered out, don't despair because you will get another chance around day 22 or 23 of the lunar cycle (June 2nd) when the Straight Wall will be lit from the opposite direction.

These are the straight goods so get out there and look skyward as the Moon puts its best face forward for a night of exploration.

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Planetarium

plays the oldest rocks in our solar system. It is recommended you allow 30 minutes or more to tour the whole self-guided exhibit.

EXO: Our Search for Life in the Universe (photo credit – Space for Life)

Continuum is a 23-minute show representing the vision of two artists, Michel Lemieux and Victor Pilon, in the Chaos Theatre. It uses images to depict our world and world's beyond to the symphonic music of Philip Glass. "From the infinitely small to the infinitely large, a cosmic poem on the link between humankind and the Universe." This domed space offers a choice of informal viewing from large bean-bag chairs or Adirondack chairs.

From the Earth to the Stars is a 40-minute more traditional planetarium production. There are two projection systems used to provide this show in the Milky Way Theatre. The Konica Minolta Infinium S opto-mechanical projector offers crisp views of the night sky at any time in human history or even from another world, and the Sky-Skan is a full-video system which complements the star projector with 360 degrees of video and images. The lecturer presents the night sky during the first half of the show—then guides the audience during the remaining video portion. "You can even leave our galaxy behind, going beyond the Milky Way to probe the furthest reaches of the universe, enveloped and carried by its immensity."

The Milky Way Theatre (photo credit - Space for Life)

You can see a video, with subtitles in English, launching the new planetarium experience at: http://www.youtube.com/watch?feature=player_embedded&v=MU0c8VBwddE

After years of seeing planetarium closures and the opening of a few very small planetariums, it's great to know that efforts are being made to enhance the experience of presenting the stars, planets and the many objects that make up our night sky to a new generation that's hungry to learn about our universe. This is an opportunity that shouldn't be missed and is definitely worth a visit. Check them out at: http://espace-pourlavie.ca/en/planetarium

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Pioneer 10

safely 7 months later on February 15 and began to explore our solar system's largest planet, Jupiter.

Images of Jupiter far exceeded the quality of any ever taken from Earth which earned the Pioneer Program an Emmy Award when they were presented to the media. The spacecraft passed within 132,000 km of Jupiter's cloud tops and sent home spectacular images of the Giant Red Spot, the planet's 350 year-old storm.

Pioneer 10 crossed the orbit of Saturn in 1976 and the orbit of Uranus in 1979. On June 13, 1983, Pioneer 10 crossed the orbit of Neptune, becoming the first man-made object to leave the proximity of the major planets of our solar system. The mission came to an official end on March 31, 1997. But the old gray mare isn't dead yet.

Pioneer 10 is still streaking along at the very edge of the solar wind's reach. That's about 177 times the 143 million kilometre distance from Earth to our Sun. Scientists estimate we have about 4 more years of communication and then Pioneer will become the first man-made craft to go where no one has gone before — interstellar space.

The Sky this Month

Mercury disappears from the morning sky early in the month and reaches superior conjunction on the 11th. Reappears around the 18th in the evening sky. The planet is 7° N of Aldebaran on the 21st, 1.4° N of Venus on the 25th and 2° N of Jupiter on the 27th. The three planets lie within 3° of each other on the 25, 26 and 27, low in the fading evening twilight in the WNW.

Venus is low in the evening twilight and becoming a poor apparation. Joins Mecury and Jupiter for conjunctions in the last week of May.

Mars is not visible. Was in conjunction with the Sun last month.

Jupiter is in the western evening sky in Taurus. Sets in late evening. Waxing crescent Moon passes nearby on the 12th. Vanishes into the evening twilight near the end of the month.

Saturn is visible most of the night in western Libra. Just past opposition and retrograding on the Libra-Virgo border.

eta-Aquarid Meteor shower peaks on the 5th at 2h00.

Moon Phases

Last Quarter	**7:14 AM**	**May 2**
New Moon	**8:28 PM**	**May 9**
First Quarter	**12:34 AM**	**May 18**
Full Moon	**12:25 PM**	**May 25**

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Siderus Nuncius

Well, I'll leave it at that but there's lots more we could discuss about your sixty-five sketches and my forty-six. Oh yes, I forgot to mention that I took your advice and measured the moon periods. I think you would like my results. This information is key to unravelling the orbital mechanics as, no doubt, you knew all along.

Wow! That's quite a summary you make after the last entry on 2-Mar-1610. You just come right out and say it "... they whirl around Jupiter in unequal circles, ..." and then anticipating your friend Kepler by nine years you observe "... the planets describing smaller circles around Jupiter are faster." Enough already, but you continue by comparing the Moon circling Earth with the Medicean stars circling Jupiter and everything traversing "... a great circle around the Sun ...". Pow! Score a knock-out for Copernicus.

Your devoted admirer,
Ken

P.S. Never mind your dust-up with the Pope -- history will be kind to you.

References

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

Your comments and questions are welcome.
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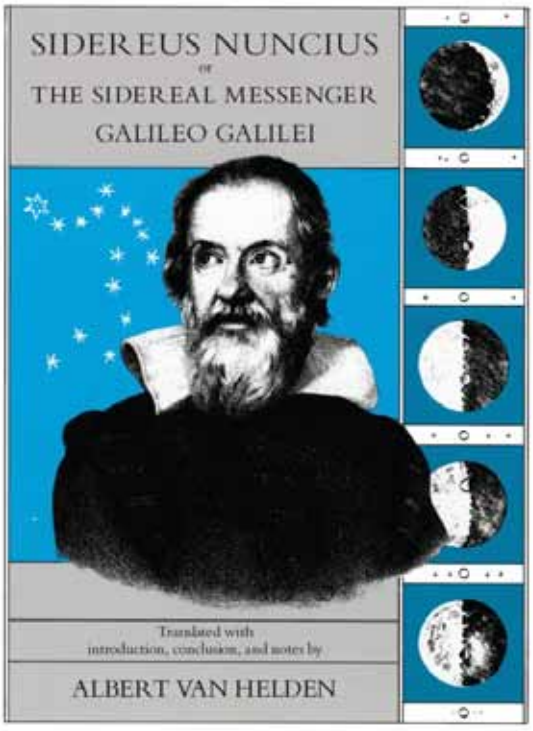

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Falling Stars

ing the fall to Earth. The minute it strikes Earth, it goes from being a meteor to being a meteorite.

Asteroids are big rocky chunks that orbit the Sun between Mars and Jupiter. It is thought that they would have formed into a planet had it not been for the gravitational pull of giant Jupiter. So, instead of becoming a planet, they continue to orbit the Sun as bits of an unkept planetary promise.

There are hundreds of thousands of asteroids in the asteroid belt and occasionally they too, bump into each other. Sometimes that changes their orbital path and sends them in towards Mars, Earth, Venus and Mercury. Those are the ones we have to watch out for. Ask any dinosaur.

That's a brief overview of comets, asteroids and meteors. There are gray areas which I have skirted simply because they are unusual instances. Keep it simple, stupid works best for Astronomy 101.

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Arctic Ocean

data collectors being ships, buoys, and instruments set adrift on the waves.

Now ocean-observing satellites measure surface topography, currents, waves, and winds. They monitor the health of phytoplankton, which live in the surface layer of the ocean and supply half the oxygen in the atmosphere. Satellites monitor the extent of Arctic sea ice so we can compare this important parameter with that of past years. Satellites also measure rainfall, the amount of sunlight reaching the sea, the temperature of the ocean's surface, and even its salinity!

Using remote sensing data and computer models, scientists can now investigate how the oceans affect the evolution of weather, hurricanes, and climate. In just a few months, one satellite can collect more information about the ocean than all the ships and buoys in the world have collected over the past 100 years!

NASA's Earth Science Division has launched many missions to planet Earth. These satellites and other studies all help us understand how the atmosphere, the ocean, the land and life — including humans — all interact together.

Find out more about NASA's ocean studies at http://science.nasa.gov/earth-science/oceanography. Kids will have fun exploring our planet at The Space Place, http://spaceplace.nasa.gov/earth.

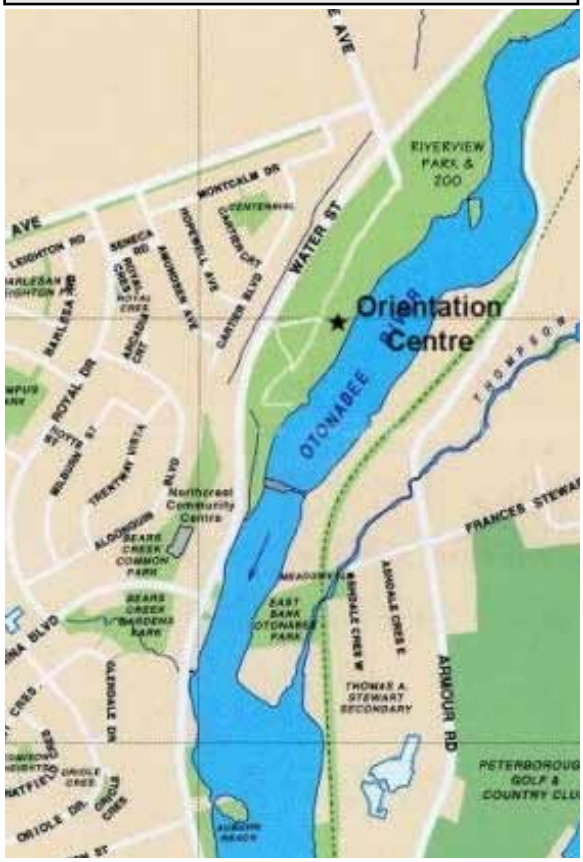
This article was provided by the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.

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 handwritten 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:
MAY 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.