PETERBOROUGH ASTRONOMICAL ASSOCIATION

THE REFLECTOR

Volume 1, Issue 9 September 2002

Editorial

September is now here and the newsletter is back after it's two month holiday. This past summer was fantastic for observing as we ended up with several clear night's when the moon was not visible. I hope you all got some time to take advantage of this, as transparent skies are sometimes a rarity in the summer.

On the August long weekend, the club had it's first annual "Star Party" courtesy of John Crossen and the Buckhorn Observatory. The weather for the event was excellent for the first night, and the second night was ok for naked eye observing only (unless you owned a Kendrick Dew Removal System). More details inside.

As we get into the swing of things again, we will be bringing back the "Beginner's Nights" at Armour Hill. These nights are intended to help beginners learn the sky by actually viewing it with the help of other more experience amateurs. These nights will occur after the meeting on night's will little or no moon visible. The first one will occur on October 4th. If the weather is not corporative, we will meet at the Zoo as normal, but there will be a talk oriented to beginner astronomers.

Next month's deadline for articles will be a week earlier than normal, because I will be moving to a new home during the week of the October meeting. Please try and give me your articles before **September 20th**, so I can assemble them in time for the October 4th meeting.

Clear Skies

Charles W. Baetsen
va3ngc@rac.ca

Mike and Ellen Ricks along with Grandson Jad and Aunt Sandy arrived Friday afternoon and had their "tent city" up and running shortly thereafter.

PAA's Summer Observing Run Enjoyed by Many

About a dozen PAA club members, their families and friends came together under the stars on the recent August long weekend. Also attending were local cottager/astro buffs and members of the South Simcoe Amateur Astronomers. The Run was held at Buckhorn Observatory, with the surrounding grounds open for camping and telescope setup.

Friday night's observing was superb with very little haze and no clouds. But Saturday was the big day, with an evening (dare I say it) star-b-cue, and plenty of scope talk, plus a reasonable night's observing. Both nights were open to the public, but Saturday night brought in the

Inside This Issue

The Bowe Scope is up and ready for Rene

most guests, with about 20 budding astronomers hopping from scope to scope.

Highlight of the weekend was getting George Bryant's Meade GPS scope up and running. In all honesty, we have Gord Simpson, a local cottager and Celestron GPS owner to thank for that. Other than Gary Gauthier, none of the club's other members have gotten that "techy" - yet. Also visiting was Jim Kendrick, known for his dew removal systems that are sold worldwide. Jim brought with him tales of Stellafane, Riverside, and a neat little 8-inch Port-a-Ball telescope, which he also just happens to sell - nudge, nudge, wink, wink.

Saturday night eventually clouded over about 1:00 a.m. So we "downed scopes", rolled the roof on the observatory closed and opened a few beers - just to console ourselves. Talk then turned to next year's Observing Run, organizing speakers for upcoming club meetings and group astronomy tours. About 3 in the morning the last droopy-eyed astronomer toddled off to bed.

The public's reaction to the Observing Run was very positive and we received many "thanks" at the end of each night. People were as surprised at the different types and sizes of telescopes available, as they were delighted with the views through them. Many guests also mentioned their appreciation of the knowledgeable advice they were given with respect to scopes, books, star charts and accessories.

So are these two studying a star chart or a recipe for fudge brownies? I'll vote for the brownies.

Our thanks to John and Debbi Crossen for hosting the event. We also greatly appreciate the work of Charles Baetsen for helping to promote the event to club members, Lyn Jackson, Rick Stankiewicz and Ellen Ricks for their culinary contributions, Mike Ricks for his mini-brochure, and everyone who setup a scope and helped with the sky tours. Let's do it again next year. With a little more lead time, more members can plan the event into their schedules. That can only make the gathering bigger - and even better.

John Crossen
JohnCstargazer@aol.com

Atmospheric Refraction And Extinction Of Starlight

When light from a star enters the earth's atmosphere several things happen to it. Because the speed of light in dense air is slower than its speed in thin air, the light will change direction as it moves through the atmosphere. We call this refraction of light. The brightness of the light will also diminish due to its scattering with the air molecules, water vapour and dust. In this article we will first discuss how the apparent altitude of a star (that is, its angular height above the observer's horizon) changes because of refraction relative to its true altitude as would be seen in the absence of air. As shown in the accompanying figure, the star's apparent altitude is always greater than the star's true altitude when the density of air increases as you

Peterborough Astronomical Association

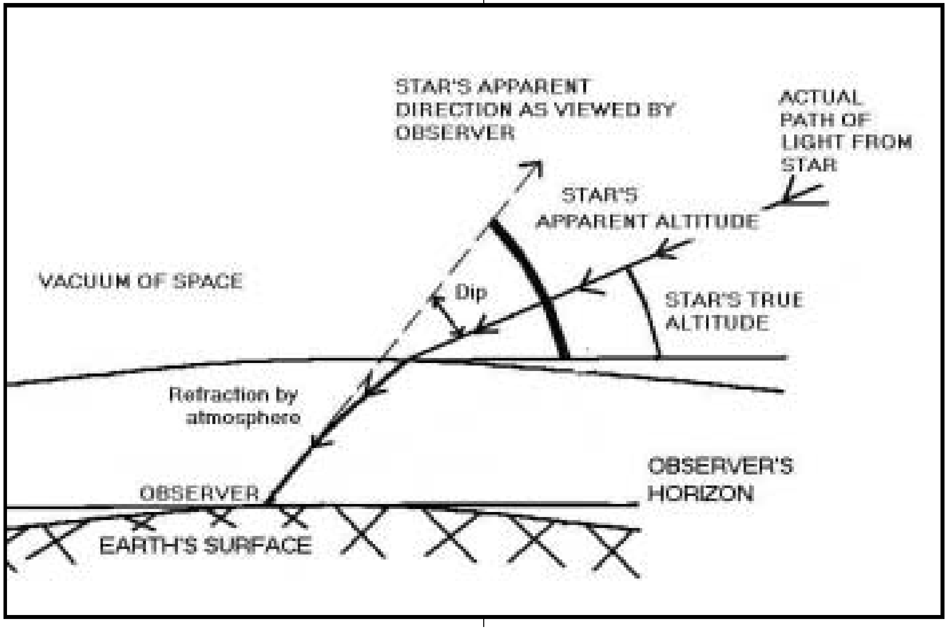
The Reflector is a publication of the Peterborough Astronomical Association (PAA). Founded in 1970, the PAA is your local group for astronomy in Peterborough and the Kawarthas.

Website
www.geocities.com/paa_ca

Email
paa_ca@yahoo.com

Club Mailing Address
c/o Dave Duffus
7 Riverview Hts.
Peterborough, ON, Canada K9J1A9

get closer to the earth's surface. The difference between the apparent altitude and the true altitude in the figure will be called the **dip** because the star is actually below where it appears. In the table below we show the amount of this dip for several apparent altitudes of a star.



Atmospheric Refraction on Starlight

These were calculated for a standard model of the density of air versus height including the effects of the curvature of the earth's surface. It is useful to keep in mind that the diameter of the Sun is about 31 minutes of arc so that a dip of 5 minutes of arc corresponds to about 1/6th of the Sun's diameter. The greatest dip is 35 minutes of arc and occurs, for example, when a setting star is barely visible above your clear horizon. The apparent altitude of the star is zero at this instant. The star has a true altitude of 35 minutes **below** your horizon. Conversely the least dip is 0 minutes of arc and occurs when the star is directly above you and both its apparent and true altitude is 90 degrees. In this case there is no bending of the light, since the light is entering the atmosphere at a right angle.

Another effect of the atmosphere is to reduce the brightness of stars as its light is scattered by the air on its journey through the atmosphere to the earth's surface. For a clear sky at night about 80% of the star's light will reach the earth's surface. This reduction in the starlight is called atmospheric extinction and is measured in stellar magnitudes or air masses. An extinction of 20% represents a magnitude difference of 0.2 so that this is the value in the bottom row and third column in the table. As the apparent altitude of the star decreases both the magnitude extinction and number of air masses increases because the light has to travel a greater distance through the atmosphere. The fourth column in the table represents this greater distance as an increase in the number of air masses. The idea is that light from a star directly overhead, with apparent altitude 90 degrees, would pass through the **least** amount of air so this thickness of air is called **one air mass**. Light from a star with apparent altitude of 30 degrees however would be passing through 2.0 air masses or double that for a star overhead. Light from a star with altitude 0 degrees would have to pass through 36 air masses. This means that the Sun as seen at sunset would appear the same at noon, high in the sky in summer, if the earth's atmosphere were 36 times thicker. A star directly above you with apparent magnitude +2 would have an apparent magnitude of +9 (= +2+7.2 –0.2) when it sets on the horizon because of extinction and so would be unseen with the naked eye. The values of these magnitude extinctions or air masses should be considered ***minimum*** values since the more smoke, dust and especially water vapor in the air the greater the **increase** in the rate of extinction. This is the reason clouds and fog block light so well. The transparency of the air can dramatically decrease and consequently the star's light extinction or number of air masses could be further multiplied by a factor anywhere from 1 to 10 or more.

One consequence of this extinction from the table is that the brightness of the setting sun is at least 6 magnitudes fainter than the sun at noon so the setting sun is

Star's Apparent Altitude (degrees)	Dip (Minutes Of Arc)	Light Extinction (Magnitudes)	Number Of Air Masses
0	35	7.2	36
1	24.3	5.4	27
5	9.9	2.1	10.4
10	5.3	1.1	5.6
30	1.6	0.4	2.0
45	0.9	0.28	1.4
60	0.5	0.23	1.15
90	0.0	0.20	1.0

about 1/250th as bright as the Sun at noon. (Note: a magnitude difference of 5+1=6 equals a brightness ratio of 100*2.512=251). Similarly a full moon high in the sky is about 250 times brighter than at moonrise or moonset. The values in column 2, 3 and 4 of the table depend on the colour of light but the values given are averages for visible light. Blue light has a much higher rate of extinction than red light. This is the reason the sky is reddish at sunset since the number of air masses is so large and the atmosphere is more transparent to red light than blue light. The blue light has largely been extinguished and so it is not visible. On the other hand, when the Sun is low in the sky, the sky is bluest about 90 degrees from the Sun. It is here that the blue light is scattered sideways the most toward us compared to less scattering of the other colours. The bluer the sky the clearer the sky as well. When the atmosphere contains a lot of water vapour the sky tends to be whitish since most colours are equally blocked leaving the white colour. Finally, the twinkling of stars is due to the passage of starlight through many pockets of air with slightly differing temperatures causing the light to refract away from and toward our line of sight.

Anton Jopko
amj@kwic.com

The Sky This Month

MERCURY:

Mercury reaches it's greatest elongation east on September 1st, but it will not be easy to observe.

VENUS:

Venus is the brightest object in the night sky this month. It reaches it's greatest brilliancy on September 26.

MARS:

Mars will not be visible this month.

JUPITER:

Jupiter will be in Cancer and appears as the second brightest object at night. It will visible in the early morning hours before sunrise.

SATURN:

Saturn will be viable after midnight near the Taurus-Gemini boundary, not far away from the Crab Nebula (M1).

URANUS & NEPTUNE:

Uranus and Neptune will be visible in throughout much of the night in the constellation Capricornus.

PLUTO:

Pluto is visible in the evening hours in the constellation Ophiuchus near η-Oph. A large telescope (≥8") is needed from a dark sky to see this planet. At mag 13.8, this illusive object is on the verge of invisibility, so a good chart (like that in the Observer's Handbook or Sky and Telescope) is needed to confirm it's sighting. Ideally this planet should be viewed over a number of days to detect movement across the starry background.

METEOR SHOWERS:

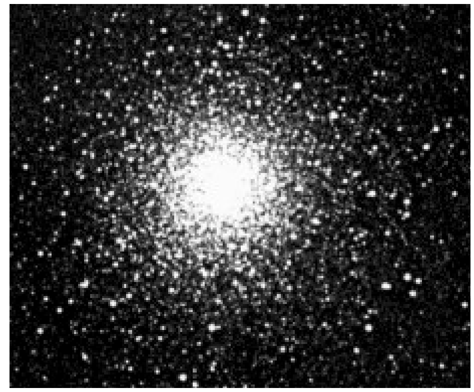
There are no major showers this month

There are several minor meteor showers this summer. For details on these see *http://comets.amsmeteors.org/meteors/calendar.html.*

Off the Beaten Path

Well summer is soon drawing to a close. In September we again can see such familiar constellation such as Andromeda, Pegasus, and Aquarius. The following is a list of often overlooked objects visible in these and other constellations this month.

M10 & M12: These are two fine, almost naked eye globular clusters in Ophiuchus. These are so bright, that I have seen them through a 6" reflector from within the city! The trick is to find the guide stars that point to them. Don't be afraid to try for these with binoculars from your backyard.



M10 in Ophiuchus

NGC 6210: This planetary nebula is located roughly 2/3rds the way from Delta to Beta-Her. Not described in Burnham's Celestial Handbook, it is nevertheless a good planetary to view in a 6" scope.

M54: This small but bright globular, located in Sagittarius has a total integrated magnitude of 8.7. Although it may seam like just another globular, it is special. It is the only bright globular that is probably not associated with our galaxy. It is associated with a recently discovered satellite galaxy (see S&T, August '94) which is almost completely obscured by the bright Sagittarius Milky Way. Had this galaxy not been in the plane of the Milky Way, it would be one of the largest objects in the sky, covering almost 10 degrees.

M22: Just north of Lambda-Sgr, M22 is an easily resolved object in a 6". It makes a great target for those of you who own (or can borrow) some Nagler eyepieces. It is actually brighter than M13 in Hercules. This is one of those objects that one can stare at all night.

NGC 7009: Known as the Saturn Nebula because of two appendages that stick out from either side, it is wonderful planetary to observe in a 10" or larger scope. A 6" scope will reveal its featureless disk, but the appendages will not be visible. It is located about a degree away from Nu-Aqr and has a magnitude of 8.

NGC 7293: The Helix Nebula. This is big, covering as much sky as half of a full moon! Because of its size, it has a low surface brightness. An OIII filter will help bring it out of the dark. It also shows well in binoculars under extremely dark skies. Although in pictures it resembles the famous Ring Nebula, it appears more like a faint disk with a little brightening near its outside edges.

NGC 7293- The Helix Nebula

NGC 253: Last but not the least in splendor. This is probably the easiest spiral galaxy to observe other than M31. it is located 7.5 degrees south of Beta-Ceti. It is easily found in binoculars and is beautiful in an 8" or larger scope (having a mottled appearance).

So on the next clear night, be adventuresome and go off the beaten path and enjoy the new scenery.

Charles W. Baetsen
va3ngc@rac.ca

Observe More Often- More Easily, With A Backyard Pier

Building a backyard pier for your telescope doesn't have to require a degree in landscaping, 10 cubic yards of cement and excavating a small mine shaft. Indeed, a pressure treated 6"X 6", a 2-foot square concrete patio slab, a spade and three 5-inch long bolts are all that's needed. The result of these easily affordable pieces and a couple hours of easy work will pay off handsomely when it comes to enjoying more time at the eyepiece. No need to lug the tripod and scope out. No more polar alignment headaches - you're already aligned. Just pull the cover off, pop in an eyepiece and let the countdown begin.

Step one is to select a spot to set up your pier. A large open area with good view of the sky and minimal or no surrounding lights is preferable. If you can locate near a door to the house, it makes warming up a bit easier in the winter. My first home pier was built through a deck next to our garden shed. In winter the shed did double duty as a warm-up room thanks to a kerosene heater.

The basics - a drill with masonry bit, cement patio slab and three 5-inch wood bolts.

Building your pier isn't hard. Simply cut a 6"X 6" to the appropriate height for your scope. Remember to allow for the depth of the hole and the extra height of the mount or equatorial wedge.

Carefully mark the outline of the 6 X 6 in the centre of the slab

The next step is to drill three holes through the concrete patio slab, with that accomplished, bolt the pier firmly to the slab.

Drill your screw holes through the slab. A Black & Decker Workmate cranked open about six inches will support the slab and give access for drilling. When you're done drilling the slab, change to a wood bit, place the 6x6 in position and pre-drill the bolt holes in it. A lovely and talented assistant to hold the 6x6 will make the job easier.

Attaching your mount to the pier will depend on the mount itself. For an equa-

Bolt the slab to the 6x6. I used large spacer/washers with each bolt to spread the pressure when tightening the bolts down.

torial wedge, a large hanger screw with a plastic knob to tighten it down is all that's required. A German Equatorial Mount will call for a bit more ingenuity. The one here was created from 1" X 6" sections with a recessed area and a central hole drilled in it so that the mount could be attached. Do make certain that the mounting provisions are adjustable so that you can do a polar alignment.

Dig your pier pit down about 8 inches and level the bottom. Save the sod for the final step.

The final step is to dig a square hole about 8 inches down and large enough across to accommodate the concrete slab. Make certain the bottom of the hole is level, then drop the pier and slab into the hole and cover it over. Give it a final tamping down and that's it. You're done.

Drop the pier in, tamp the sod down and you're ready for lift off

I've found such a pier to be stable enough for short duration astrophotography. I have also been amazed that the pier isn't greatly affected by freezing weather or the ground heaving. And with no excuses like it's too much work setting up, I've enjoyed a lot more telescope time.

John Crossen
JohnCstargazer@aol.com

The "Boxless" Dobsonian

The best telescope to have is the one you will use the most. If you are like me, the one you use the most, is one that is the lightest (for it's size) and the easiest to assemble at the observing site. For this reason, I decided to construct a Dobsonian telescope. Dobsonians are simple to build and easy to assemble at the observing site. One of the features of the standard Dobsonian that I did not like, was the heavy rocker box that surrounds the main tube. One way to get around this problem is to construct declination bearings that can be mounted directly to the tube without the use of the rocker box. This type of construction can be seen in many manufactured Dobsonians, like those from Orion, but you don't have to buy one to get this type of bearing—you can build it yourself!

These type of declination bearings can be easily made from PVC end-caps, available from any hardware store. As you can see from figure 1, the intersection curve of the bearing and the tube is not simple. It turns out that the curve of intersection is the familiar sine curve, but which one?

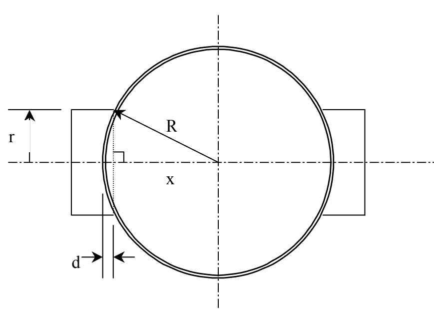


Figure 1: End View of Main Tube

In order to determine this, you will need the outside radius of the main tube (*R*), and the outside radius of the declination bearing (*r*). All sine curves have an amplitude (half the distance from highest point of the curve to the lowest). Clearly from figure 1, the amplitude is d/2 (half the distance between the center of the bearing and a chord passing through the top and bottom portions of the bearing as viewed from the end of the telescope).

Using the good old Pythagorean theorem, it can be seen that the depth (*d*) is given by:

$$d = R - x = R - \sqrt{R^2 - r^2}$$

Since we know *R* and *r*, we now know *d* as well.

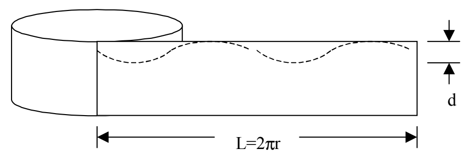


Figure 2: Template for Cutting Bearing

Now for the trick! It turns out that if one were to unwrap the bearing as seen in figure 2, the intersection curve would be 2 cycles of a sine wave with a amplitude of *d/2*. This gives us a nice way for generating a template to cut the required material away so that the declination bearings will fit snug to the telescope tube.

From the above diagram, it can be shown that the equation of the required curve is:

$$y = \frac{d}{2}\sin\left(\frac{4\pi s}{L}\right) = \frac{d}{2}\sin\left(\frac{2s}{r}\right)$$

,where *s* varies from *0* to *L* (or *2 pr,* the circumference of the bearing).

The easiest way to generate the above

template is to plot the above equation to scale on graph paper or using spreadsheet software.

Figure 3: Finished Declination Bearing

Now that we got over the math, the rest is simple. Cut the top part of the template away (above the sine wave). Wrap the template around the end cap. Mark the curve on the end cap using a permanent marker, then cut and sand. The result should look like figure 3 above. It should fit snuggly against the main tube. Make another one and then drill a hole through the center of each bearing and bolt them 180 degrees apart on either side of your main tube. You will want to bolt them at the balance point of your tube (with an eyepiece and all finders mounted) so that you will not have to add counter weights.

When selecting end-caps for use as declination bearings, pick the largest size available. The larger the bearings, the less sensitive to balance the scope will be.

Clear Skies,

Charles W. Baetsen
va3ngc@rac.ca

Classifieds

For Sale:

Slip on bracket for 50 mm finder with shoe - $15

Celestron Piggy-back Mount - $15

Manfroto 410 camera/slow-motion mount - $200

Bausch & Lomb 4000 Series Telescope: Fork-mounted with R.A. motor drive - $325 Includes: Star diagonal, 6x30 dovetail finder, visual focal reducer, 120V cord, all original owner's manuals, camera adapter piggy back mount, table-top screw-in legs (adjustable for polar alignment), hard shell carry case.

Contact: John Crossen
Phone: 705-657-7718
E-mail: johncstargazer@aol.com

For Sale:

Meade 1.25” 90° star-diagonal for Schmidt-Cassegrain Telescopes . Asking $55.

Crystal Controlled Drive Corrector. Powers any 110 Vac clock driven scope from any 12 Vdc power source. Has fast and slow motion controls and dec motor relays. Asking $100.

Contact: Charles Baetsen
Phone: 705-876-0986
E-mail: va3ngc@rac.ca

Time Travel

And away we go again, back into time to see what happened in astronomical history during the merry month of September.

Sept 9 - E.E. Barnard discovers Jupiter's moon Amalthea in 1892
Sept 10 - Surveyor V lands on the Moon in 1967
Sept 11 - Mars Global Surveyor arrives at Mars in 1997
Sept 12 - Russia launches Luna 2 in 1959
Sept 13 - Space shuttle Enterprise takes its second glide test in 1977
Sept 14 - Gemini 11 docks with Agena Booster rocket 850 miles up in 1966
Sept 15 - TV series "Lost In Space" premiers in 1965
Sept 16 - STS Atlantis launched in 1996
Sept 17 - William Herschel discovers Saturn's moon Mimas in 1789
Sept 18 - Voyager takes a photograph of Earth and the Moon from outer space in 1977
Sept 19 - Israel launch its first satellite in 1988
Sept 20 - Werhner von Braun arrives in U.S. in 1945
Sept 21 - Mariner 10 flies past Mercury for the second time in 1974
Sept 22 - Pioneer 10 exits our solar system in 1990
Sept 23 - J.G. Galle discovers Neptune in 1846 and "The Jetsons" premiers in 1962
Sept 24 - Luna 16 robot returns lunar soil samples in 1970
Sept 25 - Mar Observer launched in 1992
Sept 26 - Venus achieve greatest brightness for the year 2002
Sept 27 - Mercury comes between Earth and the Sun (inferior conjunction) 2002
Sept 28 - Saturn is 3 degrees south of the Moon in 2002
Sept 29 - Salyut 6 space station launched in 1977
Sept 30 - NASA and RASA sign agreement to share astronauts and cosmonauts in 1992

John Crossen
JohnCstargazer@aol.com

ARTICLES

Submissions for *The Reflector* must be received by the date listed below. E-mail or "sneaker-net" (i.e., floppy disk) submissions are preferred (Microsoft Word, ASCII and most graphics formats are acceptable). 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 this address:

Charles Baetsen
244 Ridgewood Rd.
Peterborough, ON
K9J 8A3

or via e-mail at:
va3ngc@rac.ca

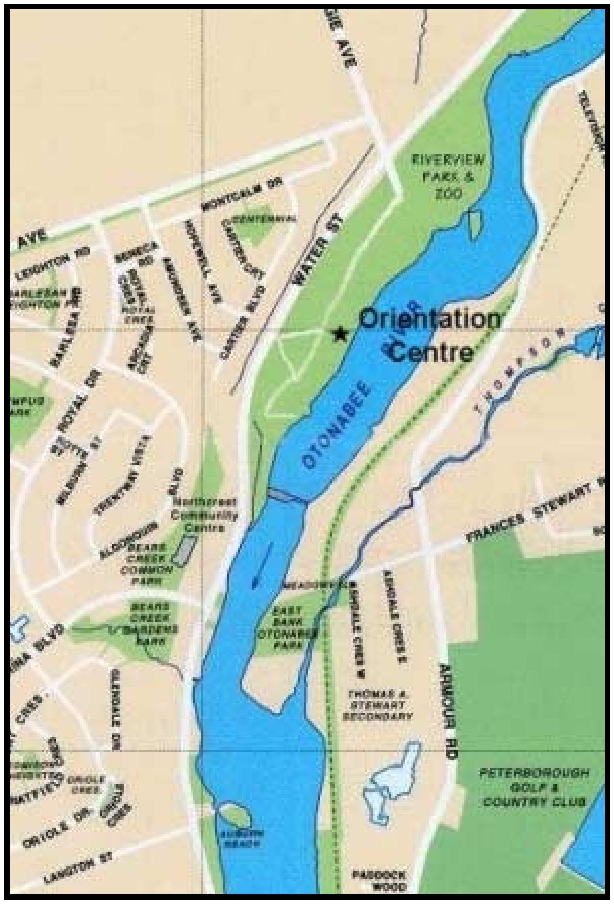
NEXT ISSUE'S DEADLINE IS

Sept. 20th, 2002

⌘

MEETINGS

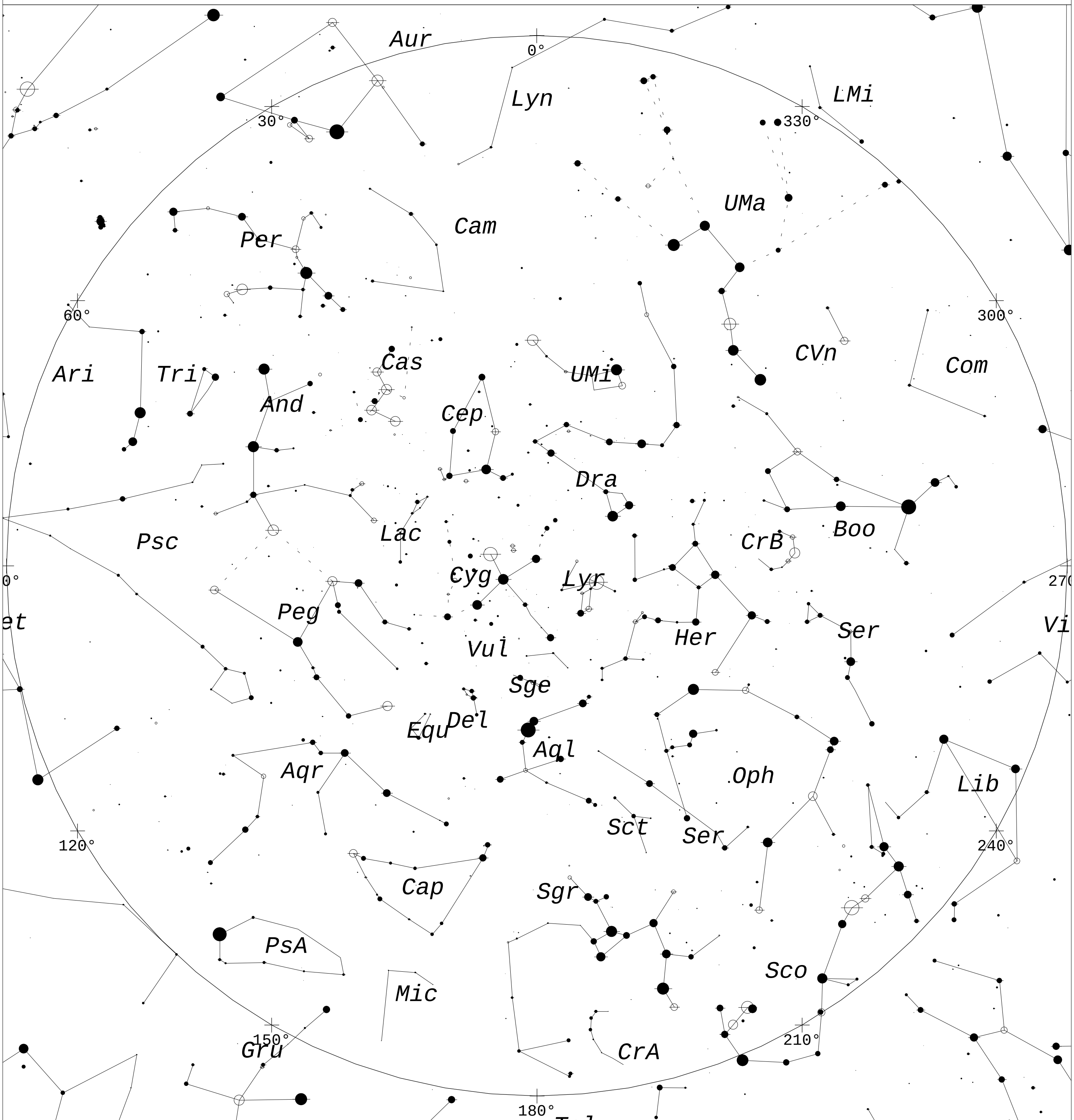
The Peterborough Astronomical Association meets every second Friday at the Peterborough **Zoo Orientation Centre** (Next to the PUC Water Treatment Plant) at **7:30 pm**.



CALENDAR OF EVENTS

September 6, 2002	**New Moon (●)**
September 6, 2002, 7:30 pm	**General Meeting** — TBA
September 13, 2002	**First Quarter (☽)**
September 20, 2002	**General Meeting** — TBA
September 21, 2002	**Full Moon (❍)**
September 29, 2002	**Last Quarter (☾)**
October 4, 2002	**General Meeting** — Topic TBA, with observing session afterward at Armour Hill

September Skies



STARS

- <1
- 1.5
- 2
- 2.5
- 3
- 3.5
- 4
- 4.5
- >5

SYMBOLS

- Multiple star
- Variable star
- Comet
- Galaxy
- Bright nebula
- Dark nebula
- Globular cluster
- Open cluster
- Planetary nebula
- Quasar
- Radio source
- X-ray source
- Other object

Local Time: 21:00:00 1-Sep-2002
Location: 43° 39' 0" N 75° 0' 0" W

UTC: 02:00:00 2-Sep-2002
RA: 19h44m13s Dec: +43° 38' Field: 182.0°

Sidereal Time: 19:44:12
Julian Day: 2452519.5833