PETERBOROUGH ASTRONOMICAL ASSOCIATION

THE REFLECTOR

Volume 1, Issue 8 June 2002

Editorial

Well it is a good thing that I did not start this month's newsletter until after last meeting. In fact the morning after the last meeting, I discovered to my horror that my computer's power supply and hard drive were burned out, presumably from a voltage spike during a lightning storm the day before. Fortunately I had almost everything I needed backed up. However, if anyone out there has a Western Digital Protégé 20.0 GB (model # WD200EB) drive for sale (or rent), let me know, as I might be able to use it to recover my old hard drive (it looks like only the PC board is dead).

Since summer has arrived, I will be taking a break from producing the newsletter until September. This should give you lots of time to write those most excellent articles. With out your contributions you would have to read my drabble every month. I would like to thank the following members who contributed to the newsletter since it's inception: John Crossen, Rick Stankiewicz, Will Juodvalkis, Jaan Teng, Rob Fisher, Peter Shewchuk, and Lyn Jackson. I also would like to thank those people who let me "lift" their articles from other astronomy club newsletters.

When your not spending time writing articles for the newsletter, you can take advantage of the many good opportunities for pursuing our hobby that summer brings. As you might well know, the summer sky can be one of the most beautiful astronomical sights you can see. One way to get out and see the summer sky the way it was meant to be, is to attend one of the many "star parties" held in the area.

The best known of these star parties is **Stellafane** held in Springfield, Vermont.

Summer is here and so are the Star Parties. Pictured above is the Pink Club House on Breezy Hill, the heart of the Stellafane Convention.

This is the "Mecca" of all star parties and is one of the oldest, with the first summer convention occurring in July 1926! With it only being a 8 or 9 hour drive away, I highly recommend attending it at least once. This year the Stellafane Convention will be held on the weekend of Aug 9th and 10th. This year's speakers include David Levy, Carolyn Shoemaker (of Shoemaker Levy-9 fame). John Dobson (creator of the Dobsonian mount) is also scheduled to attend. He usually there to help people grind their mirrors. The swap meet, where you can find those hard to find astronomical equipment, is well worth the price of admission. For more information see their web page at *www.stellafane.com.*

For those of you who do not want to travel as far, Canada also has it version called **Starfest**. This star party is held by the NYAA in Mount Forest (1 hour north of Guelph on Hwy # 6) on the same

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weekend. The talks this year look fantastic. This years line up includes Terrance Dickinson (author of *Nightwatch*) and Steven James O'Meara (author of *The Messier Objects*). I would highly recommend attending this one. It boasts magnitude 6 skies and provides an opportunity to view the night sky through almost any type of telescope. See *www.nyaa-starfest.com* for more information.

These are not the only star parties available in this area. Here is a brief list:

Gateway to the Universe held in North Bay on July 12 to 14th. See *www.gateway-to-the-universe.org* for more details.

Belleville/Bon Echo Astronomy Day held in Bon Echo Provincial Park on July 13. See *www.bellevilleastronomy.ca*

Great Manitou Star Party held in Gordon's Park on Manitoulan Island on Aug 12-18. See *www.manitoulin-link.com/starparty* for more information.

Huronia Star Party held near Alliston on Sept 5-8. See *www.cois.on.ca/~ssaa* for more details.

Hamilton Amateur Astronomers Star Party (HAASP) held in Bancroft on Sept 6-7. See *www.amateurastronomy.org* for more details.

On June 15th, the club will be going to the David Dunlop Observatory in Richmond Hill. Cost is $5.00 and the show begins at 10:00 pm. Contact Dave Duffus for more details.

Clear Skies

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Partial Eclipse of the Sun

Mark June 10th on your special events calendar, as this will be the last chance you will get to see a solar eclipse of any kind from southern

A Partial Eclipse from December 25, 2000, when the sun was about 20% eclipsed Photo taken by the author.

Canada until May 20, 2012. If we are blessed with clear skies around sunset you will have an opportunity to see the moon cover up to 20% of the sun's disc from 8:31 until the sun sets at 9:01 local time. Less of the sun will be covered by the moon, the further east and north you are. The best we can expect to see around Peterborough will be an orange disc with a nice bite out of it.

The attached photo shows an example of what you can expect to see on June 10th just before sunset. If you are lucky, you may be able to see a few large "sunspots" on the solar disc, like this photo. (This photo was taken from Peterborough on December 25, 2000, when the sun was about 20% eclipsed and there was lots of sunspot activity.)

Do not try to look directly at the sun unless you are properly equipped. This means using #14 welders' filter or special solar filters made of aluminized Mylar, black polymer or metal-coated glass. Do not mess with the infrared or ultraviolet light of the sun, as the damage they can cause can be permanent!

Prepare and plan for a view that everyone talks about but few actually see. There will not be a noticeable darkening of the sun apart from a normal sunset, but this will not diminish the event for those that are prepared to watch. So take sometime and scout for a view of a clear western horizon, get your solar filters dusted off, pull up a chair and enjoy!

Happy viewing,

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So Was My First Love Astronomy Or The Girl On The Cover Of The Textbook?

The other night I was thumbing through the bookcase in our bedroom searching for a literary sleeping tablet. Just a little something to send me off to dreamland. After a few moments of drifting, my hand came to rest on a book entitled, *All About the Stars*. It was my first astronomy book. Purchased for me by my parents when I was ten. On the cover was a drawing of a boy about my age at the time and a blonde girl with a pony tail. I remembered how I had a crush on that girl, despite the fact that she was only, as they say in the small print on new home ads, an artist's concept. At any rate, if that's what piqued my interest in astronomy, some good did come of it.

I fluffed up my pillows, stretched out, and began reading. I was surprised to

Peterborough Astronomical Association

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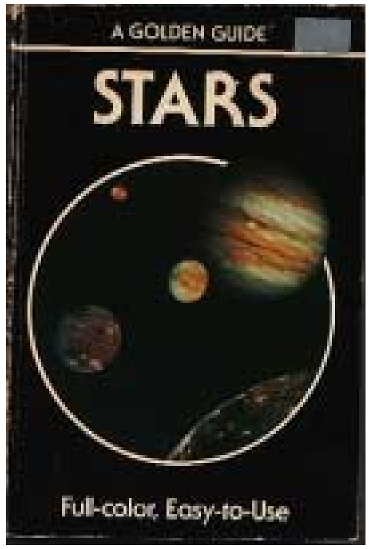

***All About the Stars* and *The Golden Guide to the Stars* were my earliest recollections of being interested in astronomy and space travel. Missing and presumed lost in a storage box, is my all-time favorite title - *Miss Pickrell Goes To Mars*. Do any of you remember these books?**

find that it was all quite interesting. In fact I read half the book before putting it down and flicking off the light. As I lay there in the dark I mused at how current the book was - especially for its publishing date of 1954. With the exception of Mercury's rotational period - they still maintained that it revolved only once per orbit - all of the information was still valid. I even learned a few things. Like the width of Moon's shadow as it crosses the Earth during a solar eclipse is 166 miles. And an eclipse can last a maximum of 7 minutes.

The section on the Moon was somewhat amusing because they were forecasting that we'd be traveling there someday - when our rockets were big enough. Little could they have imagined that just three years after the book was published Russia's Sputnik would be orbiting Earth or that in 14 years Apollo 8 Astronauts would be photographing the Earth as it orbited the Moon. How surprised they would have been to know that on July 20th of 1969, Neil Armstrong would make the first human footprint on the lunar surface and shortly thereafter Astronaut Alan Shepard would be playing golf there.

As I drifted off to sleep I thought about how far we had come in our journey to the stars. Sadly, that wasn't very far. Once the space race was over, interest - and funding - had fallen off. Still we have a space station now, just like in those old science fiction movies. And the exploration of space is truly an international effort with archenemies Russia and the U.S. now working side-by-side.

But we haven't been back to the Moon in nearly 30 years. In fact December of 2002 will mark the 30th anniversary of our last manned mission to the moon with Apollo 17. Somehow I had hoped that we'd be living on the Moon by now and that our space station would be a launching point for manned exploration of Mars. Instead we're still Earthbound and flicking expensive robo-toys at the red planet - and with an alarmingly poor success ratio.

Finally the sandman won out. But as I dropped off, one last thought trickled through my mind. If that girl on the book's cover had been real, I wonder what would her name have been?

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Off the Beaten Path

For those of you who have seen all 110 Messier Objects, you might have asked yourself “Is there life after Messier?” The answer to that question, is of course—YES! The Astronomical League puts out a booklet called the “Observe the Herschel Objects”, which describes the 400 (of the 2700+) brightest Herschel objects visible in detail. See *www.astronomicalleague.com/herschel.htm* for more information..

The following is a list of Herschel objects visible this month. All of these objects can be viewed in a 6" or larger scope from any suitable dark site.

NGC 6144 in Scorpius

NGC 6144 - Located in Scorpius, this globular is a wonderful sight in a wide field eyepiece that will show Antares and M4.

NGC 6284 - This globular is much brighter (mag. 9.0) than most of the rest of the Herschel objects in this region. It is located in Ophiuchus roughly 2 degrees north of the bright globular M19.

NGC 6287 - At magnitude 9.2, this globular is located on the ecliptic another 2 degrees north of NGC 6284 in Ophiuchus.

NGC 6235 - This faint globular (mag 10.0) is located approximately 12 degrees west of NCG 6287 above.

Picture a Conjunction?

Venus and Moon on February 2, 2000

With all the nice opportunities to record a planetary conjunction this season and in the months to come, why not give it a try? It may be easier than you think. If you have 35 mm single lens reflex camera (SLR) you are well under way to doing the job. Armed with a tripod, fast film (400 ASA or higher) and lenses of choice (e.g. 35, 50 or 135 mm) you just need a setting that will do your subject justice. With the upcoming conjunction of Jupiter and Venus on June 3rd, why not consider trying to capture the event?

When the sun has set and the sky is darkened enough to show a nice contrast between the planets and the horizon, you are ready to start taking pictures. Don't be afraid to take lots of pictures, but make sure you "bracket" or vary your exposures to ensure success. I have found that without fail, the best way to increase your percentage of good images is to meter for the skies exposure reading using the cameras light-meter, but "underexpose" by 1 or 2 f/stops. If you do not do this, the pictures will usually be too light (bright) because the light-meter does not know that you require more contrast for your bright planets to show up. You will save lots o film this way. If you can use 1/2 f/stops, do this as well.

The attached photo shows the close conjunction of Venus and Moon on February 2, 2000. That morning the planet and moon were about a degree from each other. This is close! In this case 1,000 ASA Kodak Royal print film was used with a 135 mm lens f/4.8 and 1/15 second shutter speed) on an old Canon SLR camera. On June 3rd , Jupiter and Venus are going to be 1.6 degrees apart and that will be impressive as they are the two brightest objects in the night sky, next only to the moon.

May 10th Venus/Mars Conjunction. Saturn is in the lower part of the. Venus and Mars were only 0.3 degrees apart.

If you have a camera, give it a try. All that is at stake is a roll of film. This is a cheap investment for a lifetime of memories.

Keep looking up,

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The Sky This Month

MERCURY:

Mercury will not be visible this month.

VENUS:

Venus is the brightest object in the night sky this month.

MARS:

Mars will not be visible this month.

JUPITER:

Jupiter will be in Gemini and appears as the second brightest object at night. It will disappear in the sun's glow in the later part of the month.

SATURN:

Saturn will not be visible this month.

URANUS & NEPTUNE:

Uranus and Neptune will be visible in the early morning hours in the constellation Capricornus..

PLUTO:

Pluto is visible in the morning 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 a number major shower visible

this summer::

Shower	**Peak**
June Lyrids:	Jun. 15/16
Southern Delta Aquarids	July 28/29
Perseids	Aug. 12
Northern Iota Aquarids	Aug. 25/26
Southern Iota Aquarids	Aug. 6/7
Alpha Capricornids	Aug. 1/2
Northern Delta Aquarids	Aug. 13/14
Kappa Cygnids	Aug. 18

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

Time For The Amateur Astronomer

This article first appeared in the North Shore Erie Amateur Astronomer's newsletter "The Stargazer". Reprinted with the Author's permission.

There are several scales of time used in astronomy as described in the Observer's Handbook and Norton's star atlas but only a few of them are practical for the amateur astronomer. We discuss three of the most useful and show how each of them is related to **Eastern Standard Time (EST)** which is the time shown on your wristwatch.

The basis for Universal Time and Standard Time is **Local Mean Time (LMT),** which is a time scale with reference to the position of the (mean) Sun so we introduce this first. When the time of an event in astronomy depends on your position on the earth's surface then you need to know the time for the event when it will be observed from **your location**. Such a scale will use the term ***local*** in its name and requires knowledge of your longitude. To include the effect of your latitude, if any, one needs a table giving the LMT for your latitude as well. Some examples of these events are the rising, transit, and setting times of the Sun, Moon, stars and planets. To understand LMT we need to understand the term **transit**. Imagine an arc in the sky beginning at the north celestial pole, passing directly overhead and ending on your horizon due south from you. This arc is called your local meridian. An object is said to be in transit when the object is on your local meridian. Since the speed of the earth in its orbit around the Sun is not constant the Sun appears to travel along the ecliptic at different speeds over the course of a year. To remedy this, astronomers introduced an artificial Sun or mean Sun (mean Sun is the same as average Sun) that appears to travel along the celestial **equator** during the year with a constant speed equal to its average speed. The time difference between their transits is called the equation of time, or sundial correction, and can be as large as 16 minutes. We say the real Sun runs fast when the real Sun transits before the mean Sun. Similarly the real Sun runs slow when it transits after the mean Sun. By definition **it is always exactly 12:00pm LMT, or local noon, when the mean sun transits, that is, the mean Sun is on your local meridian.** A person one kilometer west of you has a slightly earlier LMT now than you because the mean Sun transits slightly later for your neighbour. One mean solar day is the time interval between a transit of the mean Sun today at your location and a transit of the mean Sun tomorrow and contains 24 mean solar hours. A mean solar hour is the same as an hour on your wristwatch. **Universal Time (UT)** is equal to LMT at 0 degrees longitude which passes through Greenwich, England**.** A closely related scale is **Universal Time Coordinated (UTC)** which is broadcast over short wave radio. UT and UTC differ by at most a second so we consider them identical. In the monthly events section of The Observer's Handbook time is in UT. At 75 degrees west, LMT is the same as EST, which is an offset by 5 hours earlier from UT. The reason is that the Eastern Time zone is based on a standard longitude of 75 degrees west and the earth takes 5 hours to turn 75 degrees about its axis. Suppose your longitude is 75 degrees west and that a moon of Jupiter disappears in Jupiter's shadow on **February 16 at 2 hr and 30 minutes UT**. This same instant in EST or LMT will be an offset of 5 hours earlier, which is **February 15 at 9:30pm EST or LMT.** This same instant at longitude 90 degrees west in the Central time zone will be an offset of 6 hours earlier or **February 15 at 8:30pm CST or LMT**. We now show how to convert LMT to EST when your longitude is not 75 degrees west. For this you will need to know your longitude, which can be found in any atlas. Suppose we have several observers with the same latitude but differing longitudes as shown in column 1 of the table below. For each degree of longitude west of 75 that you are located you will need to add 4 minutes to the time in LMT to get the time in EST.

Your Longi-tude In Degrees West	Time Of Sunrise In LMT For Your Latitude	Longi-tude Correc-tion In Minutes Of Time	Time Of Sunrise In EST For Your Latitude
69	6:30 am	-24	6:06 am
71	6:30 am	-16	6:14 am
73	6:30 am	-8	6:22 am
75	6:30 am	0	6:30 am
77	6:30 am	+8	6:38 am
79	6:30 am	+16	6:46 am
81	6:30 am	+24	6:54 am
83	6:30 am	+32	7:02 am

The reason for this is that the earth takes 4 minutes of time to turn through one degree. So for an observer at 81 degrees west you need to add 24 minutes to LMT to get EST. In other words you have to wait 24 minutes later on your wristwatch to see the Sun rise than an observer at 75 degrees west. This is called the longitude correction. If your longitude is 69 degrees west on the other hand, you need to subtract 24 minutes from LMT to get EST. That is, you will see the Sun rise 24 minutes before the observer at 75 degrees west. These ideas can be summarized in the equation below, which is valid for the Eastern Time zone. It should be clear how to modify the equation for use in other time zones.

LMT + longitude correction in hours = EST = UT – 5 hours

The last scale of time we often use is called ***Local Mean Siderial Time* (LMST),** which is a time scale in reference to the Right Ascension of the **vernal equinox**. The terms **Right Ascension** and **Declination** are the coordinates of a star in the sky and can be read from any star atlas. The vernal equinox, or first point of Aries, is the spot on the celestial equator that the Sun crosses moving northward along the ecliptic. This is the start of spring for us! The time interval between a transit of the vernal equinox today and a transit of the vernal equinox tomorrow for your location is one sidereal day containing 24 sidereal hours. A solar day is about 3 minutes and 56 seconds longer than a sidereal day since the earth needs this much time to "catch up" to the Sun which has moved further east by about a degree from the day before. There are 24 hours of Right Ascension as well as 24 sidereal hours. One hour of Right Ascension is the same as one sidereal hour. The Right Ascension of the vernal equinox is 0 hours by definition and if the vernal equinox is on your local meridian then the time is 0 hours LMST. So if a star with Right Ascension 12 hours and 30 minutes is on your local meridian then the time is 12:30 LMST. Knowing LMST tells you which stars with the same Right Ascension will be due south at this instant. At the end of this article we will explain how to obtain LMST accurately from EST using data in The Observer's Handbook. For now we can obtain a reasonable approximation knowing that on September 20 of each year LMST is very nearly equal to LMT at all times during the day. Since the earth orbits the Sun, a clock displaying LMST will run faster than a clock displaying LMT by about 3 minutes and 56 seconds per day. So an approximate value of LMST, accurate to within a few minutes, can be found as follows:

Approximate LMST = LMT + 0.06571*number of days after September 20

The table below makes it easy to count the number of days after September 20. For example October 15 is 25 days after September 20 so if you observed at 8pm LMT then LMST = 20 hours + 0.06571*25 = 21.64275 hours. This agrees with the exact value to within 4 seconds. A more typical error is a couple of minutes. We next show how to accurately calculate LMST to within a second or so from EST time using the data in The Observer's Handbook under the topic of time signals

Date	Number Of Days After September 20
October 1	11
November 1	42
December 1	72
January 1	103
February 1	134
March 1	162
April 1	193
May 1	223
June 1	254
July 1	284
August 1	315
September 1	346

We have modified the formula to give the result for the Eastern time zone without the need to convert to Universal time. From the Handbook for June 2001, GMST(at time 0 on day 0) = 16.5051 hours.

At time *t* hours EST on day *d* of the chosen month:

LMST = GMST(at time 0 on day 0) – longitude correction in hours – 5 + 0.06571*(d + 1) + 1.002738*(t + 5)

(- 24 hours, if necessary)

(only subtract 24 hours above to get LMST between 0 and 24 hours)
For example an observer at longitude 80 degrees west at 9pm EST on June 12 has a longitude correction = 20 minutes = +0.3333 hours and the time is

LMST = 16.5051 - .3333 – 5 + .06571*(13) + 1.002738*(26) = 14.0971 hours = **14:5:50**

This means a star with Right Ascension 14 hours and 5 minutes and 50 seconds will be on your local meridian. According to the Handbook the accuracy is to within a second of time if your longitude is known to a second of arc. Here are a couple of web pages that will automatically calculate LMST when you give them your location. We thank Glen Petitpas of McMaster University for directing us to these sites. They are:

http://www.pietro.org/Astro_Lib/astro_pal.htm

http://tycho.usno.navy.mil/sidereal.html

Challenge Question: In column 1 of the earlier table of Sunrise, why are the times of Sunrise in LMT the same for all longitudes with a given latitude? Would a similar table for the time of Moonrise in LMT be the same for all longitudes?
Answer to Challenge Question:
Suppose the Sun in the sky maintained a constant Right Ascension and the observer at longitude 69 degrees west sees the Sun rise at 5 hours and 30 minutes before his local noon which is 12pm LMT. The time of Sunrise is therefore 6:30am LMT. The observers at the other longitudes but with the same

latitude would also see the Sun rise 5 hours and 30 minutes before their local noon which is still 6:30am LMT. Hence the time of Sunrise in LMT is the same for observers on the different longitudes. However the Sun does move slightly in right ascension during an hour so the actual time of Sunrise at longitude 83 degrees west would be about 10 seconds later than at 69 degrees west but this small amount would not normally be significant. The moon however moves easterly in Right Ascension about 12 times faster than the Sun so the time of moonrise at 83 degrees west would be about 2 minutes later (12 times 10 seconds = 120 seconds) than moonrise at 69 degrees west and this would be more significant. Moonrise could be a further few minutes different since the moon's declination can change some as well.

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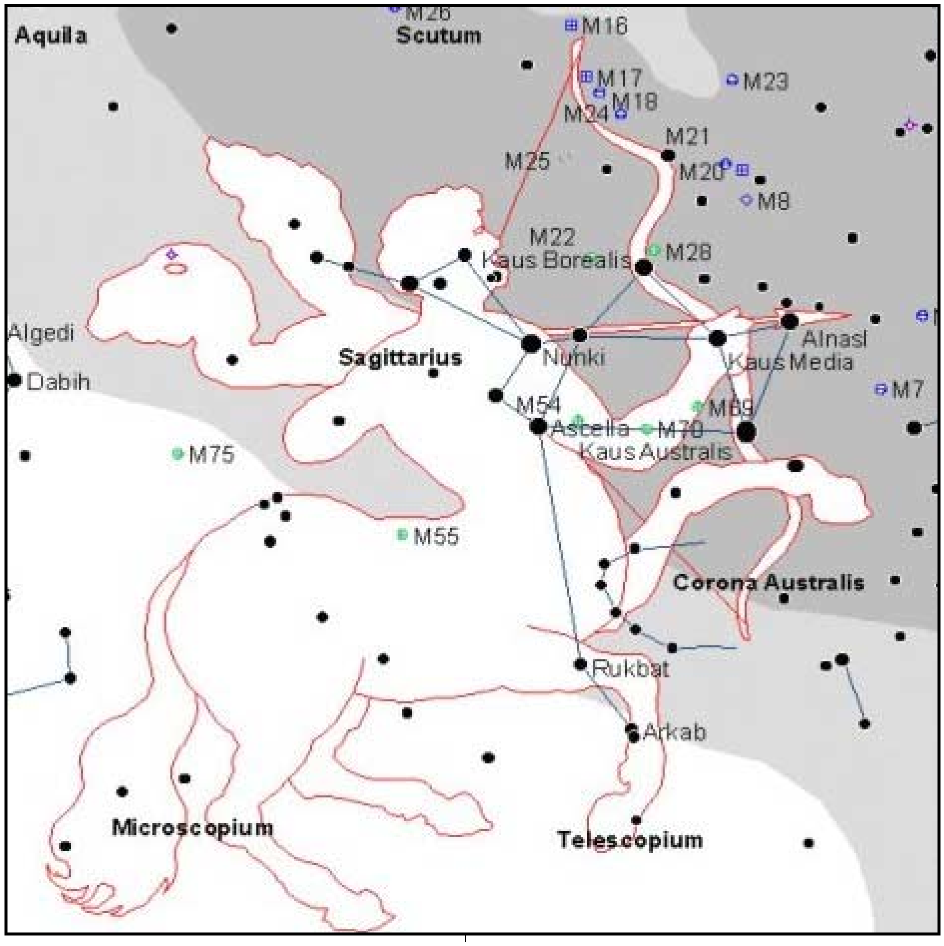
Sagittarius. A Tempest Of Treasures



Sagittarius the Archer

According to Greek mythology, the constellation Sagittarius represents an archer who is in the unfortunate condition of being half-man, half-horse. Aside from being able to bet on one's self and then collect the winnings I can't think of any useful advantage to such a genetic misdemeanor. But forget the mythology, today's amateur astronomers see Sagittarius in a more simplified form - that of a teapot.

The cool thing about this teapot is that it is boiling over with star clusters and nebula - most of which are visible in a pair of inexpensive, 7x50 binoculars. By the way, the "7x" indicates that the binoculars are 7 power and the "50 mm" means that they're 50 mm across the front lens or aperture. That's about 7 times larger than the dark-adapted pupil of human eye. It's also a whopping increase in light gathering power. And that makes binoculars a very useful, cheap, and portable astronomical tool.

Before delving into the stellar eye candy that waits, you need to understand two things. The first is that when viewing Sagittarius, you are looking straight into the heart of our galaxy - the Milky Way. That's why you can see a misty plum of stars rising from the teapot's spout.

A second useful item of information is what "the M-number things" are. The "M" stands for Messier. Charles Messier to be precise. He was an 18th century comet hunter who made careful records of fuzzy spots that weren't comets. Today we know those "not comets" are star clusters and nebula. And the Messier List, as Charles' compilation came to be called, is the Holy Grail of today's backyard astronomer. In all, Messier catalogued 110 objects. You can see 9 of them with binoculars in Sagittarius alone. That's about 9% of the whole list without buying an expensive telescope.

Starting at the bottom and to the right of the teapot's spout are two large open clusters - M7 and M6. They're actually best seen in binoculars or at very low power (20X) in a telescope.

Moving up and over towards the lid of the teapot are two globular star clusters called M22 and M28. Through binoculars you will see them as individual fuzzy patches. M22 is the brighter of the two. A 4- to 6-inch telescope at 100 power will resolve M22 into a spectacular stellar globe.

Above the teapot's spout are two more fuzzy patches. They are M8 (The Lagoon Nebula) and M20 (The Trifid Nebula). Both are huge clouds of gas and dust in which new stars are being born.

Moving further up you will encounter

five more open star clusters - M21, M25, M23, M24 and M18. Above them are two more nebula, M17 (The Swan Nebula) and M16 (The Eagle Nebula). There are other Messier objects in Sagittarius such as M54, M70 and M69. But they're very dim and difficult to see in anything but a telescope.

In early July, Sagittarius rises from the southeast at nightfall - about 10 PM. By mid-month it is well placed for observing by the same time. And at midnight Sagittarius has risen to its maximum distance above the southern horizon.

While Sagittarius is one of summer's celestial treasures, the approach of fall means it will become dark earlier. The happy result of which is that you can view Sagittarius and all within it well into the fall season before it sets in the west.

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Observatory Upgrade

In 1999, I acquired an observatory (see the Feb 2002 issue of *The Reflector*) to house my 8"-f/7.5 Dobsonian. The observatory worked quite well, but the scope took up a lot of space, and it was difficult to aim it near the horizon. This past spring, I purchased 8" Schmidt-Cassigrain that suited the building better.

The new scope came on a sturdy tripod, which was good for portability, but did not work so well in the Observatory because of it's large footprint and because it would pick up vibrations from the floor. As a temporary measure, I drilled 2" holes in the base of the floor so that the tripod legs would reach the ground below. This helped with eliminating the induced vibrations, but every time it rained, the legs would sink a bit into the dirt, throwing off my polar alignment. It also did nothing to decrease the footprint of the scope. This led me to pursue building a proper pier to mount the scope on.

The first step was to determine what this pier would look like. The end design was determined by the following specifications:

1. It had to be easy to install and remove (in case I decide to move the observatory).
2. It also had to provide a means to level it, which would make polar alignment easier, and counteract any errors in installation.
3. It had to mate with my existing telescope wedge
4. It had to place the scope at a comfortable position for observation

To meet the first two specifications, I borrowed a design I've seen used in mounting street lamps (you notice these things when you are stuck in traffic every day). Street lamps are often bolted to a cement base via four (or more) bolts through a base plate welded to the bottom of the post. This makes it easy to install, remove and adjust the leveling. To satisfy the third specification, I placed another metal plate on the top of the pier with a single bolt passing through the centre to mate with the wedge. Taking measurements from the tripod-mounted scope in the observatory, I got the height of the new mount to satisfy the fourth specification. After figuring out how to put all this together, I produced a drawing and then went in search of the materials.

Finding and purchasing the materials was not as simple as it seemed. Will Juodvalkis & I hunted around a few scrap metal shops for the pipe and metal plates, but the prices they wanted were incredible! One place wanted $100 for 3 feet of 6" schedule 40 pipe! Fortunately, through perseverance, he managed to get me pipe for $35 ($25 + $10 to cut to size). The job then fell to me, to find two 3/8" thick metal plates that would become the base and the top. After calling around, I managed to get the remaining metal locally for only $15 (including having it cut to size). Now all I needed was a $2 bolt, some drilling and for Will to weld it up.

New pier mounted on the cement base.

After the pier was welded together and painted, it was time to install it at the observatory. The pier was designed such that I could add some fine alignment devices consistent with the existing Meade mounting holes on the wedge. Since these devices have limited movement, the mount had to be aligned as close as possible to the true north (within 5 or 10 degrees). This is an interesting task in the daytime, as Polaris is not available to aid in marking out a true north south line. Normally to find a true north-south line in the daytime (since a compass would not be accurate enough), you construct a circle, set a stick in the centre and then mark off the two points where the shadow tip exactly touches the circle. Then you simply bisect these points and drawing a line from the centre to this point is your north south line. The problem with this method is it requires you to wait several hours for the sun to move enough to get both points. This is where modern technology came in. Thanks to some astronomy software, and a pdf file of a 360-degree protractor that I got off the Internet, I was able to construct a sundial good for that day. The sundial was created by plotting the sun's azimuth position as a function of time for that day. Then I mounted my sundial to the template used for holding my mounting bolts in the cement as it dried (see figure below). By lining up the template such that the shadow fell on the correct line for the current time, I my template was instantly aligned.

Mounting Template—the sundial face is used to align the mount to true north

Installation of the mount was not that straight forward. I had to separate the observatory from its base and remove the floor to pour the cement. After it hardened, I installed the pier on the mounting bolts and then replaced the floor and later the observatory. Fortunately the observatory was small enough to do this.

The Finished Product

Now I was ready for the real test – using the scope on it. It turned out that my method for aligning the pier worked quite well as I was within a degree of the true north. Polar alignment was a breeze (relatively speaking) and now I can leave it there and not worry about it.

If I were to do it all over again, the only thing I would change is to make the pipe diameter smaller as the 6" pipe was probably overkill.

Clear Skies

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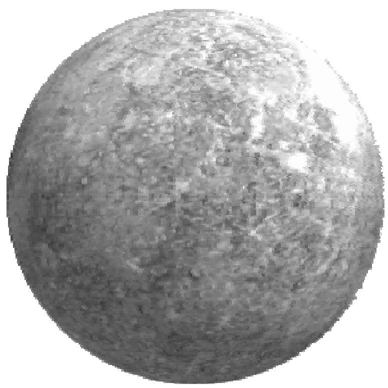
Mercury. Some Like It Hot - And Fast



Mercury looks surprisingly like our moon in shape and size,

Mercury and our Moon have a great deal in common. Both are airless. Both experience extreme temperature differences depending on which side is facing the Sun. And both Mercury and our Moon are pocked marked from ancient meteor impacts. In fact, it's difficult to tell the difference between the two when examining close-up photographs. But that's where the similarities end.

Being the innermost planet in our solar system, Mercury orbits the Sun in a relatively brisk 88 Earth days. Small wonder the Romans named it after the their god Mercury, the speedy messenger.

Since the greatest angular distance between the Sun and Mercury is never greater than 28 degrees, we only see the planet at dusk and sunrise. This caused the ancient Greek astronomers to give the planet two names. When viewed in the evening it was called Hermes. In the morning it was known as Apollo. Imagine going to bed Hermes and waking up Apollo. But no matter what you call the speedy planet, Earth's rotation rate of 15 degrees per hour means you'll never see Mercury for more than two hours at a given time.

At one time it was believed that Mercury only rotated once when orbiting the Sun. This theory was proposed in the mid-eighteen hundreds by the Italian astronomer Giovanni Schiaparelli. He's the same guy who thought he saw canals on Mars.

Schiaparelli's theory was modeled, in part, on the fact that our Moon only rotates once as it orbits Earth. Called a synchronous orbit, this one-revolution-per orbit is the reason we only see one side of the Moon. However, in 1965 astronomers using the giant radio telescope at Arecibo in Puerto Rico were able to calculate Mercury's actual spin rate at 58.6 days per orbit around the Sun. That means the planet revolves three times with every two orbits around the Sun.

While Mercury's surface can be easily mistaken for that of our Moon, it does have one unique type of geographical structure - the Scarp. These huge cliffs can even cut across the surface of a crater, indicating that they occurred after the meteor impact. It is thought that they originated because the planet's interior cooled and shrank, causing portions of its surface to resemble an old shrunken apple. The scarps probably formed about four billion years ago.

Mercury has about one-third the gravitational attraction of Earth. Thus, a rocket would only have to reach a speed of 4.3 km/second to escape the planet's gravitational pull. That's good, because given its weather; you'd want to depart Mercury fairly quickly. After all, the daytime high is a sweltering 427 degrees Celsius, while Mercury's nighttime temperature of -173 degrees Celsius will more than keep your beer cold. And don't forget, those are very, very long days and nights.

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Astronomy in Philately

This month the focus is on Jupiter and Venus as they climb closer together in the evening sky after sunset. With June 3rd being the closest encounter for these two planets for sometime to come. Back in 1975, the United States Postal Service issued commemorative stamps that highlighted the exploration of these same two planets in a stamp series on U.S. unmanned space accomplishments.

On February 28, 1975, a stamp was issued showing the Pioneer 10 spacecraft as it would have appeared when passing within 81,000 miles (130,000 km) of the giant planet on December 3, 1973. Also included in the design are 3 of the Jovian moons and the distinctive “giant red spot”. This was the first spacecraft to send close-up pictures of the planet and it’s larger moons. Pioneer 10 has continued on a path outside our solar system and continues to transmit information about the sun’s influence in

A US stamp commemorating Pioneer 10’s flyby of Jupiter

space. Pioneer 10 is currently more that 11 billion km from earth. (Pluto is only about 6 billion km from earth)

A US stamp commemorating Mariner 10’s flyby of Mercury

On April 4, 1975, the second stamp was issued. It showed the Mariner 10 spacecraft that explored Venus and Mercury, in 1974. On February 5, 1974, Mariner came within 2,600 miles (4,200 km) of Venus, on its way to explore Mercury. The Mariner program provided much of the information that we knew of the inner planets until very recently. Much of this technology was used in the Voyager program that was aimed at the outer planets in the following decade.

At only 1.6 degrees apart (that’s the width of a finger, held at arms length) on the evening of the 3rd , these two planets will be a sight to behold. The two brightest planets in the night sky will appear close, but this is just a matter of perspective. In reality, Jupiter will be 896 million km from earth and Venus will be only 192 million km away from us. In any case, let’s hope for clear skies! You won’t need a spacecraft to appreciate this celestial event.

Your Astronomical Philatelist
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Barn Door Drive

A few years ago I undertook to construct a barn-door drive for my 35 mm camera. Since I didn’t own a clock driven scope at the time, this seemed like the best way to get started in astro-photography.

The design I followed, came from an article published in the April 1989 issue of *Sky & Telescope* entitled "Two Arms are Better than One". This article offered four different designs, of which I chose the type-4 design, with a few modifications thrown in for good measure.

A basic barn-door drive consists of two boards hinged together at one end, and spread apart by a screw that turns at a constant rate to counteract the motion of the earth. The basic problem with this design is that the rate of change of the angle between the two boards is not constant with a constant speed of the screw. This problem is known as tangent error and is a consequence of geometry. Normally this is not a problem unless you want to take exposures longer than 15 minutes (using a 50 mm lens). In an attempt to counteract this effect, several designs were described in this article that use two arms instead of one. None of these can eliminate the effect entirely, but they can reduce it enough to allow for exposures up to 2 hours. Of these, the “Trott Type 4” drive was the best at minimizing this error

The original design consisted of an L-shaped secondary arm, supported by a rectangular primary arm. I did not like this design for two reasons: it was wider than it had to be, and there was unnecessary torsional stress on the secondary arm's hinges (especially if you used heavy lenses on your camera). In order to correct this, I redesigned both the primary arm and secondary arm so that one fit inside the other (see photo).

One difficulty worth noting, was obtaining a suitable trunnion (the pivoting device that hold the lower end of the drive screw). The design shown in the article required machining and

The Completed Barn Door Drive

welding, both of which are a pain, unless this happens to be your profession and you have access to the proper equipment. After many failed attempts to improvise, I found a solution. The greatest thing about this solution is that it requires no more sophisticated equipment than a drill. What I did, is drill two dimples, 180˚ apart on a ¼-20 SS nut. Then I suspended the nut between two binding posts, using nails as pivoting points (see photo below). It worked perfectly

Close-up of the Trunnion

The only problem I have left is finding an electrical outlet where there are dark skies. The 60 Hz - 1 rpm motor driving the screw, needs house current. My next project is to replace the synchronous motor with a stepper motor (that can be salvaged from old printers), so that it can be run directly from my car battery.

There are two important lessons I learned making this drive: 1.) use good brass hinges. This will save you lots of hassle in the long run, plus they will not rust. 2.) Don't use oak or any other wood that will warp. It is best to go out and buy a small sheet of ½" Baltic Plywood. It doesn't warp and it looks fantastic.

There are two improvements I would make if I were to do it again. They are: to replace the ball joint camera mount with a mount that allows independent rotation in all 3-axes. This way I could better "frame" any pictures. I would also make the whole thing ½ the size and use a ½ RPM motor (or stepper motor) to make the whole thing just that much more portable.

If you were to ask me "Would I do it again?", I would say yes! It was not a terribly difficult project to complete. If you can cut wood and drill a few holes, you can make a barn door drive.

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Classifieds

For Sale:

Slip on bracket for 50 mm finder with shoe - $15:00

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.

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Time Travel

Once again we hop into the Way-Back machine to see what astronomical events happened over the years in the latter half of June. Fasten your seatbacks, folk!

June 15, 1971 - First Titak III-D launch
June 16, 1963 - Valentian Tereshova first (and only) female solo spaceflight
June 17, 2002 - First quarter Moon
June 19, 2002 - Moon at perigee (closest to Earth)
June 20, 1985 - NASA announces cola wars to take place on Shuttle mission 51-F
June 21, 2002 - Summer Solstice 9:24 am.
June 22, 1665 - Royal Greenwich Observatory founded
June 24, 2002 - Full Moon at 542 pm
June 25, 1997 - Progress spacecraft collides with Mir Spektr module
June 27, 1868 - NEAR flies by asteroid mathilde
June 28, 2002 - Uranus 4 degrees north of Moon
June 29, 2002 - George Ellery Hale born
June 20, 1908 - Tunguska impact levels hundreds of miles of Siberian forest

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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
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or via e-mail at:
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NEXT ISSUE'S DEADLINE IS

Sept. 2nd, 2002

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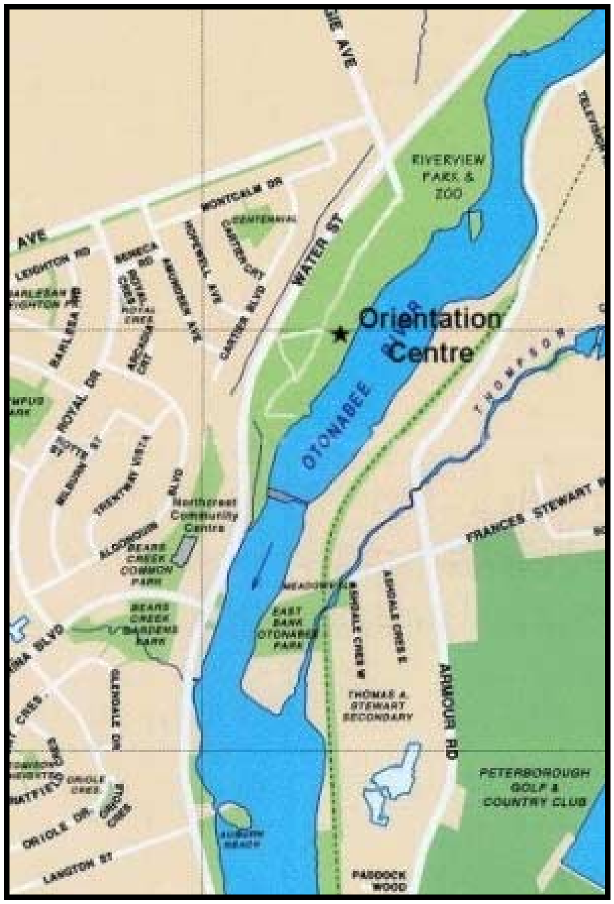
MEETINGS

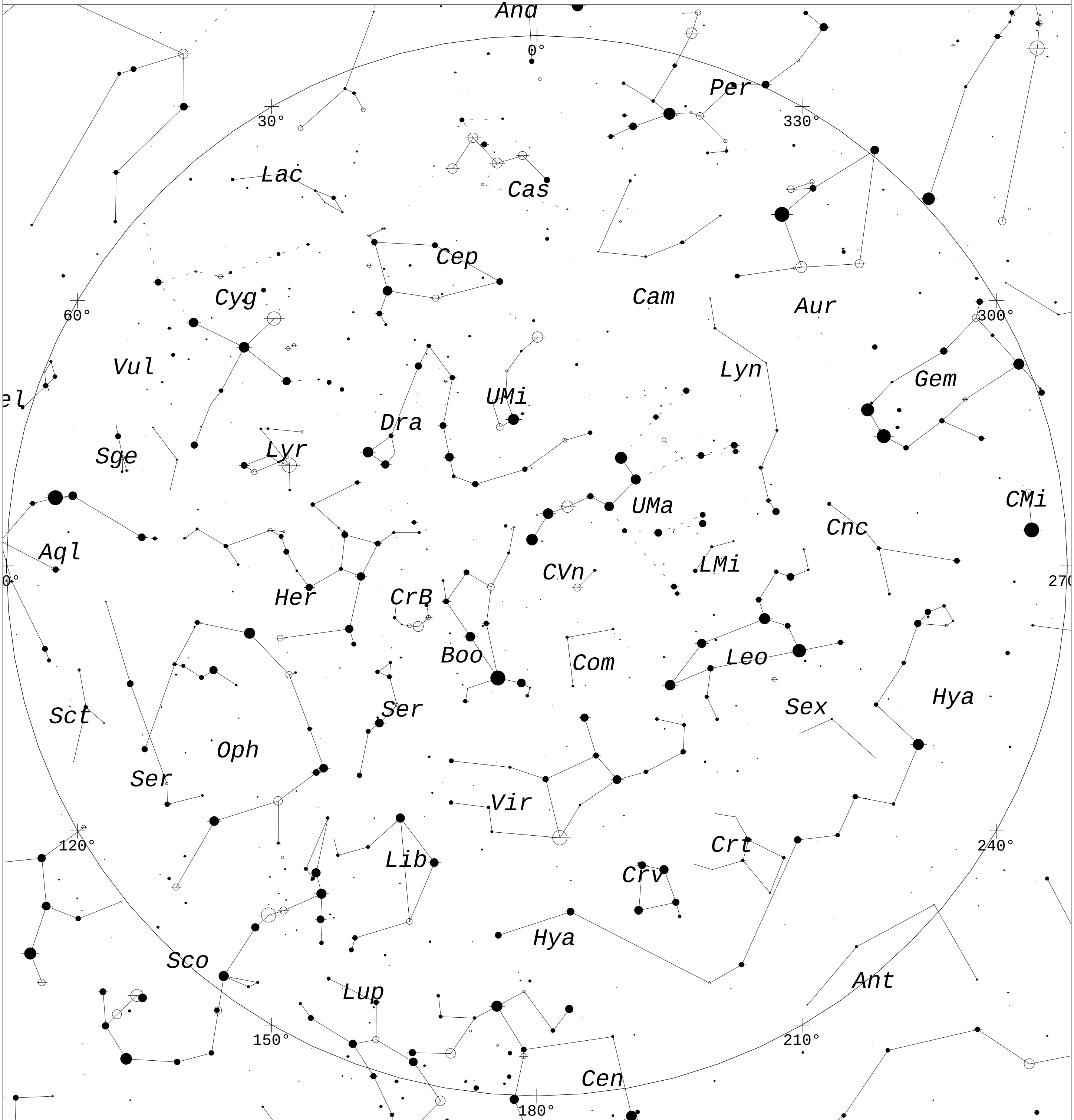
The Peterborough Astronomical Association meets every second Friday at the Peterborough **Zoo Orientation Centre** (Next to the PUC Water Treatment Plant) at **7:30 pm**.



📅 CALENDAR OF EVENTS 📅

June 2, 2002	**Last Quarter (☾)**
June 10, 2002	**New Moon (●)**
June 12, 2002, 7:30 pm	**General Meeting** — TBA
June 17, 2002	**First Quarter (☽)**
June 21, 2002, 7:30 pm	**General Meeting** — TBA
June 24, 2002	**Full Moon (❍)**
July 5, 2002, 7:30 pm	**General Meeting** — TBA

June Skies



STARS		SYMBOLS		
<1	3.5	Multiple star	Dark nebula	Radio source
1.5	4	Variable star	Globular cluster	X-ray source
2	4.5	Comet	Open cluster	Other object
2.5	>5	Galaxy	Planetary nebula	
3		Bright nebula	Quasar	

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

UTC: 02:00:00 2-Jun-2002
RA: 13h41m29s Dec: +43° 38' Field: 182.0°

Sidereal Time: 13:41:29
Julian Day: 2452427.5833