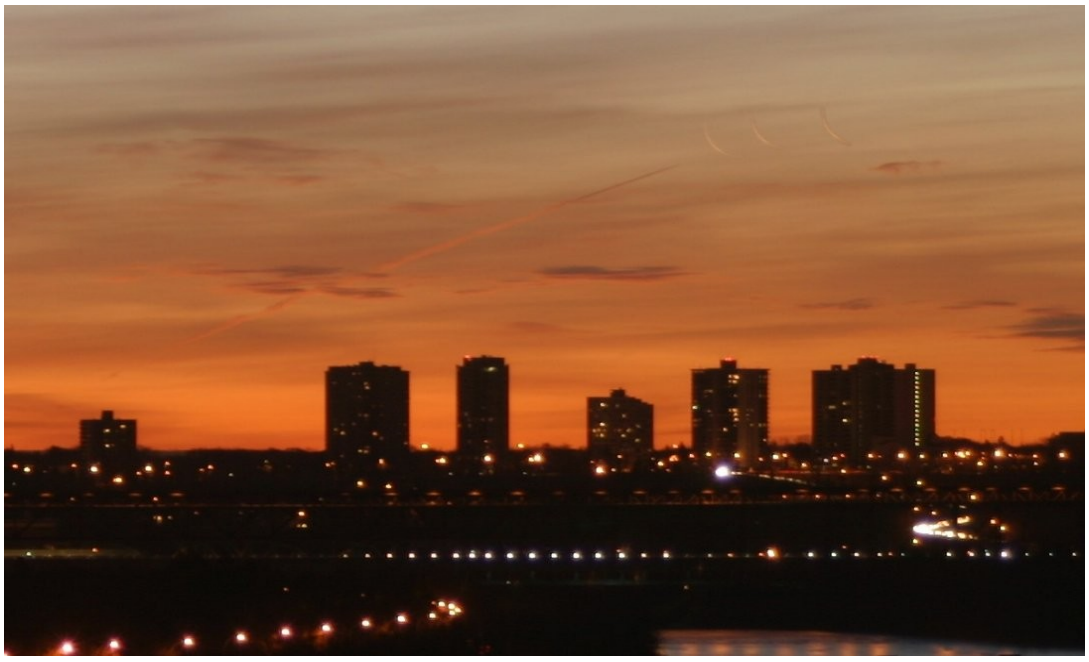
STARLUST

Newsletter of the Royal Astronomical Society of Canada
Edmonton & Dog River Centre Edition

April 2009 **Volume 54 Issue 8**



Rare conjunction: All three of Earth's moons were "new" within hours of each of other in April 2009. Photo by Alister Ling, edited for clarity by M. Ward.

Inside this Issue

RASC Edmonton Centre Contact Information

Council Positions			
President	**Krista Stefan**		
Past-president	**Orla Aaquist**		
Vice-president	**Sherry Campbell**		
General Secretary	**Luca Vanzella**		
Treasurer	**Mark MacDonald**		
Co-National Council Rep	Alister Ling		
Co-National Council Rep	Patrick Earl		
Public Education Director (PED)	Orla Aaquist		
Fund Raising Coordinator	Franklin Loehde		
Councillor	Bruce McCurdy		
Councillor	Richard Vanderberg		
Councillor	Sheldon Helbert		
Councillor	Harris Christian		
Councillor	Ross Sinclair		
Internal Communications Officer	Michael Ward		
Observers' Group Director	Paul Campbell		
Membership Secretary	Massimo Torri		
New Member Advisor	Murray Paulson		
Dark Sky Preserve Coordinator	Sherrilyn Jahrig		
Light Pollution Chair	Bruce McCurdy		
Appointed Officers			
Editor	Michael Ward		
Web Site Coordinator	Ross Sinclair		
Library Coordinator	Roxy Garstad		
Equipment Coordinator	Dwight Hanson		

Mailing address	RASC Edmonton Centre c/o Telus World of Science 11212 – 142 St Edmonton, AB, Canada, TM5 4A1
Centre Website	http://www.edmontonrasc.com
Observing Deck	452-9100 ext 2249
Stardust	Articles for Stardust may be submitted by email to **mward@interbaun.com**. Submission deadline is the last day of the previous month (e.g. for the May issue submit by 30 Apr). Submit in any standard document format (MSOffice, OpenOffice, AbiWord, plain text). TimesNewRoman 10pt single-spaced is preferred. Don't bother with fancy formatting, odd spacing, strange fonts, etc.; it will only be discarded. Graphics (GIF or JPG please) may be submitted as separate files, and clearly identified.

Edmonton Area Astronomy Discussions: astro@mailman.srv.ualberta.ca
To subscribe send a blank email to: astro-request@mailman.srv.ualberta.ca
with the subject line: `subscribe`

The above mailing list is completely independent and is not associated with RASC Edmonton Centre in any way.

Upcoming Events, Meetings, Deadlines, Announcements

MEETINGS 2009

	General	Council	Observers	NewMoon	FullMoon
Apr	13	27	6	24	9
May	11	25	4	24	9
Jun	8		1	22	7
Jul			6	21	7
Aug			5	20	5
Sep	14	28	2	18	4
Oct	19	26	5	18	4
Nov	9	23	2	16	2
Dec	14		7	16	2

MEETING LOCATIONS 2009

Regular General Meetings are at 7:30pm in Telus World of Science , 11211 – 142 St.
follow the signs, from the main entrance

Council Meetings are at 7:15 pm in the ATA Building, 142 St & 111 Ave.
follow the signs, from the main entrance

Observers Meetings: *location varies*

The Planets *by Murray Paulson*

Venus and **Mercury** have both had their date with the sun at the end of March. Venus passed between the earth and the sun, headed for the morning sky, while Mercury passed behind the sun into the evening sky. In a scant 4 weeks time, April 26th, Mercury will be at Greatest Eastern Elongation where it will set 2 hours and 15 minutes after the sun, or at 11:18 pm. The ecliptic rises sharply against the western horizon, so this should be a very good evening apparition. On the 26th, Mercury will display a magnitude 0.3, 8.0" crescent. This is worth getting out there to see.

Venus has passed into the morning sky, and will trace its way up into the pre-dawn sky over the next few months. It was wonderful in the month before it passed over the sun, and it will reverse the process, as it waxes back into a fatter crescent in April. I managed to see Venus after sunset one evening and again the next morning because it was so high above the sun. Fantastic! In late March it looked like the sun in the last moments before totality in the eyepiece of my Sky 90. The twilight sky was pretty wiggly, and the chromatic scatter in the atmosphere near the horizon made for quite the sight. At the beginning of April, Venus shows a magnitude -4.0 razor thin 59"crescent in the eyepiece. The crescent is quite visible in binoculars. Give it a look before it shrinks too much. On the morning of April 22nd, Venus is occulted by a thin crescent moon in the dawn hours. Guide gives me a disappearance at 6:39 am and reappearance at 7:41 am for the city of Edmonton and Saskatoon. Venus sits 33 degrees from the sun and shows a 45" crescent. The sun rises at 6:11 am in Edmonton, (5:47 in Saskatoon) so what you need to do is get out there before sunrise, and locate Venus in your polar aligned, equatorially driven scope. Watch the disappearance, then come back 55 minutes later and watch the reappearance. Venus disappears on the lit side of the moon and reappears on the dark side, so you will not know exactly where to look for it. Use my chart to get your bearings, and switch to high power for the reappearance. The slender tip of the crescent will be the first part to reveal itself. Venus is quite large, so it will take 60 seconds as the moon slides off of it. It should be very cool. In the first week of May, Venus will shine at Magnitude -4.5 and will show a fat 37" crescent in the eyepiece. It has leapt out to 40 degrees elongation from the sun, but hovers just above the eastern horizon in the twilight.

At the beginning of April, **Mars** shines at magnitude 1.1 and shows a 4.3" disk in the eyepiece. The morning ecliptic is shallow, and will make it just about impossible to find. It will move from the constellation of Aquarius to Pisces over the month, passing 26 minutes of arc below the planet Uranus on April 15th. Uranus is magnitude 5.9 at this time. Mars is in conjunction with Venus in the 3rd week of the month where Venus passes 4.1 degrees above it at closest approach on the 24th. At the time Uranus sits 4.2 degrees west. This is your best opportunity to find Mars with the bright sign post of Venus nearby.

Jupiter is in the eastern side of Capricorn and shines at magnitude -2.1. In the eyepiece it shows a 36" disk and lies low in the South East in the morning sky. The rising twilight will make for a narrow window to spot it. It will not be well placed until the summer star parties when it will be at opposition.

Saturn has been spectacular with its rings nearly edge-on. I have had a few nights with great seeing where you could see little moons sprinkled about the rig tips. It is a great time to hunt for those inner satellites with significantly less glare from the rings. At the beginning of April, Saturn shines at magnitude 0.6 and shows a 19.5" disk in the eyepiece. Over the month the planet will shrink slightly till on the first week of May, Saturn will shine at magnitude 0.7, and the disk will be to 18.8". Here is a listing of Titan events for the next month.

Titan satellite events

Date	Event	UT	Local time
5-Apr	EcD	9:21	3:21
5-Apr	EcR	13:37	7:37
13-Apr	ShI	7:22	1:22
13-Apr	ShE	11:51	5:51
21-Apr	EcD	8:20	2:20
21-Apr	EcR	13:10	7:10
29-Apr	ShI	6:22	0:22
29-Apr	ShE	11:16	5:16
7-May	EcD	7:23	1:23
7-May	EcR	12:40	6:40

Blotting out starlight: Upcoming Edmonton occultations: prime events *by Alister Ling*

Venus occulted by the Moon! If there's one event to see this month, it's this one, the morning of Wednesday April 22. It's been a long time since I've seen the Moon cover and uncover Venus: 1987 if I'm not mistaken. It won't be quite as spectacular since that one was at dawn before sunrise, and this one is after sunrise, but don't let that slow you down. Hide the Sun behind something and watch.

The Moon will be deceptively pale to almost invisible, depending on the clarity of our atmosphere. The disappearance is almost smack in the middle of the crescent. Its return is shown in the accompanying diagram, which has zenith up (binocular view). Venus has a very similar phase, so it will be invisible until the event is almost over, but imagine a couple of horns coming out first!

```
day  Time    P                      Moon   CA
 y   m  d  h  m  s      No  D     Alt Az    o Times are MDT
09 Apr 22  6 39 16 D Venus       13 103 -89S
09 Apr 22  7 40 33 R Venus       22 117  63S
Duration of planetary disk occultation: predicted time +/-46.3 secs
```

No reasonable asteroid events this month. Other grazes on deck for this year are: **1)** Thu eve June 25-26 10:41 pm mag 5 star, **2)** Sat eve Nov 7-8 11:21 pm, mag 6.3, and **3)** Tue eve Nov 24-25, 7:53 pm mag 5.9.

Crescents and Full Moon Photo-Ops *by Alister Ling*

Hey, a nice chance for a 24hr young crescent Moon on Saturday the 25th! Not a record by any means, but for those who have never tried, this could be a personal best for you. Quite easy with binoculars – just need a good WNW horizon.

```
yyyy/mm/dd/hh:mn  Sol Alt Lunar Az  Alt   Age

2009 04 25 21 41   -7.0°   299.2°   5.6° 24h19m
```

If you can, watch the Moon set at 22:32 and azimuth 310 through a scope – you might be treated to some cool atmospheric refraction effects. Sunday evening the crescent sets at 23:58 and azimuth 316.

The dawn is now getting a bit early (5:30 am), so I'm omitting those events here. The near full Moon rises are quite far to the southeast (low summer Moons!), where there are no nice buildings from the vantage points I have at my disposal, so I have no events listed. Nonetheless, if you visually like these, they happen from the 6th to the 10th of May.

IAU Designates Gaseous Planets as Brown Dwarf stars by Paul M. Soon, Nature, March 31, 2009

It has happened: the IAU has followed on the heels of the decision to downgrade Pluto to a dwarf Planet to include gaseous planets as failed stars. This decision has come as a blow to the astronomical community who were already reeling from the impact of the demotion of Clyde Tombaugh's 9th planet in a prior IAU decision in 2007. On Monday March 30 2009, in a meeting in Brussels, the IAU decided in a 193 to 186 vote to re-designate the outer gaseous planets to be failed stars, - Brown dwarfs. The reasoning behind this was that Jupiter actually emits more energy than it absorbs from the sun, and in a similar argument, Saturn, Uranus and Neptune fell into the same category. At 12:30 UT on March 31, our solar system was reduced to 4 planets. In the afternoon sessions a surprise proposal was submitted by Dr. Harvey J. Milner of Cal Tech, Department of Astronomy and Astrophysics, to designate the smaller bodies in the solar system that are planets, but are the same order of the size as a planetary moon, to be designated "Moons without Planets". A hot debate ensued with name calling from the opposite ranks. Tempers flared, but in the end Mercury fell in a similar show of strength to the vocal majority who believe that "it's a planet if it's like Earth." Then there were 3.

Dr. Yeomans from the JPL laboratories in Pasadena California was quoted saying "This is a grim day in astronomy and astrophysics!"

The Hazards of Astro Flashlights by Paul D. Murrayson

It's the fools edition, and this article labors to expound on some of the hazards I have identified with Astro flashlights. One common thing amateur astronomers do, is hold a flashlight in the mouth as the "third" hand. I have discovered a few hazards associated with this practice. Think twice about that flashlight offered to you in the dark of night. You never know just where it has been!

One potentially harmful side effect is that you tend to inhale past the body of the flashlight, and aspirate a quantity of dust, pocket lint, … whatever, into your lungs. The particularly bad culprit for this is the small clip lights that have lots of surface area and pockets for lint-dust to accumulate. And these do not act as a good seal in your mouth. I have managed to inhale a quantity of debris into my lungs and this precipitated a cough that lasted me three or four months. I did get over it, and I now am much more careful.

A second rather serious issue comes about when you are holding onto that flashlight in your teeth and clamp down while straining to do some task, and break a filling in a tooth in the process. Yes, dear reader, I have done this one too, and at a remote week-long star party to boot. Fortunately the injured tooth was not painful except with hot and cold fluids, so I lasted the duration of the week. Moral: If you hold a flashlight in your teeth, buy a soft flashlight!!!

At the Winter Lights Star Party out at Elk Island Park, (Alberta), I managed to encounter a new hazard, but with one of those white light Led flashlights. It was a small unit made with an Aluminum body, and it was -20 C. Do you remember putting your tongue on a chain link fence in the winter time? For some reason I didn't at the time, but I was promptly reminded of it as soon as the metal of the body of the flashlight touched my moist lower lip. There it was, dangling, frozen to my lip, promising

exquisite pain if I tore it off! Oh did it burn! I quickly realized that I needed to warm the flashlight in a hurry so it would come off without much of my lip attached to it. I clamped my other lip around it and used my tongue to warm it up, and the flashlight came off with only a bit of my taste buds still stuck to it. (OUCH!) Lesson; beware of metal bodied flashlights in winter!!!

One last hazard with your red light flashlight. I once was exuberantly showing a real cool star off to friends at a star party. The star was T Lyra, a pulsating variable star, and it was at it's very coolest – very very red. The star is located about 2 degrees south from Vega, but I was not exactly sure of its exact location. I was using the Uranometria and a little bit too-bright a red flashlight in hopes of locating it. Did you know that looking at a page illuminated with a red light will photo bleach your retina in the red part of your dark adapted cones? When you look into the eyepiece, you will not see a single red thing in the field of view. Nada! I spent 10 minutes trying to find this gorgeous red star until that particular property of vision occurred to me. Photo bleaching! DOH! Dim down the light! Moral of the story; if you are hunting dim red stars, use a dim red flashlights on your charts and let your eyes adjust.

I hope this article on Red Flashlights was Illuminating, and I also hope to deter you from my follies.

President's Report *by Sherry Campbell*

What to do if you arrive at an observing session and realize you left your counterweights at home.

It's happened to all of us. Well, those that have a refractor, anyway. You arrive at a dark site, it's beautifully clear and warm…for a change…and as you are unpacking your telescope, you realize that the counterweights for your scope are still sitting on the garage floor. Fear not! Here are some (un)proven, possibly helpful suggestions on what you can do and one proven, definitely helpful suggestion on what you should do. You decide which one is which.

- There is plenty of wildlife wherever you are. Rummage around in the bush until you find a suitably sized animal. **Caution!** Ensure the animal is properly secured and muzzled. Those little guys can sure wiggle.
- Fill your toque with snow and secure it to the mount with bungee cords. **Caution!** This will not work well at temperatures near zero degrees Celsius. Over the course of the night, the snow will melt and your scope will not balance properly.
- If you are camping, borrow the water jug from a neighbouring camp and secure it to the mount with bungee cords. **Caution!** Don't swing your scope fast or the water jug will shatter your knees.
- If you are at a star party, wander the field until you find a scope with the same counterweights as you have. Inform the observer that there is a massive TeleVue eyepiece sale going on for the next 10 minutes only on the other side of the field. Once he is gone, steal his counterweights. **Caution!** In order for this to work, you must be the first one to proclaim loudly to all who will listen that the security around here is soooo lax. If theft is not your thing, leave the small animal as trade.
- Find the object you want to look at and then drive your vehicle within millimetres of the scope to prop it up. There are no cautions with this option.
- Find a rock the same weight as your missing counterweights. Use a (small) thermonuclear bomb to melt the rock into slag and while it is still malleable, shape the rock around the counterweight shaft. **Caution!** Beep your car horn twice before setting off your thermonuclear bomb so other observers can shield their eyes from the white light.

Richard Vanderberg is trying the water jug option. In the background, Don Brown is shielding his eyes from someone's thermonuclear device.

Tips from the Past President *by Krista Stefan*

Now that I've had a few months to reflect on my term as President, I'd like to offer to the current President and all who follow the following tips and tricks in dealing with some of the difficult situations that a President may encounter. I hope these are useful.

How to Encourage Quorum for a Meeting with an Important Motion

- Know well ahead of the meeting what constitutes quorum. This information is included in the By-Laws.
- When publishing the motion in Stardust and on the Astro list, explain the importance of the issue at hand.
- Provide proxy forms if appropriate according to the By-Laws.
- Contact key members individually to ensure that they will attend the meeting. This is particularly important if certain members are required for quorum (such as the Executive for Council meetings).
- Schedule something particularly fun or interesting for the meeting – this should be placed *after* the critical vote.

- **Use bribery**. When publishing the motion, announce that there will be particularly tasty treats available after the meeting. Don't forget to actually provide the treats; otherwise the bribery will not work a second time.
- Avoid using threats. This may have the side effect of driving members from the club. Unless this is the desired effect….in which case threats can be very effective.

How to Extend a Meeting When a Featured Presenter Has Cancelled at the Last Minute

- If the cancellation comes a few days before the meeting, get someone to do a "Show and Telescope" or similar presentation.
- Ask the astrophotographers in the group to show some of their latest efforts. As many of them (such as the Noble Mike) come to the meetings either with laptop in hand or with a memory key of images so they can be approached during the meeting. The time needed to load the images into the theatre computer system can also help kill excess time.
- Require any Council members and portfolio holders in attendance to give an update on their activities. Even if they have no activities to report on, it takes time to get them up to the podium to say so.
- Get the Observatory opened for viewing. This only works if it's clear.
- Ask Bruce McWordy to give a "brief" report on anything.
- Have Frank demo the latest planetarium show being considered for the public.
- If all else fails, adjourn the meeting early.

How to Shorten a Meeting Which is Running Late

I have no idea. I've never been successful at this. I don't believe this is possible without isolating the meeting and applying time dilation to the rest of the Universe.

What to Do if There Are Technical Problems During a Meeting

- Shuffle the agenda so verbal reports are delivered while the technical problems are being fixed.
- Offer to re-schedule any presentations that require technical resources to a future meeting. At this point you may want to refer to "How to Extend a Meeting When a Featured Presenter Has Cancelled at the Last Minute".
- Call a brief break for people to chat, collect their Stardust, run to the bathroom, or run out for a quick smoke. This will reduce tension and restlessness in the group.
- Ask Bruce McWordy to give a "brief" report on anything. This will give ample time to fix the problem.
- At this point, you may need to refer to the section "How to Shorten a Meeting Which is Running Late".

MONEY MOTIONS

Moved that $2350.00 from the casino account be used to support the U of A Institute for Space Science, Exploration, and technology Space Academy in 2009, by funding bursaries to offset the costs of the student fees to attend the Academy and to purchase "Build Your Own Telescope Kits" for each child. Subject to Gaming Commission approval.

Moved that up to $2,000.00 (USA) plus shipping and brokerage fees be used from the Casino account to purchase an "Orion EQ-G" computerized mount, and a suitable power supply. To replace the current broken mount on the club 4.7 refractor. Subject to Gaming Commission approval.

Moved to support a "No cost" extension to "Black Nugget Lake Observatory Toilet Building" $2500.00 expenditure from the Casino Account requires Approval for the extension, from The Gaming Commission as it has expired.

Moved that Up to $13,000.00 from the Casino Account be used to purchase "Skyways"; to provide as many grade 9 Alberta Class rooms out of a possible 870 with a copy of the RASC SKYways.

Greek Mythology: A Tale of Two Bears *by Michael Ward*

This is the first article in a series about the stories behind the constellations. My purpose is to tell the stories, and give the oldest sources. The only way we know about ancient myths is if they were written down. The stories themselves were already ancient by the time they were written, and had been retold orally countless times for generations. Numerous variations arose, and seldom do two ancient authors tell exactly the same tale.

The one constellation that just about anyone knows the name of, and could recognize, is the Big Dipper. Astronomers call it Ursa Major. The two words are Latin, and are commonly - and somewhat inaccurately - translated Great Bear. *Maior* is the comparative degree of the adjective *magnus*, meaning *great*, so *maior* means *greater:* the Greater Bear. Greater than what? Greater than the nearby Lesser Bear, or Little Dipper, Ursa Minor. *Minor* is the comparative of *parvus*, (little). Neither of these two characters were bears, originally.

Ursa Major: The form *ursa*, as opposed to *ursus*, indicates that this bear is female. She was at one time a nymph **[1]** named Callisto, a companion of Artemis **[2]**. Her name means *most beautiful* **[3]**. As with many Greek myths, there are several versions of this story, but the following seems to have been the most common. I have indicated some minor variations.

Her name accurately described her appearance, apparently, for she attracted the attention of Zeus, which was usually bad news for females of any sort. One day she became separated from Artemis and the other nymphs, and Zeus saw her. He had seen her before, but never alone. He was instantly inflamed with lust. Disguising himself as Artemis, Zeus approached Callisto.

In one version of the story, Callisto greets Zeus (disguised as Artemis) with something like, "Hail Goddess, greater in my opinion than Zeus!". Zeus embraces Callisto rather too passionately and kisses her. Callisto senses something is not right. Either she realizes this is not Artemis (one version) or Zeus reveals himself (another version). She tries to break free of his embrace, but to no avail; he is too strong. He rapes her then goes on his way. She is no longer a virgin and therefore not qualified to be in the retinue of Artemis.

Callisto finds the real Artemis – at first fearing it is Zeus again - and the other nymphs. Not wishing to be ostracized, she says nothing to anyone. Artemis senses there is something different about Callisto, but can't determine what it is, and doesn't ask. Some of the other nymphs figure it out. Unions with deities are never fruitless. Callisto is pregnant, a fact that becomes increasingly difficult to hide. One day, when Artemis and her band find a secluded pool, they decide to go swimming, naked. Callisto tries to make excuses but the other nymphs forcibly undress her, revealing her by now swollen belly. Artemis expels her. Callisto has a son, whom she calls Arcas.

Hera, the long-suffering wife of Zeus, now steps in. Hera cannot do anything to Zeus, since he is the all-powerful king of the gods, but she frequently takes revenge on the females with whom Zeus has affairs, and/or upon the resulting offspring of those unions. Hera accosts Callisto, and Callisto is polite and respectful, but Hera in her rage doesn't hear anything she says. Hera turns Callisto into a bear. At the request of Zeus, Arcas is raised by Maia, one of the Pleiades (the seven daughters of Atlas and Pleionê).

When Arcas is 15, he is out hunting and encounters a bear. It is his mother, Callisto. She (somehow) recognizes her son, but he just sees a bear who keeps following him. He runs terror, gives up, and turns to attack. He is just about to kill her when Zeus intervenes and places them both among the stars. Callisto becomes Ursa Major, the Great Bear.

Arcas became Ursa Minor in one version of the story. Why a male bear is referred to as *ursa* remains a mystery. Other versions of this story have Arcas becoming Boötes (who is otherwise a completely different character), or the star Arcturus. The Greek word for bear is *arctos* (ἄρκτος). The ancient Greeks also used the word arctos to mean "north", and that's why we do. Arcturus is from arctos+oupos (ἄρκτος + οὖρος), meaning "bear guard".

Sources: Apollodorus, 3.8.2; Hyginus, *Astronomica* 177; Ovid, *Metamorphoses* 2.496-507; Pausanias, 8.3.5-8.4.1

Notes

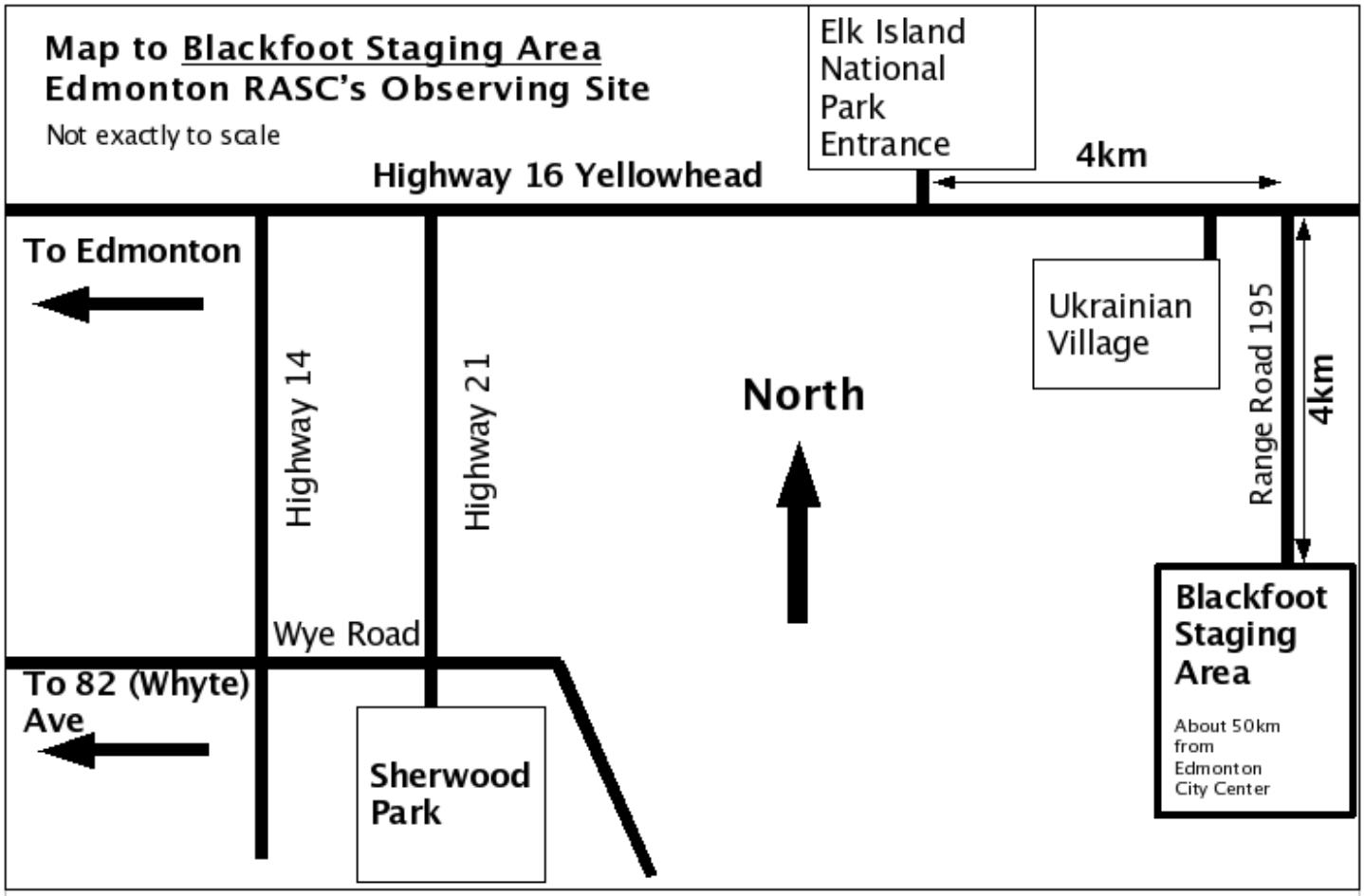
[1] Nymph: a type of lesser deity associated with natural things, and in art generally depicted as human females just on the verge of womanhood, perhaps age 12 to 15. Nymphs were nature spirits, or the "souls" of trees, ponds, streams, valleys, mountains, the ocean - just about anything. The notion of fertility, of life ready to burst forth, is always lurking in the background with nymphs, although in the stories, with few exceptions, they are not much interested in reproduction. Nymphs are frequently pursued by hormone-crazed males. In ordinary parlance, the feminine nymphê (νύμφη), also meant *bride*, the masculine nymphos (νύμφος), *groom*.

[2] Artemis (the Roman Diana): an ancient goddess with a complex character. Artemis was associated with nature, wild animals, and hunting. She was also connected with fertility, which perhaps doesn't quite make sense to the modern mind - she herself was a virgin, and she insisted that all her companion nymphs be as well.

[3] Callisto (Καλλίστω) formed from the superlative of kalos (κάλος), *beautiful*. The word is also recognizable in *callisthenics*, from kalos + sthenos (κάλος + σθένος), beautiful + strength, and *Gallipoli*, from kalos + polis (κάλος + πόλις), beautiful + city.

FOLLOWING PAGE:
Magnetospheres of the Solar System – Summary Table *by Dave Cleary*

Body	Field strength	First detected	Magneto-sphere	Aurora	Dynamo	Stability	Orientation
Sun	1 gauss. (10-4 Teslas). Field strengths in active regions can reach 1000 gauss (0.1 T)	George Ellery Hale discovered magnetic fields (1908) using spectrographs of sunspots that exhibited the Zeeman effect where a spectral line is split when in the presence of a magnetic field.	Yes.		Convection of plasma caused by energy transfer from the interior to the surface. Differential rotation, where material at different latitudes rotate at different rates, also causes induction of magnetic fields in the plasma	Pole reversals every 11 years.	
Mercury	1.1% of Earth's. 0.003 gauss (300 nT)	Mariner 10 – 1974/75	Yes. Bow shock est at between 1.3 and 2.1 Mercury radii. 1000 to 2000 km above the surface. Mercury is 4879 km in equatorial diameter.	No	Iron core in liquid state maintained by solar tidal forces	Some variations detected since Mariner 10 observations.	Bipolar – aligned with axis of rotation
Venus	0.000003 gauss (approx). 10^{-5} that of Earth's field.	Pioneer Venus Orbiter 1980	Bow shock is close to the planet (1.5 R_v) due to the weakness of the field and is related to the position of the ionosphere as this is where the magnetic sheath is generated. Venus is 12,104 km in diameter	Ultraviolet aurora detected on the night side of Venus by the Pioneer Venus Orbiter.	Induced by interaction between ionosphere and solar wind. Magnetosphere is too weak to protect atmosphere from solar wind. Atmosphere is being depleted by solar wind.	Dependent on variations in the solar wind.	
Earth	Strength at the equator - 0.3. 0.6 gauss (3.1×10^{-5} T) at the poles. 58 μT ($5.8\times10-5$ T) - at 50° latitude	Compass first used with certainty by the Chinese in 1000s ACE. Possibly invented by the Olmecs BCE. Measured by gauss in 1835.	Bow shock is 13 Earth radii. Earth is 12,756 km in diameter	Yes and radiation belts	Solid iron-nickel inner core. Liquid outer core	Poles moves slowly over time. Pole reversals occur on avg at 250,000 year intervals	Dipolar – currently aligned at 11 degrees off axis of rotation. Poles wander.
Mars	10^{-4} that of Earth's. Allows direct solar bombardment of surface in N hemisphere. Banded magnetic fields in crustal rock in S hemisphere. Planetary magnetic field subsided ca 4 billion yrs ago	Mariner 4 detected magnetic bow shock in 1964	6,792 km in diameter. Bow shock at 1.5 R_M		Induced by interaction between ionosphere and solar wind. Magnetosphere is too weak to protect atmosphere from solar wind. Atmosphere is being depleted by solar wind.	Dependent on variations in the solar wind.	
Jupiter	14x earth's (8.4 gauss). 4.2 gauss at the equator. 10 -14 gauss at the poles.	Radio emissions detected in 1955, linked to moon Io in '60's. First explored directly by Pioneer 10 in 1973	Bow shock is 75 Jupiter radii (15.4 million km). 142,980 km in diameter. Magneto-tail extends almost to orbit of Saturn.	Yes and radiation belts. Caused by solar wind but also strongly affected or caused by Io. Aurorae also detected by HST on Io, Ganymede and Europa.	generated by eddy currents—swirling movements of conducting materials—within the metallic hydrogen core		Dipolar -Tilted 10 degrees from the rotational axis
Saturn	0.22 gauss. Slightly weaker than Earth's and 1/20th that of Jupiter's	First detected by Pioneer 11 in 1979.	Bow shock is about 28 Saturn radii. Tail extends slightly past Titan's orbit. 120,540 km in diameter	Yes and radiation belts	Currents in metallic hydrogen layer dynamo		Exactly aligned with rotational axis of the planet.
Uranus	(0.25 gauss) at cloud tops at the equator, similar to Earth's. Magnetic moment is about 50 times that of Earth due to size of the planet.	First detected in radio waves by Voyager 2 in 1986. Bow shock detected by Voyager 2 at 20 R_U (600,000 km) from the centre of the planet.	Bow shock is approx 20 R_U. Magnetosphere is corkscrew shaped and extends about 10 million km. Planet is 51,120 km in diameter.	Yes. Also radiation belts similar in strength to Saturn's	Originally thought to be generated at shallow depths in a water/ammonia ocean, now deemed to be unknown. Source is 1/3 R_U offset toward south rotational pole.		Tilted 59 degrees from axis of rotation.
Neptune	0.15 gauss. Weaker than Uranus. 1/3 that of Earth's.	Voyager 2 in 1989	27 RN. Magnetotail extends 72 R_N. Quadropole field like many magnets arranged on a table. 49,530 km in diameter	Yes. Also radiation belts	Unknown. Source is ½ R_N from centre of planet.		Tilted 47 degrees from spin axis.


Map to Blackfoot Staging Area
Edmonton RASC's Observing Site
Not exactly to scale
Elk Island National Park Entrance
4km
Highway 16 Yellowhead
To Edmonton
Highway 14
Highway 21
North
Ukrainian Village
Range Road 195
4km
Wye Road
To 82 (Whyte) Ave
Sherwood Park
Blackfoot Staging Area
About 50km from Edmonton City Center